Bone Tissue Engineering *in vitro* and *in vivo* using a Novel Multilayer Cell Sheet Technology

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This summer I had the privilege of working for two months with my PhD collaborators, Prof. Okano’s group at TWIns in Tokyo, Japan. This opportunity was made possible through a JSPS Summer fellowship that was jointly funded by the British Council and JSPS (Japan Society for the Promotion of Science) to encourage research collaborations between Japan with North America and Europe (Figure 1). Through the fellowship I learnt numerous practical research techniques that will provide a strong foundation for my PhD. I have also gained a realistic experience of research in Japan, as well as international networking and research collaborations. This summer experience strengthened my commitment to a research career and has opened up future career opportunities for me as a JSPS alumnus to apply for post-doctoral fellowships to do research in Japan. I would highly recommend others to apply for this fantastic opportunity.

![Figure 1: This photograph was taken during orientation week of the JSPS board and JSPS Summer Fellows from the UK, USA, France, Germany and Sweden, including representatives from the each respective country’s collaborating funding body.](image)

**My Research**

Our continuously ageing population suffers from bone damage caused by trauma, cancer, congenital defects or common age-associated diseases, such as osteoporosis. There is an urgent clinical need to develop alternative approaches to efficaciously repair bone due to the limitations of current available technology. Cell sheet technology was developed at TWIns and is emerging as a promising solution that is already being clinically translated in regenerative therapies for other tissue types (Figure 2). Therefore this research is working in collaboration with the pioneering research group of this technology to develop cell sheet technology for bone to meet the growing demand for bone regeneration from our ageing population.
Advantages of multilayer cell sheet (MLCS) technology compared to conventional cell culture methods. Multilayer cell sheet (MLCS) technology provides intact monolayer sheets of confluent stem cells that can be stacked to make a 3D tissue graft. MLCS averts damage to cells and the extracellular matrix which can then be retained for clinical therapy.

The main aim of my summer research was to learn different techniques for cell sheet technology which are key for my PhD. I was really pleased to collect good preliminary results for my PhD and to have achieved beyond my expectations. It was also beneficial for me to experience research in Japan, meet and work with my collaborators, and strengthen the collaboration between our two universities. This summer fellowship was invaluable and will provide an excellent foundation of knowledge and skills for my PhD by learning first hand from the experts and pioneers of cell sheet technology.

Work in Japan
From speaking to other JSPS summer fellows, it seems like the experience of working in Japan was varied depending on your institution, lab and supervisor. Personally, I absolutely loved working at TWIns (Figure 3). I thought Japanese labs were very organised and had more of a community approach to research, in particular with how the lab ran and how people were united in overcoming any issues.
that arose. Furthermore, the general standard of English in the labs was good so there were not any significant language barriers.

**Life in Japan**
This fellowship was not only instrumental for my research, but it has been an amazing, eye-opening cultural experience. Japanese culture is very rich and different to western culture, which has been fascinating to experience from the very traditional to the cutting-edge modern. The JSPS Summer Programme started off with a rare and untraditional cultural experience of being able to meet the Emperor and Empress of Japan, which was very special. The Japanese people are really lovely and I know I have made good friends during my time here. It was great to meet with other JSPS fellows to go to shrines, temples, festivals (祭) and to the famous Sumidagawa fireworks. I also had fun trying to learn and practice Japanese. Most Japanese people do not speak any English so you do have to make an effort to learn a few key words and useful phrases, but the Japanese people are really nice and helpful. One of my favourite experiences was going to the Sumo Championships in Nagoya, which was a really exciting atmosphere and I would highly recommend it to everyone. After the fellowship I travelled to Okinawa, Osaka and Kyoto, which were all great places to visit. Overall I absolutely loved this summer experience; it has been unforgettable and I hope I have the opportunity to return to Japan in the future.

Thank you again to JSPS and the British Council for this amazing opportunity.

If you would like to know more, please do not hesitate to contact me: mnerk@leeds.ac.uk