## PROJECT DETAILS

### Project Title

Gait cycle analysis after Total Knee Replacement

### Project Summary

**Aim:**

- Gait analysis of a controlled group with Total Knee Replacement (TKR) using the new generation of implants.

The most common reason for knee replacement surgery is osteoarthritis [http://orthoinfo.aaos.org/topic]. 16% of adults over 45 have symptomatic osteoarthrits of the knee [http://www.cdc.gov/arthritis/basics/osteoarthritis.htm]. The rates of knee replacements have increased the most in younger patients. Knee replacement surgery (arthroplasty) involves replacing a damaged, worn or diseased knee with an artificial joint. In more elderly patients, a replacement knee is expected to last at least 15 years. How ever in reality, particularly for younger patients, the knee may wear out sooner and therefore new systems are being continually developed to increase the longevity of these implants [http://www.limacorporate.com/products-3dkneetm-2.html]. There are two main types of surgery, depending on the condition of the knee: 1) Total Knee Replacement (TKR) where both sides of the knee joint are replaced 2) Partial (half) Knee Replacement (PKR) when only one side of the joint is replaced (in a smaller operation with a shorter hospital stay and recovery period). Source: http://www.nhs.uk/Conditions/Knee-replacement/Pages/Kneereplacementexplained.aspx

Adults of any age can be considered for a knee replacement. Younger patients, however, having joint replacement are more physically active and are more likely to wear the joint out, requiring further replacement surgery. Knee replacement surgery is a common operation and most do not experience complications. In general, the surgery consists of replacing the diseased or damaged joint surfaces of the knee with metal and plastic components shaped to allow continued motion of the knee. Different implant manufacturers require slightly different instrumentation and techniques. No consensus has emerged over which one is the best. Retaining the Posterior Cruciate Ligament (PCL) has been shown to be beneficial for patients. Removal of the PCL has been shown to reduce the maximal force that the individual can place on that knee (Mahoney, 1994). However, no studies have shown long-term benefit (Leopold, 2009). Younger patients requiring knee replacement have higher functional demands.

A new TKR internal knee prosthesis, developed by the Lima Group, aims to improve: life, range of motion, stability, wear resistance, post operation complication such as joint failure, stability, detachment, tension settings and excess motion. Lima is offering match funding to join BU and the DSRC to conduct research in collaboration with Poole NHS hospital and Salisbury Hospitals. The aim of the research is to determine the effectiveness of the new knee prosthesis and to assess whether the new implant meets the functional demands of younger patient. This will be determined by conducting full gait analysis (using Salisbury Hospital’s Gait lab) of a controlled number of patient both pre and post operation with the new knee prosthesis and compare their recovery against national averages. This will involve studying the kinetics and kinematics through quantifying the change in gait and joint forces over time. When possible the kinematics of gait before and after operations will be studied to measure the relative contribution of the intervention. This will be accompanied with simulated kinematic data using kinematic model simulation. As part of this study new information regarding the function of the knee prosthesis will be developed.

### Academic Impact

The outcome of the proposed research will be a methodology for better assessment of the functional outcome of a TKR operation and in particular the function of a knee replacement designed for younger more functionally active patients. It should also have a direct impact on the way future interventions are planned and performed. Continuation of this study should, over time, inform the way these operation are carried out, the effect on rehabilitation time, the time spent in hospital, the improved range of stable motions and positional accuracy and measurement.
Application of the new knee in the longer term will provide a large amount of information regarding the effect of the relative and absolute function of the knee, especially on the joint stability, relative and absolute displacements. This research also complements current research by the team with Royal Bournemouth NHS Hospital on monitoring the tension and contact force between surfaces of shoulder implant joints.

**Societal Impact**

More than 70,000 knee replacements are carried out in England and Wales each year, and the number is rising. Most people who have a total knee replacement are over 65, but an increasing number are now between 45 and 65. The average cost is around £7k per operation. Other additional costs to NHS include rehabilitation, hospital admission costs and physiotherapy. This makes the actual total cost of each operation £20k or more (Source: Deputy Int). With increasing numbers of younger patients undergoing knee replacements there is likely to be an increase in the number of patients requiring revision or redo surgery as these implants wear out. The proposed new knee system will potentially offer better function and prosthesis longevity (knee replacement life span), due to reduced wear, thus potentially reducing the cost of revision surgery to the NHS. A pain free, stable and high functioning knee will result in improved quality of life for a significant proportion of patients with such implants around the world. Accurate gait analysis results in better assessment of the functional outcome of such operations and can be used against national benchmarks in order to inform on ways to reduce costs and rehabilitation times.

**Training Opportunities**

BU’s Graduate School provides the infrastructure to promote excellence in postgraduate research to enhance the researcher’s experience, including generic and employability skills training, providing opportunities to engage with researchers from other Academic Schools or from relevant industries. Postgraduate researcher will be encouraged to participate in relevant training by taking some prerequisite modules, such as, research methods, etc. The School of Design, Engineering & Computing (DEC) is very active in research and collaborative work with national and international institutions and has an entrepreneurial culture with many student projects/research ideas being commercialised. The Design Simulation Research Centre (DSRC) is actively participating in the Biomechanical engineering related research and in collaboration with key industries (Blatchfords), Institutions (AECC), and other universities (UM, UMP, UWE) and the NHS hospitals (Southmead, Poole, Royal Bournemouth, Salisbury). The knee unit at Royal Bournemouth Hospital has extensive clinical experience in this field. This collaboration opens up many new possibilities of extensive applied Bio-Mechanical engineering research with strong clinical applications. The student will be encouraged to participate/network in all DEC & BU activities, visit Bournemouth Hospital and participate in creation of publication and attending conferences, etc.

**SUPERVISORY TEAM & RESEARCH ENVIRONMENT**

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<tr>
<th>First supervisor</th>
<th>1. Prof. Siamak Noroozi</th>
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<tr>
<td>Additional supervisors</td>
<td>2. Mr Adrian Harvey (Consultant Orthopaedic surgeon Royal Bournemouth Hospital)</td>
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<td>3. Dr. Philip Sewell</td>
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**Recent publications by supervisors relevant to this project**


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**INFORMAL ENQUIRIES**

To discuss this opportunity further, please contact Professor Siamak Noroozi via email: snoroozi@bournemouth.ac.uk

**ELIGIBILITY CRITERIA**

All Candidates must satisfy the University's minimum doctoral entry criteria for studentships of an honours degree at Upper Second Class (2:1) and/or an appropriate Masters degree. An IELTS (Academic) score of 6.5 minimum (or equivalent) is essential for candidates for whom English is not their first language.

**HOW TO APPLY**

Please complete the BU Research Degree Application 2014 and submit it via email to the School Research Administrator - Naomi Bailey - scitechresearch@bournemouth.ac.uk by **24 March 2014**. Further information on the application process can be found at [www.bournemouth.ac.uk/phd2014](http://www.bournemouth.ac.uk/phd2014)