Sports in Society *The bionic body*

Medical-tech gains bring the bionic human closer to reality

Humans may be running faster, jumping higher and going longer than at any point in our history, thanks to technology. Ultramarathoner Richard Donovan is leading the way — even after having his knee replaced.

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Richard Donovan running in Patriot Hills, Antarctica, in January 2006 as part of the Antarctic 100K ultra race, the event he helped establish in the early 2000s. He has won the 100K ultramarathon three times, most recently in 2009. (Photo by Mike King)

Written By

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Did You Know? *Tap to expand*

Standing at the top of the world, a frozen ocean at his feet and a perpetual sun hanging overhead, Richard Donovan gets ready to run.

He's arrived at this specific point — geodetic latitude 90 degrees north, to be precise — by an Mi-8 Russian military chopper, compliments of a pair of hardened former Eastern Bloc pilots. Donovan, an adventurer, ultramarathoner and extreme event organizer from Galway, Ireland, has come to the North Pole to scout a race site for safety and logistics.

There are polar bears, potentially lethal cracks in the ice, and the obvious frostbite concerns in a climate where temperatures can plunge to minus 40 degrees Fahrenheit. But before he's able to take his first stride into the blinding white terrain, Donovan is stopped by one of the Russians.

"Cannot start without gun," the pilot said.

Not sure what to do with this information, Donovan pauses as the pilot rummages through the chopper and returns with a firearm — a flare gun to see the runner off.

"*This is insane*," Donovan thinks. *"I love it."*

For Donovan, swashbuckling in exotic locales and under extreme conditions have become his passion and livelihood. He is one of many athletes around the world, amateur and professional, who make it their business or pleasure to field test the boundaries of human athletic performance.

Richard Donovan has helped organize ultramarathons all around the world. He is shown here in the Atacama Desert in 2018, located in Northern Chile, where the annual Volcano Marathon is run. (Photo by Mark Conlon)

But that would not be possible for Donovan, 54, if not for a procedure he underwent in 2019. A partial knee replacement essentially rolled back his odometer on one of the most important load-bearing joints required in the act of running. It's a testament to the stunning advancements made in medicine in just the past few decades alone.

Humans may be running faster, jumping higher and going longer than at any other point in the history of our species, in part because of our collective drive to see those things done just a *little* better than before. And as the fitness craze has joined sports to become big business, a legion of trainers, physicians, researchers, lab rats and entrepreneurs have thrown themselves into the challenge of helping athletes explore those limits and explode expectations.

From the NFL's Gale Sayers to the NBA's Bill Walton to Major League Baseball's Mark Prior, athletes over the years have seen their careers cut short or severely diminished by injuries. Today, those same injuries might have been treatable with a higher probability of success, thanks to advancements and new technology in health and wellness.

It started with athletic leaps made possible by individuals such as Tommy John, who became the first pitcher to return to MLB after having the ulnar collateral ligament replaced in his pitching elbow, and Frank Jobe, the doctor who performed the surgery in 1974. It continued with the work and legacy of Dr. James Andrews, the surgeon renowned for repairing the anterior cruciate ligament in countless professional athletes. Today, for every superstar lost to the sports-injury fates — think Bo Jackson of NFL and MLB fame — there are many more rescued by modern technology.

For Donovan, it was a left knee that gave out on a routine training run just after he turned 50. After visiting a local physician who told him his condition was bone on bone — a severe case of osteoarthritis and deterioration of the cartilage in the knee joint — and that his days as a competitive runner were over. He sought a second opinion. That's when he found an orthopedic surgeon, Dr. Kevin Stone, who understood that his patient wasn't ready to hang up his running shoes.

The X-ray showing Richard Donovan's left knee partial replacement in June 2019. The technology used to rebuild the knee included cobalt chrome implants on the ends of the femur, titanium plates covering the top of the tibia, and high molecular-weight polyethylene buttons that act as a new meniscus. (Photo courtesy of The Stone Clinic)

"His attitude was more along the lines of, 'Yeah, I can get you back doing that,'" Donovan said.

At his San Francisco clinic, Stone specializes in several procedures that he pioneered, including regrowing and replacing meniscus cartilage and articular cartilage, which act as a joint's shock absorber

and can wear down over time — especially in the bodies of active athletes.

