Spotlight on Science

Deciphering Key Components of Human Hair Follicle Regeneration

Erin Weber, M.D., Ph.D
Postdoctoral Fellow
Keck School of Medicine
University of Southern California

Erin Weber, MD, PhD is a postdoctoral fellow in Dr. Cheng-Ming Chuong's laboratory at the Keck School of Medicine of the University of Southern California. She is also a resident in Plastic and Reconstructive Surgery at USC. Her research focuses on tissue engineering new hair follicles for patients who have lost hair and skin due to burns, traumas, or various types of alopecia. More specifically, the goal is to identify the transcriptional regulators that are responsible for defining the dermal hair follicle stem cell. This information can then be used to develop a renewable source of hair follicle stem cells for transplantation or full follicle development in vitro.

How did you become interested in the field of reconstructive medicine?

I chose the field of plastic and reconstructive surgery for the creativity and artistry that many of the procedures require. Many other surgical fields involve the removal or excision of diseased parts of the body. But in plastic surgery we are often tasked with recreating missing parts and refashioning other parts of the body (nerves, muscles, skin) to serve new purposes. I enjoy the challenge of "engineering" new solutions to replace what patients have lost, both functionally and cosmetically.

What is the basis of your research?

For burn patients, hair loss causes devastating cosmetic and physical problems. While the body may eventually heal burn wounds, hair follicles are not regenerated and patients suffer from brittle skin, decreased sensation, and impaired thermal regulation. There currently is no adequate way to treat extensive follicle loss.

Successful human hair follicle regeneration in the laboratory has been quite elusive and is limited by low frequency and prolonged regeneration times of 2-3 months.

How are you studying hair follicle regeneration?

Human fetal hair follicles contain stem cells which are capable of directing follicle regeneration. Using dissociated fetal scalp, we have identified the culture conditions that allow early follicular structures to form rapidly within four days from fetal follicular stem cells, providing an assay system to study human follicle regeneration.

How has NuGEN enabled your research?

I began working with NuGEN because I was having difficulty obtaining usable next generation sequencing data from my tissue samples, which were of suboptimal quality for standard RNA sequencing methods that we had used before. NuGEN's technical support staff and sales representatives helped to identify the system that was most closely applicable to my needs.

We used the Ovation RNA-Seq System V2 to generate our libraries for transcriptome analysis and were able to obtain reproducible and usable transcriptome data from ~500 pg total RNA with RIN scores of 2-3. This total RNA was extracted from hair follicle cellular subpopulations that were microdissected from frozen sections of whole skin.

What are the next steps in your project?

We have now successfully completed transcriptome analyses to identify key differences between fetal follicle stem cells and the equivalent adult populations. We are currently evaluating select factors for their role in fetal follicle regeneration and the ability to induce folliculogenesis in adult skin.

And the final goal of this study?

With this new transcriptome data, our ultimate goals are to generate engineered hair follicle stem cells and produce a renewable source of complete human hair follicles for transplantation into burned skin.