Western Faculty Profile: Dr. Douglas Hamilton

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No conflicts of interest declared

Background

Dr. Douglas Hamilton is an Assistant Dean for Research and Associate Professor in Oral Biology and Anatomy & Cell Biology at the Schulich School of Medicine and Dentistry. Hamilton completed his PhD at the University of St. Andrews in Scotland. His research is in the field of cell biology, biomaterials, and tissue engineering, with a focus on how the surface features of different implant materials effect cell behavior. His lab studies wound healing, and has developed biomaterials that result in 5-10x faster closure in diabetic models. In addition to serving as a Principle Investigator, Hamilton also teaches in undergraduate and graduate cell biology and critical thinking courses, as well as first year dentistry mammalian histology.

Tell us about yourself and your career path.

I initially went to the University of St. Andrews in Scotland for an undergraduate education in marine biology. However, at the end of second year, I was much more interested in cell and molecular biology. As I specialized, I decided to pursue a PhD. In Scotland, completing a Masters is not necessary to starting a doctorate degree. During my PhD, I had the opportunity to spend periods of time at the research headquarters of Smith & Nephew, a medical equipment manufacturing company. Because of this, I was able to establish a balance between academic and industrial research right from the beginning. During my thesis, I worked full-time for an advanced wound care company. These experiences allowed me to decide that I did not want to work in industry. In 2000, I moved to the United States and worked at the McGowan Institute for Regenerative Medicine at the University of Pittsburgh, where we did work in vascular biomechanics and stem cell differentiation. Three years later, I moved to the University of British Columbia (UBC) to do my post-doctoral fellowship in the Faculty of Dentistry. I became a faculty member at Western University in 2007.

What is your main research focus?

My lab asks a very simple question – why do cells make extracellular matrix (ECM)? What turns the regulatory signals on and off? We take examples from different pathologies in which cells over or underproduce ECM and look for biochemical differences. Once we understand the mechanism involved, we can work on developing biomaterials that control these signals.

The research that I do has definitely evolved over the past few years. When I was at UBC, we studied the effect of topographical features on cell signaling. I then came across a paper that led us to use a genetic knockout mouse, which gave us the opportunity to assess a specific protein's role in wound healing. We found that in these knockout mice, the wildtype phenotype could be rescued by exogenous protein delivered by a scaffold. This prompted us to pursue therapeutic applications in impaired healing associated with diabetic patients. We then started to collaborate with vascular surgeons, studying amputation cases in order to understand what is going on with these tissues on a molecular level. However, we soon discovered that these patients may have compromised microvasculature, which then was the start of another collaboration with Dr. Chris Ellis and Dr. Geoffrey Pickering in the Department of Medical Biophysics.

What sparked your interest in dental research?

The mouth is a very interesting environment. It has an extensive microbiome and is exposed to a lot of bacterial colonization. Additionally, it has very complex tissue architecture – there are multiple cell types that need to interact at close proximity in order for the tissue to work properly. As we understand more about the mouth, we begin to understand that it is a window into an individual's systemic health. If you can regulate what occurs in the mouth to a certain extent, you can impact general health.

What are some challenges that you have faced in this research?

The biggest thing that we've come up against in the subject of impaired healing is the fact that there is no animal model for chronic wounds. Animals do not develop chronic wounds, and it is very difficult to replicate *in vivo*. There's also a large disconnect between what a vascular surgeon goes through on a daily basis and what researchers study. Current evidence is suggesting that microvascular dysfunction plays a large role in impaired wound healing, yet surgeons have no way of measuring that in the clinic. A lot of the decisions that they make are based on well-established clinical predictors, but it doesn't tell them what's going on at the microcirculatory level. As long as you are aware of the problems and limitations, you can then turn those challenges into opportunities for innovation. We constantly try to feed the information that we get from primary data back to the clinicians, in order to get their opinions. That's the only way you'll be able to move forward; recognition of challenges, developing strategies to get around roadblocks, and understanding why the problem exists in the first place – those steps are what makes *good* research. If you come across a problem that hasn't been addressed by any of the current literature, then you know that you are at the forefront of that field.

What advice do you have for students interested in research?

The first thing that I always ask students is "what interests you?" If you are not interested in the area of research that you're working on, you're simply not going to enjoy it. Find a lab that is innovating in a field you find interesting. The next step would be to talk to the professor. I think the disconnect between professors and students is for the most part due to their perceived unapproachableness, but the reality is very different. Class sizes have increased massively which makes direct contact with professors more difficult, but start a conversation and you will see there is no disconnect. Be willing to volunteer, most labs will not be able to fund students from the start. See it as a learning experience. Don't be afraid to switch into a different field if you discover that a particular lab isn't for you. It is also important to read the relevant literature. There exist many opportunities for students to develop their article review skills; read open-access papers, get involved in journal clubs, speak to professors. Just start getting a taste of all the different research that exists; even if you find that you don't like a particular area, you will find what you *do* like. That is the most important outcome.