

LifeLongJoints meets patients – how Leeds data are improving implants

At first glance the audience in the lecture theatre seems a uniform group of active middle-aged Yorkshire folk. For biomechanics researcher David Lunn, however, each person there represents a unique data profile, differing in age, gender and body mass index. They also have something in common: each has had a total hip replacement at Chapel Allerton Hospital in Leeds in the past five years. They have come to Leeds University Business School to hear how the data they have provided are being used by LifeLongJointsⁱ, an EU-funded multinational research project, in a bid to improve implant function.

With the number of hip replacements increasing worldwide, patients living longer and staying more active, and operations being performed earlier, artificial joints need to last longer and respond more robustly to the variability of wear and loading encountered in daily living. Varying patient characteristics are one of the factors that influence how implants perform and whether they fail, yet testing standards are still based on a simple walking profile for a standard user performing five million cycles, equating to no more than a couple of years of use at the 10,000 steps a day now considered essential for a healthy lifestyle. More realistic data are clearly needed, and that is where the audience in Leeds comes in. Their contribution to LifeLongJoints is to provide realistic movement patterns, resulting in a large amount of data that are patient group specific and reflect the activities of daily living.

David Lunn and his colleagues at Leeds Teaching Hospital Trust approached 1,300 potential participants from among the 1,000 patients a year who have a hip replaced at Chapel Allerton. Of 430 who responded, about 35 per cent have been recruited, with around 150 analyses due to have been completed by the end of September 2015. Participants range in age from 55 to 91, and some are more active than others. During testing, reflective markers are placed over anatomical landmarks and sensors attached to the skin to measure muscle activity. Movement, force and pressure data are captured, determining each participant's movement characteristics during a variety of activities of daily living: walking, fast walking, sitting, standing and climbing stairs. Some more active participants were also asked to squat, lunge and jog.

Next the data are fed into a computer model, relating the human skeleton to the anatomical landmarks from the testing. Using the computer model, which runs software by LLJ partner AnyBody Technology, individual movement patterns become apparent. Rather than being averaged, data can be stratified by gender, by age, by BMI, or according to whether participants have had one or both hips replaced, for instance. This detailed, realistic information about how people with replacement hips move is crucial for the design and implantation of successful replacement joints. It is fed into mechanical wear simulators designed by LLJ partner Simulation Solutions which can now test implants according to parameters derived from real rather than assumed movement patterns. In future, implants will be able to be tested more robustly, testing will be specific to the people using the implants, and computer simulation will enable implants to be designed and developed faster and at a lower cost.

LifeLongJoints is just one of about 30 active projects addressing joint replacement at Chapel Allerton Hospital, which is home to the NIHR Leeds Musculoskeletal Biomedical Research Unit (LMBRU)ⁱⁱ, a collaboration between the Leeds Teaching Hospital Trust and the University of Leeds. Professor Anthony Redmond, LMBRU's Head of Clinical Biomechanics and Physical Medicine, says that the target is for everyone who comes in to the hospital system in Leeds to participate in research if they wish, so that no opportunity for advancing health care is wasted. "LMBRU allows data to be gathered and applied in ways directly relevant to patient care. It's transformed the way we go about clinical

research. We involve young orthopaedic surgeons in research right through their training. The result is better patient care.”

For the audience in Leeds, hearing how their data were finding practical application was eye-opening. Of particular fascination was a lively presentation on the virtual patient by Stephen Ferguson, Professor for Biomechanics at ETH Zurich, another LLJ partner. Learning how data such as theirs could improve implant performance through simulation made it clear just how important their contribution to the project was. “I’m so glad to be able to give something back” and “I’d definitely take part in research again” were frequent comments. That will please David Lunn and Anthony Redmond. Having a captive audience was too good an opportunity to pass up, and so they put out an appeal for participants in a further two projects. It seems researchers at Leeds will have no time to twiddle their thumbs.

ⁱ LifeLongJoints unites 15 research institutes and industry partners in Denmark, Germany, Sweden, Switzerland and the UK, including LMBRU and the University of Leeds, which coordinates the project.

ⁱⁱ LMBRU is a centre of excellence for translational musculoskeletal research funded by the NHS National Institute for Health Research.