Advancing Research Shoulder to Shoulder

Surgeons and Laboratory Scientists at Rush Team Up to Improve Shoulder Replacements

Total shoulder replacements are the fastest-growing implant surgery in the U.S. The vast majority of these surgeries result in successful, long-lasting implants. However, even a very small failure rate affects thousands of patients. Physician **Grant Garrigues, MD,** *and scientist* **Robin Pourzal, PhD,** *discuss how orthopedic surgeons and laboratory researchers at Rush are building on a decades-long track record of collaborative research to understand why some shoulder replacements fail and how to make them last even longer.*

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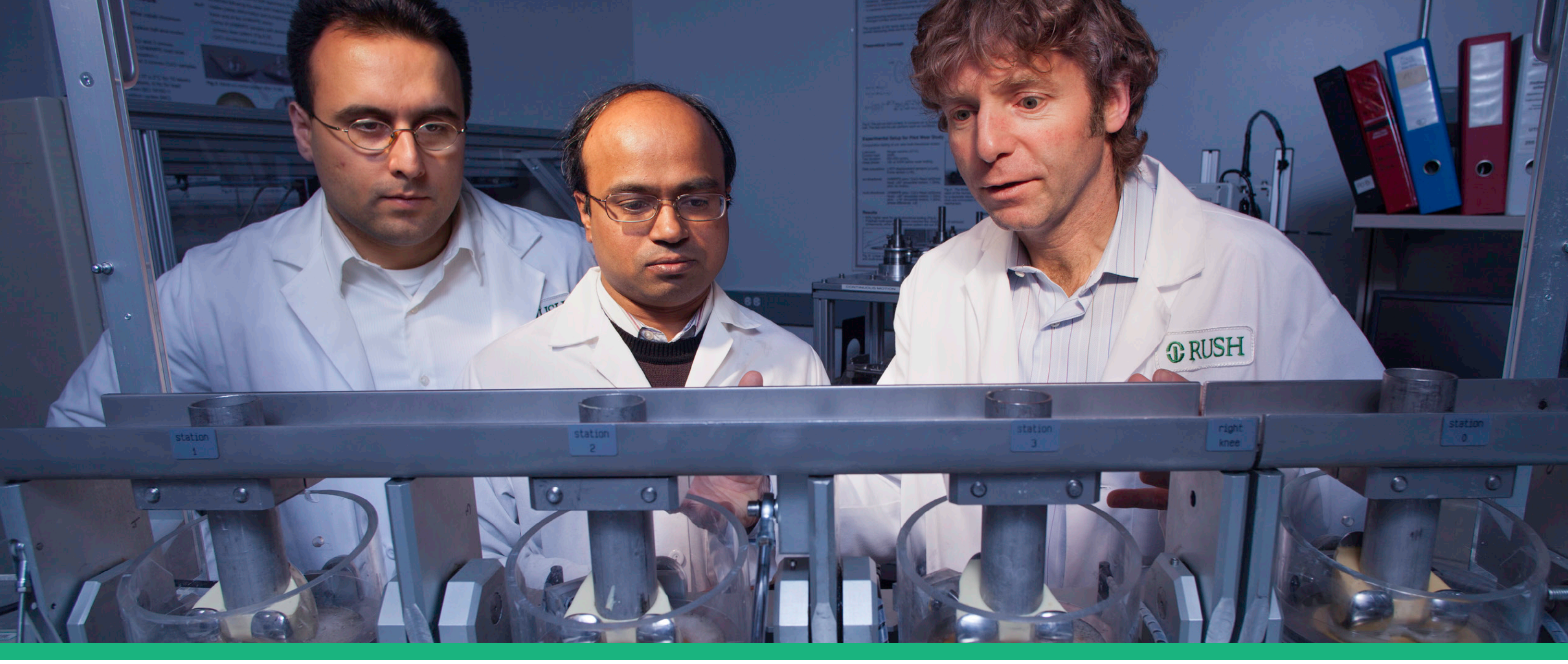
Garrigues: Shoulder replacement surgeries have been around longer than total hip replacements. Even though they're less common, they're generally fantastically successful, and surgeons are performing more each year. For patients, it's a life-changing operation. However, we want to maximize longevity. Let's say a patient comes to Rush when their original implant fails — we'll reconstruct their shoulder with a new implant and then send the device that comes out to the Rush Implant Tribology Lab. Robin, what led you to specialize and collaborate in this area of research?

