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# Welcome to **ORIBU**



**Professor Robert Middleton**  
Head of Orthopaedic  
Research Institute

**In our second annual report I will highlight the growth and development of ORI BU. It is a prime example of how Fusion at BU is driving forward Education, Research and Professional Practice. As a result we are seeing tangible benefits for students, healthcare and the NHS, business and the biomedical industry globally.**

The important developments in education have been the introduction of our PhD programme and International Fellowships. Working across faculties at BU, two PhD students are engaged in leading edge research using the GRAIL Gait Lab and our virtual reality surgical trainers. The ability to collaborate through these PhDs with the National Centre for Computer Animation and Department of Human Sciences and Public Health strengthens the impact of this research and will deliver world leading publications. In collaboration with the NHS, ORI BU offers three International Orthopaedic Fellowships. Surgeons from around the world will spend a year at BU acquiring the skills that will be required for them to deliver the surgery of the future. We are one of only a few centres globally able to offer robotic hip surgery training.

Two important grants have been awarded to ORI BU for world leading research. The first for CLEAT, a clinical trial comparing standard treatment in the NHS to a cycling exercise lifestyle programme. This is a £350,000 grant from the prestigious National Institute for Health Research (NIHR) Research for Patient Benefit. The outcome of this trial will influence the treatment of hip arthritis in this country and around the world. The second from an American Multinational Industrial partner represents a £200,000 inward investment into UK research. The study

will be the first in the world to evaluate the outcomes of robotic hip surgery using the facilities at the ORI gait and performance lab.

Radical changes are occurring in the world with the advent of artificial intelligence and robotic technology. These will affect healthcare significantly. I predict more changes in the way we deliver healthcare in the next 10 years than we have seen in the last 100. ORI's leading role in the development of virtual reality surgical trainers and robotic surgery will drive the development of new and existing businesses both at home and abroad. We are at the forefront of a healthcare revolution similar to the one the technology industry has been through in the last decade.

Investment in staff is the key to success. I would like to welcome Louise Burgess and Professor Ian Swain to ORI. Louise takes up the role of Orthopaedic Research Assistant. Her academic background is in sports psychology, exercise physiology and injury rehabilitation. Professor Ian Swain joins us from Odstock Medical. He brings us a wealth of research, teaching, biomedical engineering and industry experience.

ORI BU is now well established and forging links within the university and wider world. We look forward to working with you to develop the future.



# ORI believes that no-one should suffer from arthritis

The Orthopaedic Research Institute (ORI) at Bournemouth University works with patients, the health service, colleagues at the university, the local community, and industry partners to prevent and treat osteoarthritis. It's led by Professor Robert Middleton and Associate Professor Tom Wainwright, who believe that in the future, no-one should suffer from arthritis.

ORI is driven by the needs of patients and society. We combine world-class research with the latest professional thinking to stimulate new ideas, learning and thought leadership. State-of-the-art scientific facilities help us develop new techniques and treatments for osteoarthritis, through high quality research and educational outputs that have a proven impact for patients, clinicians and society.

Our research and academic outputs have advanced the fields of orthopaedic surgery,

related diseases, treatments and devices. We work to improve patient outcomes with local and international partners by engaging with clinicians, patients and the public, and involving them in our research, education and consultancy activities.

We can offer our expertise and services to partners through a variety of educational, research, professional practice, and consultancy related activities. If you think we could help you in any way, please get in touch for an informal chat.

**Osteoarthritis in numbers**  
 As our society ages there is an increasing and pressing need to find solutions to effectively manage the disease burden of osteoarthritis and musculoskeletal disease  
**8.75 million people** in the UK have sought treatment for osteoarthritis  
**6.5 million by 2020**  
 The number of people with osteoarthritis of the knee is estimated to increase to 6.5 million by 2020 (allowing for the size and ageing of the population and increasing levels of obesity)  
 Musculoskeletal conditions account for **30.5% of all years lived with disability**  
**Over 100,000 GP consultations** every day in the UK about a musculoskeletal problem  
 The cost of treating and caring for hip fractures in the UK could rise to **£6 billion by 2036**

