The PSF Research Grant Awards

Unearthing growth factor-free bone regeneration

Editor’s note: The following is part of series highlighting The PSF Research Grant Award winners and the research they’re conducting to improve patient safety and develop new technologies for plastic surgeons.

THE RESEARCHER
Justine Lee, MD, PhD
Title: Assistant professor, Pediatric Cleft and Craniofacial Surgery, Division of Plastic and Reconstrucitve Surgery, UCLA Medical Center
Award: The PSF Pilot Research Grant
Project: Osteoclast Mediated Resorption of Engineered Human Bone

PSN: What is your approach to the study of engineered human bone?
Dr. Lee: Our work involves utilizing custom nanoparticulate mineralized collagen glycosaminoglycan scaffolds for the purposes of human bone regeneration. We have also incorporated the concept of inhibition of resorption in the host microenvironment in promoting osteogenic differentiation. Our proposed work is a pilot study developing the in vitro system to study the interactions between mineralized scaffolds and osteoclasts.

PSN: What have you found so far in your investigation of these interactions?
Dr. Lee: We’ve completed our characterization of osteogenic differentiation on our custom scaffolds using adult primary mesenchymal stem cells in two different species. In both humans and rabbits, we’ve found that mineralized collagen scaffolds induce efficient osteogenic differentiation in comparison to nonmineralized scaffolds. When we looked at the signaling pathway that was responsible for this increased efficiency, we found that activation of molecules downstream of the bone morphogenetic protein receptor was constitutively present. In other words, we found that this biomaterial can induce osteogenic differentiation independent of addition of growth factors.

PSN: What are the possible practical applications of this osteogenic differentiation for treating patients?
Dr. Lee: Currently, there are two FDA-approved growth factors that are in clinical use, BMP-2 and BMP-7. However, growth factors are not necessarily benign molecules. They are usually added in supraphysiologic concentrations and may cause untoward clinical side effects such as diminished maxillary growth in children, ectopic bone formation, osteoly-sis and an elevated risk of cancer. Thus, there’s significant need to pursue alternative growth factor independent methods for stimulating osteogenesis, potentially utilizing material science alone to inhibit resorption by the host microenvironment.

PSN: At this early stage, have you found anything unexpected that could change the course of your research?
Dr. Lee: The unexpected finding in our research is that we were able to induce growth factor independent osteogenic differentiation with our scaffold. We were also able to describe the molecular mechanisms responsible for this finding.

PSN: Who has helped guide your career as a surgeon-scientist?
Dr. Lee: I’ve had many clinical and scientific mentors throughout the years who have been incredibly important to my development. Scientifically, one of the best scientists that I know is Marcus Peter, MD. As my former thesis advisor in graduate school, he set the example of how to do good science and how to do it efficiently. Clinically, Larry Zachary, MD; Russell Reid, MD; Larry Gottlieb, MD; Jim Bradley, MD; and Henry Kawamoto, MD; have made the most significant impact on my career. Dr. Zachary introduced me to plastic surgery in medical school and made me fall in love with surgery. I credit Dr. Reid for helping me find craniofacial surgery as a career path and letting me do a run-through of life as a surgeon/basic scientist during residency. Dr. Gottlieb taught me how to operate and how to think about surgery, and he showed me what it means to be a great doctor. Dr. Bradley and Dr. Kawamoto taught me everything I know about craniofacial surgery – and they continue to inspire me on a daily basis to always push the boundaries of the possible. Professionally, I could not have done any of this without the mentorship of David Song, MD; Tim Miller, MD; George Rudkin, MD; and Andy Da Lio, MD. I’ll never forget the day (almost nine years ago!) that Dr. Song told me as a medical student that I had to do plastic surgery, as that decision changed my life forever – not to mention matching me to the University of Chicago plastic surgery residency, which will always be one of the best years of my life. Tim, George and Andy hired me, supported me, mentored me in my early academic career, and I can’t thank them enough.

PSN: What do you like to do with your time away from the lab?
Dr. Lee: I love to hike and explore parks and forests close to San Francisco. It’s a great way to stay healthy and feel connected to nature.

PSN: Have you always been interested in a career in medicine?
Dr. Lee: I’ve always wanted to be a doctor, but I thought I would be a pediatrician because I love kids. It wasn’t until my third year of medical school that I realized surgery is just so much fun, as well as a better match for my personality.

PSN: Outside of your current PSF-funded research, what has been your most successful project?
Dr. Lee: Outside of my current work, my favorite project was my dissertation work on apoptosis signaling with a protein called DREDD – believe it or not.

PSN: What sounds are most regularly heard in your home?
Dr. Lee: Michael Jackson, Joao Gilberto, Astrud Gilberto, Antonio Jobim, Stan Getz, Pink Martini and Madeleine Peyroux. But usually, the residents and Fellows just put on whatever they want.

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