A qualitative evaluation of patient acceptability of a clinical sensor-based approach to movement feedback rehabilitation

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Background

- The identification and assessment by physiotherapists of movement adaptations during functional tasks in people following a knee injury are subjective, relying on observational skills to detect potential risk factors.
- It is challenging to identify movement patterns in both lower limbs at three joints, each with six planes of movement whilst performing tasks. Technology exists to improve the objective identification of compensation strategies through using wearable biomechanical sensors in the clinic.
- An intervention is being developed that provides the treating physiotherapist and patient with a movement feedback report [1], based on the assessment using sensors. In providing objectivity, there is potential to provide reassurance in understanding biomechanics related to sub-optimal recovery and re-injury presented in a format that the physiotherapist and patient can understand.
- Personalised and tailored treatment approaches can be developed to target the movement adaptations associated with the ACLR patient population.
- Physiotherapist acceptability and usability have been explored as part of the development of a new biomechanically informed movement feedback intervention. [2]
- This study aimed to evaluate patient experience and acceptance of the sensor-based movement feedback during rehabilitation.

Methods

- There are 4 stages to this mixed methods study (Figure 1). This study focuses on stage 3 – The patient experience.

Stage 1 → **Stage 2** → **Stage 3** → **Stage 4**

Reliability & validation study → Pilot biomechanical feedback report → Training of physiotherapists & evaluation → Data collection in physiotherapy clinics → Interviews of physiotherapists → Data collection in physiotherapy clinic → Serial interviews of patients (pre & post intervention) → Final biomechanical feedback report → Recommendations for consultation model

Figure 1. Flowchart showing research stages

Stage 1.

✓ Wearable biomechanical sensor technology is suitable for clinical movement analysis in clinical practice
✓ Proven to be reliable and valid [3]

Stage 2. Training and data collection

1. Training sessions of physiotherapists introducing the sensor technology and biomechanical feedback have taken place across 5 physiotherapy departments in the local health board.
2. Kinematic and temporo-spatial data have been collected from ACLR patients receiving physiotherapy
3. Subjects performed up to six functional tasks in the clinical environment (figure 2.)

Stage 2. Data collection and Feedback

Double Leg Squat → Single Leg Squat → Vertical Jump → Stairs Ascent → Stairs Descent → Gait

Figure 2. functional tasks

Figure 3. Biomechanical feedback

Stage 3. Patient experience interviews

- Interviews questions developed using themes developed from physiotherapist interviews[2] and the TiDier framework [4]

9 ACLR patients → 18 serial interviews → 1. pre-sensor feedback interview → Clinic sensor data collection → 2. post-sensor feedback interview → Thematic analysis [5]

Results

- Themes and subthemes from pre-sensor feedback experience are represented in table 1 and post-experience in table 2.

Table 1. PRE-SENSOR FEEDBACK EXPERIENCE

Themes	Subthemes
Use of technology in the patient population.	'Lifestyle' using technology in daily life
	'Application' of technology in daily life
	Technology use for physical exercise
	Reasoning and attitudes for using technology
	Knowledge of technology
Strategies for technology use and engagement.	Use of web-based resources
	Psychological & internal factors
	Social & external factors
	Behaviour modification
	Treatment monitoring
Insights to the future of movement feedback using wearable sensors in physiotherapy.	Web-based resources
	Wearable technology and its use in healthcare
	Using objective data
	Barriers to technology use
	Future design and service provision
Multifaceted role of the physiotherapist.	Physiotherapist providing feedback
	Physiotherapy consultation
	Physiotherapist as a coach and educator

'So who hasn't got a social media account these days?'

'You can't trust anything off the internet, can you'

'It's always changing. It's trying to keep up with that trend'

'If I didn't have the help, I wouldn't have a clue of what I was doing'

'It can be overwhelming, I guess'

'It motivates you. Even if your leg is not doing as good as it should'

'more longer sessions that are more detailed but less frequent'

Table 2. POST-SENSOR FEEDBACK EXPERIENCE

Key Themes	Sub-themes
Feedback in physiotherapy practice	Benefits of objective sensor-based feedback
	Role of the physiotherapist in providing feedback
	Value of visual feedback in rehabilitation
	Optimising engagement during rehabilitation
	Usability of sensor-based feedback
	Understanding and interpretation of sensor-based feedback report
	Increased understanding of rehabilitation and movement
Use of technology in the clinical setting	Personalising treatment in rehabilitation
	Sensor Technology - Usability
	Monitoring and directing a change in treatment
	Recognition of movement patterns/highlighting compensation strategies
	Attitudes to using sensor technology
Future perspectives towards development of sensor-based technology into physiotherapy practice	Feedback design recommendations
	Service considerations for sensor-based feedback
	Service considerations in the wider healthcare setting

Conclusions

- Patients already use various forms of technology, including sensor technology, to assist with exercise.
- Sensor-based biomechanical feedback is usable and acceptable to ACLR patients.
- Data saturation and biomechanical terminology present a challenge to patient understanding.
- Quantifiable data has the potential to motivate and educate patients using a digital format.

- Patients were receptive to feedback combined with their rehabilitation to monitor and inform treatment.
- The physiotherapist is crucial in interpreting and applying sensor-based feedback findings.
- A plan for integrating sensor-based movement feedback into rehabilitation defining the provider, nature, setting, frequency and amount is proposed, guided by the TiDieR framework.

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