MGH Center is a pioneer in knee repair

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By Shira Springer
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It was the lone cooperative effort between the New England Patriots and New York Jets this season. At least, that became the running joke as Patriots team physician Thomas Gill and Jets team physician Ken Montgomery recently experimented with a new technique for anterior cruciate ligament reconstruction. Prodding a cadaver knee mounted on a robotic arm, the surgeons reviewed the single-tunnel double-bundle ligament replacement procedure, expressing hope the more anatomically correct reconstruction would produce a stronger, more stable knee for future patients.

With the graft in place and the cadaver knee stitched back together, the robotic arm went to work, bending the joint in a preset pattern. Bioengineering laboratory director Dr. Guoan Li and a team of researchers monitored how the knee and graft responded to robotic movement designed to simulate the running, cutting, and jumping demanded of athletes. With every twist and turn, the cadaver knee represented sports medicine innovation in progress.

Theoretically, the research and experimentation done under the auspices of the Massachusetts General Hospital Sports Medicine Center today could be in the operating room tomorrow and improving performance on the field six months from now. Local professional athletes have already benefited from the innovative work done through the center, recovering more quickly, and, in the case of Curt Schilling's ankle repair, resuming a career many experts thought was over.

"There's one main reason why these teams [the Red Sox, Patriots, Bruins, and Revolution] come here, and that is because they know we're at the cutting edge," said MGH foot and ankle specialist and a Red Sox team physician George Theodore, who served as a supervisory consultant when Schilling suffered a debilitating tendon injury during the 2004 playoffs, then reconstructed the pitcher's ankle after the season.

The true tests of innovative surgical techniques, replacement parts, and treatment options come when they move from cadaver knees and laboratories to the playing fields. Ideally, a significant sports medicine advancement offers patients a less invasive option, better outcome, and quicker recovery. Satisfying those three conditions, Theodore added, represents the ultimate for professional athletes and the doctors.

While publicity may follow professional athletes who make unexpected comebacks, many sports medicine breakthroughs are less dramatic. It may not matter much to an athlete or another patient precisely how Gill reconstructs torn ACL ligaments or how he replaces knees or how he resurfaces joints losing cartilage, at least not until months or years later when the results are far better than expected.

"Can we change the natural history?" said Gill. "The day a player stops being an NFL player would it help to operate on that player, give him a ligament and help prevent him from getting arthritis down the road? Is that a good time to do microfracture or regrow cartilage?

"A lot of our research is on the ligament side and the biomechanic side. What we're trying to do is learn better ways to stabilize joints and make them move properly. Just because you had a surgery doesn't mean you have to go on to arthritis because your knee is not moving properly. We should be

able to find the best treatment for all patients, through tissue engineering, through optimizing ligament reconstruction techniques."

Based on data gathered from experimentation with cadaver knees, Gill has already altered where he places ligaments during reconstructions. Depending on the results of ongoing biomechanical research, the way Gill, Montgomery, and others perform ACL reconstructions could also permanently change.

"We're working to see if we can identify any major improvements in the ligament-reconstruction techniques we perform for our athletes," said Montgomery. "Is [single-tunnel double-bundle] better than what's being done now? Can we prove the knee is working better?

"We want to determine which reconstruction most closely recreates the normal knee. A knee that is more stable will most likely function better and be at less risk for re-injury. By identifying improved reconstruction techniques, we can then translate this into clinical practice."

Regeneration repair

In a laboratory not far from the cadaver knee, the opaque, flexible, plastic-looking cube Mark Randolph displayed in the palm of his hand could change joint repair when introduced into clinical practice. The cube is an example of the regenerative replacement cartilage created in the MGH Musculoskeletal Tissue Engineering laboratory directed by Randolph. In the future, the cube and the research behind it should allow doctors to regenerate an injured joint.

"From the standpoint of an athlete, what we're interested in is the mobility of the joints because those are the parts that have to work well," said Randolph. "[The regenerative cartilage] has to be durable. It has to regenerate a surface that will withstand extreme athletic activity, which is putting a lot of undue stress on the joints as it is.

"If we can make it work in an athlete, we can certainly make it work in a common man like myself who's just going up and down stairs every day.

"What we anticipate is that if we can actually restore the joint surface, then you could not only extend athletes' careers, but you would also extend the lifetime of the joint before they either have to do a joint replacement or some other intervention to restore the surface. That's our goal."

