

Functionally stratified design and manufacture of hip and knee joints

Our aim

Our aim is to develop and deliver new simulation methods for the design and manufacture of hip and knee prostheses, to be evaluated through two design and manufacture case studies. The resulting robust design solutions will accommodate patient and surgeon variability, delivering greater reliability in a cost-effective manner.

The **academic partner** leading this project is the University of Leeds (Fisher, Wilcox, Jennings and Ingham). **Collaborators** are simulation specialists, Simulations Solutions Ltd; device manufacturers, DePuy Synthes; Jiaotong University in China; distribution partners in China, Gaitech, Shanghai.

Clinical collaborators from the NIHR Leeds Musculoskeletal Biomedical Research Unit (LTHT LMBRU) are Venkatesh and Stone (surgery), Redmond (gait analysis) and Conaghan (imaging).

This project has **three research challenges**: (1) To develop models characterising variations in geometry, properties, surgical delivery and activities of the patient population. (2) To develop simulation models predicting biomechanical and biotribological function. (3) To apply these new approaches to hip and knee prostheses.

Our approach

We will **define**:

- > Models of hip and knee anatomy, geometry and properties, compatible with engineering design systems which characterise both the eastern and western patient population;
- > The variation in surgical positioning of artificial hip and knee joint components in these patients;
- > A set of biomechanical and kinematic inputs for hip and knee joint replacements for a variety of different activities - control, standard walking, stair-climbing and descent, and rising from a chair – through collaborations with Leeds, North America and China.

Using these inputs, we will **develop** finite element models to predict the biomechanical and biotribological function of the joint replacements for a range of activities and surgical positions.

We will experimentally **validate** functional predictions, with evidence from patients and tissue specimens.

This work will result in a **validated** tool-kit of stratified pre-clinical simulation methods which will functionally differentiate the design and manufacture of new prostheses, the application of which will be demonstrated through case studies.

What we want to achieve

1. Parameterised models for natural hips and knees which characterise variations in anatomy, geometry, material properties, surgical delivery and patient activities.
2. New simulation methods which predict biomechanical and biotribological function for the parameterised models.
3. Functionally stratified design solutions using the hip and knee simulation systems.
4. A systematic design methodology, consisting of parameterised models, data and simulation systems, to predict function which can be adopted as an international standard by manufacturers and their supply chain.



Join our community

The MeDe Innovation Network exists to provide support to the medical device sector, including academic, industry and clinical members. As a member of the Network, you will benefit from:

- > access to information about manufacturing research, from our Centre's research outputs, international partnerships, and clinical centres in medical device innovation throughout the UK
- > access to Technology Roadmapping techniques to help shape and inform future research needs
- > updates on sector news and events, through e-newsletters, network events and an annual conference
- > access to commercial opportunities arising from our work with the Medical Technologies Innovation and Knowledge Centre
- > being part of an influential contributor to the UK medical device landscape
- > marketing opportunities to highlight your organisation's news and events on the MeDe Innovation website

Dissemination of research and moving it along to adoption and commercialisation is central to our mission and we value input from those working across the medical device sector in the UK. The network aims to not only inform, but also to connect, enabling businesses, policy makers, academics and clinicians to share information, knowledge and ideas and debate the challenges and issues facing the community.

Membership is free and it's easy to join – contact us now.

Contact us

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