Alexandra Magold

Good morning, Science. My name is Alexandra Magold, and it is a great pleasure to be talking to Nicole Black today. Nicole is a bioengineer at the Wyss Institute. Her project is amazing. It demonstrates exactly why I started this podcast to remind us that we do not have to take what fate throws at us. Her team's project came out of the Boston Marathon bombings. How did this all start for you personally?

Nicole Black

Yeah, so I first started the project back in 2015. I met two surgeons at Mass Hospital in Boston, Dr. Aaron Remenschneider and Dr. Elliot Kozin, and in particular Dr. Remenschneider had worked with a lot of patients from the Boston Marathon bombing back in 2013 and realized actually that the number one injuries sustained by these patients was actually perforated eardrums. And so he worked a lot with these patients and actually performed some follow up studies where he discovered that outcomes were imperfect for these graft materials that were being used.

Nicole Black

He found that a lot of these grafts failed because they either retracted from the surrounding tympanic membrane, leaving another perforation, or a lot of these patients had very poor hearing outcomes, mainly because these tissues do not have the complex circular radial structure that your normal tympanic membrane has. So that's what really motivated me to get started and try to build and design better grafts for these patients. I was really drawn to the tympanic membrane perforations and thought that it fit in really well with my previous experience in polymer and tissue engineering in general and regenerative medicine.

Nicole Black

And ultimately, we are not looking to just close the hole. We're looking to recapitulate this very complex structure. And so 3D printing in that case is more than just a manufacturing method. It actually allows us to design these graphs so that they are what's called biomimetics. So they mimic the structure of the eardrum and therefore can vibrate well at low and high frequencies. So there is a lot of mechanical and acoustic engineering also involved in this project. So it's not just cellular engineering and like traditional tissue engineering, there are other components to it that I thought were really interesting and particularly learning more about acoustics and how the ear works.

Nicole Black

I became even more motivated to solve that challenge.

Alexandra Magold

That's amazing. What stage are you at right now?

Nicole Black

So right now we have a final graft prototype. We knew that we wanted to mimic this circular and radial architecture. But really, what would this look like? Would there be gaps between these fibers or not? And then really started looking at the material itself. So we began prototyping with off the shelf materials that are found in other devices like silicones and PLA or poly lactic acid and polymers like that. And we discovered that none of these polymers really have the right properties to match that of the eardrum.

Nicole Black

So namely, we are trying to see if we could create something that was biodegradable. So as the ear regenerates and new tissue forms on it. This graft could eventually go away, reducing any sites for foreign infections on the material itself and then also be elastomeric. So match the mechanical properties of the eardrum. And so a lot of our work was really based on designing this biodegradable elastomer that we could print at high resolution in these complex architectures. And so that's where a lot of my work is focused.

Alexandra Magold

Amazing. Is there a time limit to how long after the injury has occurred that you can still use it?

Nicole Black

There's no upper limit that I know of when you can. This won't regenerate anymore, particularly a lot of these graft materials that are currently used like fashion cartilage. They're not really regenerating the eardrum. They're more so closing the hole. So there's some techniques you can do to sort of like freshen the wound a bit when you put these new grafts on. But, yeah, I mean, a lot of patients just try to wait at least a month to see if their perforation heals and then after that decide to undergo surgery.

Alexandra Magold

Brilliant. What's next for you?

Nicole Black

So next for us is finding how we can bring these grafts to patients. So we are involved in some various accelerators and venture competitions and we have some mentors who have medical device experience. And a lot of these large medical device companies really prefer to actually acquire small companies that have successful products already on the market rather than doing the research and development from the ground up themselves. And so that's really inspired us to try to have our own venture, which we're calling: Beacon biomimetics around this graft technology and hopefully even using this materials and 3D printing technology for other tissue regeneration applications.

Alexandra Magold

What could that be?

Nicole Black

Cartilage grafts, potentially vascular grafts as well. And we're also looking at ways where we might be able to possibly augment the structure of the eardrum. So for people that have a normal intact eardrum, but perhaps don't use hearing aids for different reasons, problems with batteries or maintenance, so having a device that could actually passively conduct sound waves and be sort of an implantable device for that. So those are the main things that we're looking at right now.

Alexandra Magold

So Nicole if anybody wants to invest or work for you, where can they find you? How can they contact you?

Nicole Black

If you're interested in contacting me or learning more about our venture, you can find a contact form below and I'm looking forward to getting back to you. Thank you.

Alexandra Magold

Great. Thank you so much for talking to me. Have a great day, Nicole.

Nicole Black

Thank you, Alex. Have a great week. Bye.

Alexandra Magold

You, too. Bye.