# ORI in numbers

**32**  
 Peer-reviewed journal publications

**29**  
 Peer-reviewed international conference papers

**£1,000**

 Prize money for best abstract at World Congress of Enhanced Recovery after Surgery

**22**  
 invited international lectures

**10**  
 Visiting fellows

**143,636**  
 air miles travelled to attend conferences, meetings and presentations

**£2.6 million**  
 in research grant funding

**4.6FTE**  
 Full time staff

**10**

 cross faculty academic research collaborators at BU

**13**  
 active agreements/partnerships with industry/healthcare/academia

**3**  
 Associated PhD students

**Over 700**  
 participants in ORI research studies

**Over 400**  
 members of the public spoken to at BU public engagement events

**3**  
 Undergraduate Research Assistants

**38**  
 companies have visited ORI to discuss research collaborations





## Robotic hip surgery

In October 2017, Professor Middleton performed his first hip replacement using Mako robotic-arm technology at the Nuffield Health Hospital in Bournemouth. The hospital has partnered with Bournemouth University to lead the research into the use of robotic assisted technology in hip replacements, following a £200k grant by the world's leading medical technology company, Stryker.

Professor Middleton, said: "I was first trained in robotic-assisted surgery 20 years ago. The Mako technology is now at a level where patients are seeing a true benefit of receiving robotic-assisted surgery. As a professor and an orthopaedic consultant, not only did I want to perform hip replacements using robotic technology to the highest standard, but I wanted to prove the benefits of using this technology over current standard practices so all can benefit in the future."

Professor Middleton will see patients before operating and then up to one year after at ORI's Grail Gait Lab. The facility has state-of-the-art equipment including a 180-degree screen where medical professionals can take a deeper look at a patient's gait or walk, and as they swerve, jump and kick animated objects will appear on screen.

Professor Middleton added: "Patients in the UK and Bournemouth will see a multitude of benefits from receiving robotic-assisted

arm surgery including a quicker, less painful recovery and a longer lasting implant. A hip replacement is the most common surgery conducted in the UK and, by improving this procedure; patients will have the opportunity to get back on their feet and back to work quicker, as well as competitive sport."

John Fletcher, BU's Pro-Vice-Chancellor of Research and Innovation, commented: "This partnership will bring real benefits, not just to Dorset and the UK, but globally, as we work together to drive forward innovation and improvements in medical science. This project is just one of many good examples of how we are investing in some key areas and it underlines the university's commitment to the combination of research, education and professional practice, something we call 'Fusion', and how this research can make a real difference to our lives."



## Enhanced recovery after surgery

Professor Robert Middleton and Associate Professor Tom Wainwright's work over recent years on Enhanced Recovery After Surgery (ERAS) is an excellent example of how we fuse research, education, and professional practice in order to make a real impact.

The successful implementation of ERAS has significant societal impact, as it improves patient outcomes and makes financial savings within the health service. Introducing ERAS requires leadership and inspirational professional practice, accompanied with high quality research evidence to support its introduction, and inspiring educational interventions to help train and enthuse staff.

Professor Middleton and Associate Professor Wainwright have influenced professional practice and promoted the introduction of ERAS through their work nationally and internationally. Associate Professor Tom Wainwright is orthopaedic lead for the national ERAS Society and is leading the formation of the guidelines for hip and knee replacement, as well as lumbar spine surgery. He is also treasurer of ERAS UK and is involved in the organising of conferences for both organisations.

This work has been heavily supported by research outputs, and over the past 4 years Professor Middleton and Associate Professor Wainwright have published 16 peer-reviewed journal papers, and presented 19 peer-reviewed papers at international conferences on the topic of ERAS. The publications detail the clear health gains of implementing ERAS within hospitals, such as a reduction in length of stay, a decrease in re-admissions, a decrease in mortality, a decrease in complications, and an increase in patient satisfaction. Subsequently, their work has been cited in national health policy

documents in both the UK, and abroad in the USA and New Zealand. Over the past year they have been leading the expansion of ERAS to other surgical procedures such as Fractured Neck of Femur and Spinal surgeries.