Working with the sports medicine center, tissue engineers use cartilage cells and bone marrow cells in culture to produce replacement cartilage that is as durable, strong, and smooth as the original cartilage in ankles, knees, hips, and shoulders. Currently, in procedures such as microfracture surgery, the cartilage that grows as a result of drilling small holes in bone is inferior. Better cartilage means better functioning, longer-lasting joints.

More concretely, think about high-profile microfracture recipients like the Phoenix Suns' Amare Stoudemire and the Portland Trail Blazers' Greg Oden possibly returning quicker and playing longer if they had the benefit of regenerative cartilage engineered at MGH.

The cells grown in culture are suspended in a liquid gel along with a special, light-sensitive chemical. Researchers inject the gel in a joint defect and expose the area to light. Then, the light starts a process that knits the scaffold together, forming a firm gel within minutes. The process is somewhat like

spackling a hole in a wall. As the gel biodegrades, the cells form the new cartilage, essentially regenerating the joint surface in the following weeks.

At the moment, the laboratory tests the injectable cartilage on pig joints, but Gill believes such "biologics" will be the next big breakthrough in sports medicine. Randolph hopes it won't be long until athletes and other patients benefit.

"With the right investment, I would expect to see new types of biologic repair of cartilage within five years," said Randolph.

Saving graces

Some treatments tested at Mass. General have already saved the seasons, and perhaps the careers, of local professional athletes. Red Sox infielder Kevin Youkilis could testify to that.

Suffering from a debilitating case of plantar fasciitis (two seasons ago), Youkilis benefited from an innovative, noninvasive technique tested and put into practice at the center. He received shock wave therapy for the injury. As the name suggests, the therapy involved shock or sound waves traveling through the base of his foot, triggering the body's means of healing itself. Youkilis played during the treatment and avoided surgery, which would have sidelined him 3-6 months.

A few years before Youkilis underwent shock wave therapy, US doctors realized operating on the plantar fascia produced variable results with a success rate of about 70 percent and the potential for infection and painful scars. With high-performance athletes, a poor surgical outcome could be disastrous. While shock wave therapy was available in Europe, it had not be refined or approved for use in the United States. MGH became one of a few test/study centers for the treatment, and remains one of the few places that offers it in Boston.

"It has been FDA approved and become one of the leading ways of treating advanced or debilitating plantar fasciitis in the athlete," said Theodore. "There are no incisions. You can return to play within 24 hours. And since you are functionally able to return to things, your recovery is shortened. So, this is the ultimate for an athlete [at the moment], along with arthroscopy."

Pitching arthroscopy

With the mention of arthroscopy, Theodore commented that the unprecedented and expedient procedure performed during the 2004 playoffs to suture Schilling's tendon out of joint and prevent it from snapping across the ankle represented an unusual event. When Theodore repaired the torn tendon sheath and stabilized the rest of the ankle with complex, innovative arthroscopy, it was a prime example of the ways in which injured professional athletes can drive sports medicine. The fact that Schilling could resume his career and pitch well is testament to cutting-edge techniques.

"What we did for Curt [with the tendon repair during the 2004 playoffs] would be rarely done for anyone else," said Theodore. "It was not something unique done that we want to carry over to other athletes ... There was a strong possibility that Curt was not going to pitch at the level to which he was accustomed again without creative ankle surgery. It was only the operation after the playoffs that restored him to his ability to play now."

Since athletes are celebrities and push their bodies to compete, Schilling raised the stakes, the expec-

tations, and awareness of cutting-edge sports medicine.

In the near future, athletes may generate greater awareness of the growing field of hip arthroscopy. With the procedure in its infancy, MGH hip specialist Peter Asnif, also a Red Sox team physician, has been developing new techniques and new instruments. Hip arthroscopy holds the same innovative promise already realized in knee, shoulder, and ankle arthroscopy, potentially preventing the onset of arthritis and the need for hip replacement in professional athletes and regular patients.

“In sports medicine, you can operate on the ambassador to France, you can operate on the CEO of Gillette, or whoever it is, and it doesn’t get the same public scrutiny of Tom Brady. If Tom Brady can throw the ball 60 yards rather than 70 yards after he got operated on, people notice,” said Gill. “People know and relate to professional athletes. They view the Red Sox as part of their family. So, your results with professional athletes are under a microscope.”

Such close examination should not necessarily be viewed as negative. The biomechanical testing, tissue engineering, and cutting-edge treatment being done through the MGH Sports Medicine Center, once again, shows how attention paid professional athletes leads to better care for every patient. After all, in sports and sports medicine, everyone hopes for big gains and better outcomes.