Pourzal: I'm a mechanical engineer by training with a focus on material science. I've been studying implant materials for a long time, especially the metals and polyethylene used in total hip and knee replacements. Those happen to be, for the most part, the exact same materials used in the shoulder. We are at a point now where it's really important to start looking at how those shoulder implants wear down. Any bearing has, by design, wear and tear in which foreign particles are released into the joint. That debris can impact patients. When you joined Rush — not only as an extremely experienced revision surgeon for total shoulders but also one with a great research resume — it was frankly the perfect match. We've collected more than 100 implant devices from patients over the last three years and currently have the country's largest registry of shoulder devices and donated tissues.

Garrigues: You mentioned speaking the same language — I did a med school research program that was a Harvard- and MIT-combined program. It was basically medical school for engineers. So this has been a passion of mine going way back, and Rush's expertise in this area is what drew me here. You and the entire basic science group have an incredible track record of doing this kind of research in the hip and



knee arena. While the problems in hips and knees are a little different than those in the shoulder, there are a lot of similarities. That led to our collaborative work to look at the factors affecting whether an implant will last five years or the rest of a patient's life. Obviously that is a huge difference. Companies will design implant devices, and then the FDA looks at a couple of years of data. No one ever looks at them again unless someone like you and me team up.

Pourzal: And for the most part, this work is retroactive. Patients first have to use these implants. Ideally they won't fail at all, but some obviously do. When that happens, patients from around the country find you, your team retrieves them in the operating room, patients generously consent to share them with our lab and we learn from them. Over time, the human body interacts with these devices in ways we can't always anticipate. The development of better implants takes many years of research. It's not something that just happens immediately.

Garrigues: I agree. I routinely work with companies to help design new implant systems. We're constantly asking, "What's the clinical problem, and how can we make this better?" We're trying to more precisely pinpoint these problems by studying how the implants hold up over time in people. We've gotten to the point where we're going to find some design features that were not good ideas and could lead to premature failure. We currently retrieve a couple of failed implants each week — it's on us to make these problems known and get those implants out of circulation. What else would you say will come from the analysis of the implants we're gathering?

Pourzal: You need to study both the implant and the surrounding tissue to get the full story. You need to see the cellular response to debris in the tissue and what types of different cells could be associated with inflammation. We're already beginning to make some very interesting findings in this regard, but it's important we don't overreach and make big claims without additional study and a larger sample size. As we've proven in our work with hip and knee implants over the years, this is research that will never really end. Our goal now is to get an NIH-funded grant, which will provide us with the funding needed to keep us going independently and further strengthen the credibility of our findings. Donor support has positioned us really well for this by funding preliminary studies, high-tech equipment we use in the lab, its continued maintenance, student stipends and salaries for postdoctoral researchers.

Garrigues: You said it perfectly. What resonates with me the most is that this research is never done, and donor support keeps us going. We might identify a problem that will impact how implants are designed going forward, but we don't know that those changes will solve the problem without creating a new one. These implants work well, but they're not perfect. It's coming back full circle — we want patients to have a shoulder that is pain-free, has full motion and allows them to do all the things they want to do throughout their lifetime. Even if there's only a low failure rate, it becomes significant if it happens to you or your loved one. That's why it's important we make them better. I'm confident we can do that thanks to Rush's scientific legacy in the field of joint replacement.