## CASE STUDY:

### NIHR Research for Public Benefit Funding

ORI has been successful in being awarded a £350,000 funding grant to deliver a randomised controlled trial comparing outcomes for participants on the CHAIN programme with outcomes from participants who have standard care physiotherapy for their hip osteoarthritis.

ORI worked closely with a Patient and Public Involvement Group to strengthen their funding application and to ensure that the research remained highly relevant to patients.



*National Institute for Health Research*

# Non-surgical management of osteoarthritis

**A**round a third of people aged over 45 years in the UK (8.75 million in total) have sought treatment for osteoarthritis, and 2.12 million people have done so for osteoarthritis of the hip.

CHAIN, Cycling Against Hip Pain, is a 6-week programme conceived by Professor Middleton and Associate Professor Wainwright and developed with local partners in Dorset. It was designed as an effective way to implement NICE guidelines on hip osteoarthritis. The programme provided a combination of education and static cycling, designed to improve mobility and increase people's confidence in managing their condition. It brought together a range of local partners in a unique and innovative partnership to provide the programme. An initial programme was delivered from October 2013 to April 2015.

#### CHAIN programme

Each week, groups of up to 15 people attended a 30-minute education session with a physiotherapist, followed by 30-minutes of exercise on static bikes at Littledown and Pelhams Park Leisure

Centre operated by BH Live. Participants were given a home exercise programme, encouraged to cycle and asked to keep a diary. Over 78% of participants had improvements in function, and ability to carry out everyday activities, and 100% of participants said they would recommend the programme. Participants reported feeling fitter and stronger, having improved flexibility, less disturbed sleep and reduction in pain and their need to take analgesics. Participants also reported feeling more motivated to continue exercising.

Following the success of the initial programme, ORI has now been contracted by the Royal Bournemouth and Christchurch Hospitals NHS Foundation Trust to deliver the CHAIN programme at a range of leisure centres in Bournemouth and Poole.



# Virtual reality surgical training

Professor Middleton has been involved in the development of robotic surgery and the use of computer navigation in surgery since 1997 when he published a paper titled "Active compliance in robotic surgery – the use of force control as a dynamic constraint." More recently Professor Middleton and Associate Professor Wainwright have collaborated with colleagues from the Faculty of Science & Technology at Bournemouth University to publish a review of the current literature on virtual reality based training in orthopaedic surgery. Further work on the use of virtual reality training simulators in orthopaedics continues within ORI and with academic partners from the BU National Centre for Computer Animation (NCCA), and also

leading industry partners. ORI is now working in collaboration with Virtamed in Switzerland and OSSIM Technologies in Canada in developing world leading virtual reality trainers. This has resulted in ORI having the only lab in the world to have both simulators, and the only OSSIM Technologies knee replacement simulator outside of North America. Current research and educational projects on the simulators include the vital clinical validation studies required to further develop the simulators, so that they may be adopted into mainstream clinical practice and in September 2017, a team from ORI attended the British Orthopaedic Association Annual Conference to collect data from surgeons across the country.



## CASE STUDY:

**Mara Catalina Aguilera**  
Canon

**Role: PhD Student**

**Joined ORI: October 2017**

**Collaborating with: National Centre for Computer Animation (NCCA)**

"I am excited to begin working with ORI and with the virtual reality training simulators available in their facilities. Their partnership with industry and experience of world-class virtual reality simulation has helped me to have a better understanding of the current state of the market and I am looking forward to developing my simulator's prototype for PhD."

# Helping to develop new technologies

## The geko™ device

ORI provides clinical and research expertise, in conjunction with state-of-the-art orthopaedic labs, to local, national and international start-up technology companies. It has been working with a number of companies on devices that aim to reduce rehabilitation time, and improve patient healthcare outcomes.

The geko™ is a battery powered, disposable, neuromuscular electro-stimulation device designed to increase blood circulation in the veins of the leg. The product, and the technology behind it, is owned by a British start-up technology company called Firstkind Ltd. ORI research has been essential in helping them to develop the product so that it may be developed and sold internationally. Data from research conducted by Professor Middleton and Associate Professor Wainwright was a key contribution to the NICE application for the device in the UK, and was also used in the FDA approval process in the USA. This work was completed over three years and was funded by the Medical Research Council and Technology Strategy Board as part of a £1.2million funding grant. Studies have been completed at local NHS and private hospitals on the device and have not only provided excellent data for Firstkind Ltd, but have improved outcomes and patient experience for those involved.