“The advantage to having a biologic joint (replacement) is that it potentially could last forever, or if you’re injured, it’s easy to replace,” said Stone. “And it feels more normal than medical metal or plastic joints.”

Donovan’s knee was too far gone for such a procedure, but the partial knee replacement he received at the Stone Clinic was a space-age revelation in its own right. Instead of receiving a full knee replacement, the standard procedure for this type of injury, he was outfitted with a more natural-feeling artificial joint — one that maintained the existing geometry of the knee and left the ligaments intact.

The technology included cobalt chrome implants on the ends of the femur, titanium plates covering the top of the tibia, and high molecular-weight polyethylene buttons that act as a new meniscus. The use of a CT scan helped build a 3D computerized model of the knee and optimized component placement, a method far superior to the old hand-held approach. A robotic arm employed in the replacement surgery ensured accuracy and minimal invasiveness.

The results were astonishing. Donovan was walking days after the surgery and within weeks began training for a run across Antarctica. Now scheduled to return to San Francisco in April for a right knee replacement, he credits the advanced technology and forward-thinking at Stone’s clinic for rebuilding him.

“Like the bionic man,” Donovan said.

Perfecting these new technologies and procedures, even after they've been cleared by regulators, is a series of trials and errors. In Baltimore, Dr. Patrick Maloney is an orthopedic surgeon and director of resident education at Mercy Medical Center's Institute for Foot and Ankle Reconstruction.

Dr. Patrick Maloney is an orthopedic surgeon and director of resident education at Mercy Medical Center's Institute for Foot and Ankle Reconstruction. (Photo courtesy of Mercy Medical Center)

In 2016, Maloney's group helped develop a procedure using a synthetic cartilage implant — roughly the same dimensions and composed of the same materials as a contact lens — to reduce pain and maintain mobility in the joint of an arthritic toe. Following a successful pilot program, Maloney said the results of the procedure

haven't been replicated, with the implant degrading within a year or two of surgery.

"One light at the end of the tunnel is, there's potential in other areas of the body," said Maloney, who cites encouraging work being done with implants in the hand, which could have untold positive implications for athletes ranging from tennis players to fisherman. "And potentially it lasts longer in the hand because there's not quite as much force or workload across it."

Maloney, a big NBA fan, points to the improvement in outcomes of Achilles tendon surgery in basketball players. For many years, an Achilles tear was a death sentence for a player's career. Until recently, only Hall of Famer Dominique Wilkins came back from the injury to recover a form that resembled his pre-injured athletic ability.

Over time, physicians discovered best practices for the procedure and rehabilitation. Now more than 30 past and current NBA stars such as Kobe Bryant and, most recently, Kevin Durant, were able to return to top form after an Achilles injury.

Even a layperson can imagine how one advance may inspire the next. Just as platelet-rich plasma therapy — a procedure in which a patient's blood is removed, concentrated and reinjected to promote healing — became a hot treatment among professional athletes several years ago, Stone has researchers examining stem cell treatments for optimization and self-repair. Maloney is excited about the implications of 3D printing in joint replacement, citing less manufacturing waste and a more consistent product.

So what else will the next generation of performance tech bring to the athletic arena? Think recovery.

Athletes driven to maximize their training are learning to make the most of their rest. That means sleep-enhancement tech, cell-manipulating pulsed electromagnetic field therapies (PEMF) and biomarker wearables that track metrics ranging from an athlete's bone density to lipid levels.

Richard Donovan, shown here running near Hoopeston, Illinois, ran 3,200 miles from San Francisco to New York in August 2015. The ultramarathoner had a partial left knee replacement in 2019 and is scheduled to have a partial right knee replacement in June 2021. He is currently training to run across the U.S. and Antarctica again. (Photo by Paul Grealish)

It's a bold new world — one in which everyone from 43-year-old NFL quarterback Tom Brady to Maloney's 77-year-old softball-player patient is willing to settle for nothing less than peak performance.

"I think there will always be improvement in athletic performance," said Donovan, the man who became the first North Pole marathoner

and the first man to run seven marathons on as many continents. “There’ll always be somebody who stands out — and someone doing something to help bring those people along.”

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