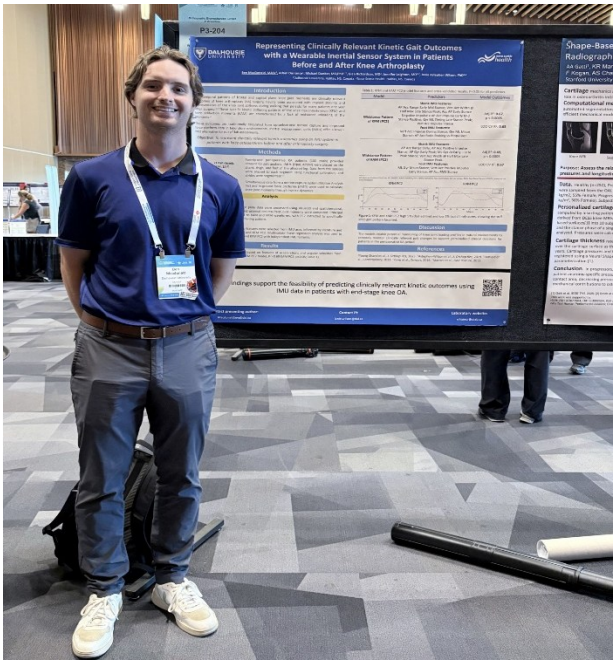
Canadian MSK Rehab Research Network

Representing Clinically Relevant Kinetic Gait Outcomes with a Wearable Inertial Sensor System in Patients Before and After Knee Arthroplasty



We wanted to know

Can we represent clinically relevant kinetic outcomes using an IMU system in patients with knee osteoarthritis before and after arthroplasty surgery?

What is the problem?

Knee joint loading patterns during walking are clinically important following knee arthroplasty (KA), as they provide insight into recovery and persistent stiff-knee gait. However, these patterns are typically measured using specialized laboratory equipment, making routine assessment outside the lab impractical. Developing methods to estimate these outcomes using wearable inertial measurement units (IMUs) could enable accessible, real-world monitoring of recovery and support more informed clinical decision-making.

How did you study the problem?

Twenty-one people undergoing knee arthroplasty participated in this study and completed walking assessments before or after surgery. During each assessment, participants wore small wearable motion sensors on their leg while walking, and their movement was also recorded using a laboratory motion analysis system. The laboratory measurements provided a detailed reference of how the knee was loaded during walking. We then examined whether information from the wearable sensors could be used to estimate these clinically important loading patterns. Statistical analyses were used to identify the sensor measurements that were most closely related to the laboratory results and to develop models that predicted knee loading from the wearable sensor data alone.

What did you find?

The wearable sensor models were able to estimate important patterns of knee loading during walking with good accuracy when compared with laboratory measurements. Using information from sensors placed on the lower leg and foot produced the most accurate results.

How can this research be used?

These findings suggest that wearable sensors could provide a practical way to assess walking patterns outside of a laboratory, allowing clinicians to remotely monitor recovery after knee arthroplasty and support more personalized treatment decisions.

Cautions

These findings are not without their limitations, specifically, these models are built on a population of Nova Scotians before and after knee arthroplasty and therefore may not be representative of a different demographic. Future work should test these models on different populations in real world environments to validate their efficacy.

Reference: MacDonald, B. et al. (2026). Following the Footsteps: Wearable Sensors Quantify Kinetic Gait Outcomes Before and After Knee Arthroplasty, Journal of Biomechanics. 10.1016/j.jbiomech.2026.113428.

Funding Sources: Mitacs Accelerate and Nova Scotia Health IT#IT33942