## TTP Ventus Disc Pump

Research undertaken by ORI contributed to the launch of TTP Ventus Ltd, a UK spin-out company of The Technology Partnership (TTP) plc. TTP Ventus created the Disc Pump, a system developed to treat chronic lower leg conditions. It comprises a light-weight leg cuff containing a powerful integrated pump system that administers pressure to the appropriate leg muscles (usually the calf) in a cyclical pattern which enables the muscle to act as a peristaltic pump to promote active circulation of blood and lymphatic fluid.

### ActiPath

ORI has been working with ActiPath, a local Dorset based company, to develop an innovative online data management system to support the implementation of the CHAIN programme with Royal Bournemouth Hospital. The unique system will manage the pathway, capture clinical outcome data and allow two-way and real time communication across multiple users.

### Professor Ian Swain

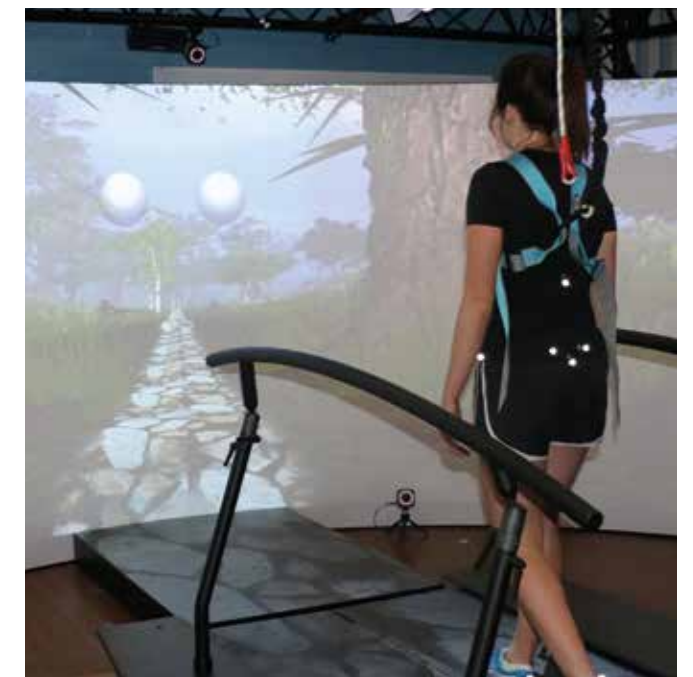
Professor Ian Swain joined ORI in November 2017. Ian was Director of Clinical Science and Engineering at Odstock Hospital, Salisbury, where he developed a novel and highly successful functional electrical stimulation (FES) device. His principal area of research is in rehabilitation and FES, and he undertook the first randomised controlled trial to show the clinical efficacy of the Odstock Drop Foot Stimulator (ODFS), which is now recommended by NICE and the Royal College of Physicians.



## The ORI Gait Lab

The ORI Gait Lab is a world-class facility utilising the Motekforce Link GRAIL system that uses an instrumented dual-belt treadmill, Vicon motion-capture system and synchronized virtual reality (VR) environment next to three video cameras and electromyography. This is the best available equipment on the market and one of only a limited number of GRAIL systems in the world.

ORI also has a fully equipped biomechanics lab with state-of-the-art equipment such as the PrimusRS for muscle testing. At ORI we use the gait analysis equipment to monitor patient outcomes after surgery. It is a unique selling point that, combined with a proven 10-year track record of industry research, high volumes of surgery, and excellent clinical outcomes, makes ORI such an attractive partner for international orthopaedic multinationals.





# Fusing education, research and professional practice



## CASE STUDY:

**Name:** Francesco Ferraro

**Role:** PhD student

**Joined ORI:** July 2016

**Collaboration:** Professor Alison McConnell

“Working at ORI has been an excellent opportunity for me to improve the quality of my research as well as to develop new working skills, with the help and support of the whole staff. Indeed, among all the excellent facilities and technologies that are available what makes the ORI so unique are the people who work here.”

