# BOA European Travelling Fellowship 2018 – James Fletcher

I was honoured to be a recipient of a **BOA European Travelling Fellowship Award 2018** to attend the AO Research Institute Davos, Davos, Switzerland.




*Figure 1 - AO Research Institute Davos*

For 6 months over the summer of 2018, I was invited to be a research fellow at the AO Research Institute Davos (ARI). The ARI has a long standing, international reputation as a centre of excellence for orthopaedic research with techniques that have been developed there being used in every hospital around the world, virtually every day. Implant concepts established by the AO Foundation have been emulated by every implant manufacturer and through the AO courses that are delivered in countries around the world, discoveries made are disseminated in a broad, expeditious fashion.

With this fellowship occurring during my PhD candidature at the University of Bath, I had arranged to continue experimentation on fracture fixation whilst developing my skills and experience as a clinical researcher. The ARI has four main areas of research, reflected in the four departments: infection, polymers, musculoskeletal regeneration and biomedical development. I was based in the latter under the supervision of Prof. Boyko Gueorguiev, the head of biomedical development. The department has a broad spectrum of employees, including masters students, PhD candidates, post-doctoral researchers and clinical fellows. The facilities are incredible, with three operating theatres available for cadaveric human and in-vivo animal testing; this latter activity occurring in a large pre-clinical facility run by AO veterinarian surgeons and researchers.



*Figure 2 - Other commuters*

Despite arriving at the end of April, there was still plenty of snow around (Figure 1). Fortunately, the flat I had rented for the fellowship was only a 5-minute walk from the institute (Figure 2). Though, given how picturesque my commute to work was, maybe I should have lived further away!

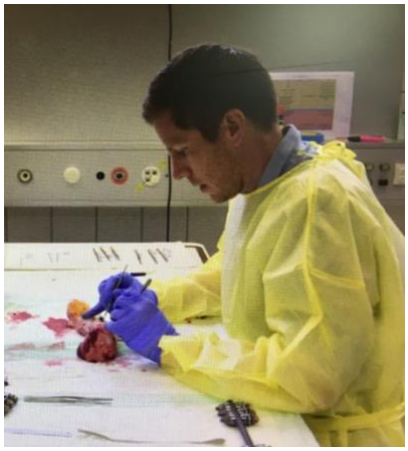

*Figure 3 - Dissecting sheep tibiae for ActiveFix project*

The first month was spent orientating myself at the facility, receiving inductions for equipment and theatres, and planning research projects related to previous work I have undertaken in the UK. I received training on using the operating theatres for biomechanical specimen preparation, how to build the apparatus needed for testing and what facilities were available for enhancing experiments, such as using computerised numerical control (CNC) machines to make highly accurate testing materials. The ARI has licences for cadaveric human and live animal testing, though I would only need the former for my work. Following group discussions with my supervisors and lab technicians, we designed a testing apparatus to capture the compression generated during automated screw insertion to a targeted screw tightness. This was followed by immediate pullout, to establish the optimum non-locking screw tightness – this work will lead to better screw insertion, reducing the fixation failure rates currently seen.

Using one of the three onsite CT scanners, I performed detailed analysis of the human tibial samples being used. Following this, using a specialised Instron machine, screw insertion could be automated, whilst providing real time evaluation of the forces occurring around the screw. As was a common theme at the ARI, I was able to collaborate with another researcher who could use the data from these experiments to develop a computational model that could predict screw pullout force based on the stiffness of the sample.

Several in vivo animal studies are performed at the ARI, and I was able to help on one by performing the dissections of sheep legs as part of a project called 'ActiveFix' (Figure 3). Here osteotomies in sheep tibiae were made, and then partially fixed, with the 'ActiveFix' system used to cyclically load the osteotomy site to assess the effects of strains on bone healing. The hope with this project is to determine the optimum loading protocol for bone healing.



*Figure 4 - Being greeted by sheep on arriving to work*

Numerous other innovative projects were underway whilst I was on my fellowship, and I was able to help with one, 'SystemFix'. Here, a validated computational model for proximal humeral fractures was being used to optimise the use of the current PHILOS plate and develop modifications to its design. I was able to witness the cutting-edge equipment used in these experiments, such as using dissolvable plastics when 3D printing cutting jigs, so that once osteotomies are made and the fracture is stabilised, the jig can be removed allowing the same fracture pattern to be biomechanically tested each time. Furthermore, I was able to interact with implant development teams to understand how concepts can be commercialised and brought to operating theatres, and how these processes can be balanced against rapidly promoting research findings.

Following on from the work I was able to undertake, we developed the 'TightRight' project aiming to improve the screw insertion technique of surgeons, including testing 300

surgeons at the AO Courses held in December. This work will lead to clinical improvements by raising awareness of the ease and dangers of overtightening screws, and how using augmented screwdrivers can dramatically reduce this.

The work-life balance in Switzerland is spot on. The working atmosphere at the ARI was efficient and incredibly productive, but having a healthy outdoor lifestyle was equally encouraged. I was able to regularly go hiking, including once joining the Swiss Academy of Sciences to visit an archaeological site at 2500 m (Figure 5).



*Figure 5 - View from archaeological dig site*

I would like to express my gratitude to the BOA for awarding me this travelling fellowship and to my supervisors **Dr. Ezio Preatoni, Prof Geoff Richards, Prof. Boyko Gueorguiev, Mr Mike Whitehouse** and **Prof. Richie Gill,** and my training programme director **Mr Simon Thomas** for supporting my application. Last but not least, I must thank my wife, Clarissa, whose support and understanding made my time away from home possible. I would strongly encourage anyone interested in undertaking world-leading research that promotes advancements in patient care to consider spending some time at the ARI or to contact them to discuss collaborative projects.

## Executive summary

I was honoured to receive a BOA European Travelling Fellowship 2018 that enabled me to attend the AO Research Institute Davos, Davos, Switzerland. The fellowship led to me developing advanced research skills related to biomechanical testing, alongside enhancing my understanding of alternative research methods and processes for delivering clinical innovations to operating theatres. Through the work I was able to perform, I established the optimum tightness for non-locking screws and using this research, I lead a project educating surgeons, at the AO Courses, of the consequences of overtightening screws. The BOA European Fellowship enabled the development of international collaborations that will lead to the solving of current and future orthopaedic problems. Through the immense help of the BOA, I was able to be the first orthopaedic trainee to become an ARI fellow and I hope that future surgeons can follow in my footsteps, gaining an extensive research education from the ARI alongside learning the skills needed to realise clinical benefits for all patients.