Fusion is the combination of inspirational teaching, world-class research and the latest thinking in the professions which creates a continuous and fruitful exchange of knowledge that stimulates new ideas, learning and thought leadership. ORI works across Bournemouth University and with hospitals, industry partners and academia to produce high quality research and educational outputs that have a proven impact for patients, clinicians and society.

We currently have a number of collaborations with research professionals across Bournemouth University with the aim of combining expertise to create world-class research. The latest professional thinking and clinical best practice are combined to create a rich environment that stimulates new ideas, learning and thought leadership.

This is the best available equipment on the market and one of only 23 GRAIL systems in the world. There are only two other systems in the UK. ORI also has a fully equipped biomechanics lab with state-of-the-art equipment such as the PrimusRS for muscle testing.

At ORI we use the gait analysis equipment to monitor patient outcomes after surgery and we have proposed future projects with industry partners such as ZimmerBiomet, Stryker, Depuy, and Lima Corporate. It is a unique selling point that, combined with a proven 10-year track record of industry research, high volumes of surgery, and excellent clinical outcomes, makes ORI such an attractive partner for international orthopaedic multinationals.

## Current cross-faculty collaborations

### Professor Tim Rees

Professor in Sport, Faculty of Management

### Professor Alison McConnell

Professor in Sport/Health Science, Faculty of Health and Social Sciences

### Professor David Osselton

Emeritus Professor in Forensic Science, Centre for Forensic Science

### Dr James Gavin

Lecturer in Exercise Physiology, Faculty of Management

### Dr Hammadi Nait-Charif

Principal Academic in Computer Animation, National Centre for Computer Animation

### Dr Xiaosong Yang

Associate Professor of Computer Animation, National Centre for Computer Animation

# Global engagement

ORI's work is truly international; we work with a range of stakeholders, institutes and industry partners. Based on our research, we aim to improve patient outcomes both locally and nationally, engaging with clinicians, patients and the public to influence professional practice. On a national scale, we work to influence changes to policy, standards, treatment guidelines and patient expectations through the dissemination of our research.

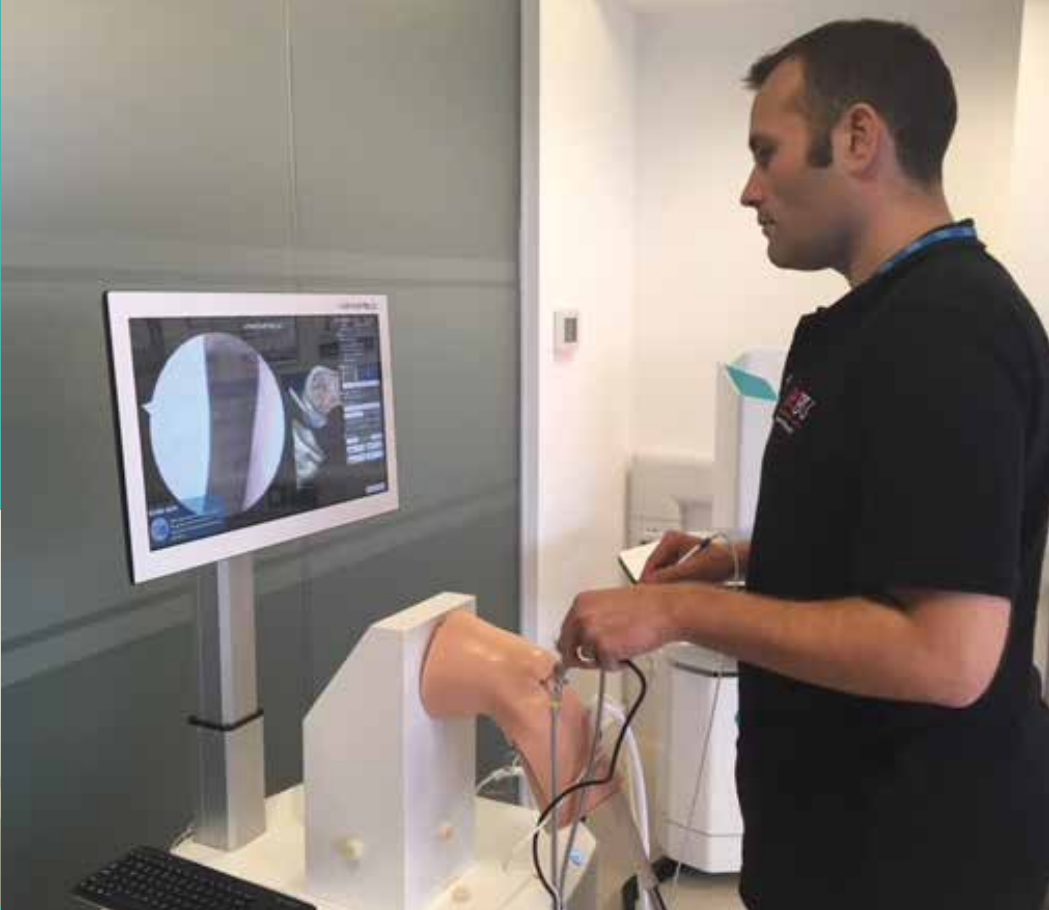




**CASE STUDY:**

**Name:** Jop Antonis  
**Role:** Consultant Surgeon  
**Joined ORI:** June 2016  
**Left ORI:** August 2017

“I took part in the Hip Fellowship from June 2016-April 2017. At the time, I was working in The Netherlands as a locum consultant, but wanted to become a hip specialist. During this 1-year period, I worked together with 2 other hip fellows, under the supervision of Professor Robert Middleton. We had our own clinics and theatre lists, and 1 day per week was scheduled for research at the Orthopaedic Research Institute of Bournemouth University, as a visiting fellow of the university. I learned a lot and improved my surgical skills, and developed at a personal level as well.”



# Education and training

In collaboration with The Royal Bournemouth Hospital and Poole Hospital, ORI BU offers three surgeons a year a Fellowship in hip surgery and research. The Fellowship is designed for Orthopaedic Surgeons who have finished their training and wish to spend a year studying to become a specialist in hip surgery.

The fusion of clinical work in the NHS and academic study at Bournemouth University is attracting applicants from around the world. The Royal Bournemouth Hospital offers one of the busiest hip replacement units to work in, while Poole Hospital operates on more hip fractures than any other hospital in England. Clinical Research at the two hospitals is coordinated from ORI BU and this ensures the Fellows are involved in all the projects from start to finish. We are able to teach them skills

that few other universities can. These include virtual reality surgical training and robotic hip surgery. The Fellows have the opportunity to be actively involved in the Institute’s research projects as well as getting support for their own work.

The Fellows enrich the teaching experience at Bournemouth University. Being fully qualified Orthopaedic Surgeons they are able to lecture, demonstrate and run workshops for a wide range of healthcare professionals.

Through their contribution to BU, they are able to apply for Visiting Faculty Status, so when they leave to take up posts in the UK and abroad they can continue to support and work with ORI BU.

# Meet the team

**Staff members:**



**Professor Robert Middleton:**  
 Head of ORI



**Associate Professor Tom Wainwright:** Deputy Head of ORI



**Tikki Immins:**  
 Research Development Manager



**Professor Ian Swain:**  
 Professor in Clinical Engineering



**Shay Bahadori:**  
 Project Manager



**Louise Burgess:**  
 Research Assistant

**Visiting Fellows**

- Kieran Gallagher - Consultant Surgeon
- Vivek Gulati – Consultant Surgeon
- Sam Heaton – Consultant Surgeon
- Jop Antonis – Consultant Surgeon
- Simon Newman – Consultant Surgeon
- Paddy Subramanian - Hip Fellow
- Ravi Pagoti - Hip Fellow
- István Batta – Hip Fellow
- David McDonald – Service Improvement Manager

**Visiting Associates**

- Matthew Low – Consultant Physiotherapist
- Eduardo Martínez-Carbonell – PhD Student

**Associated PhD Students**

- Mara Catalina Aguilera Canon
- Francesco Ferraro
- Susanna Bentman



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[www.bournemouth.ac.uk/ori](http://www.bournemouth.ac.uk/ori)



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