

by Cary Groner

SURGERY



Unlucky breaks fuel ACL reconstruction debate

It was a standard scare tactic in the old gangster movies: If you didn't cough up the dough, Nicky, the no-necked thug with the flattened nose, was going to come over to your house and break your kneecaps.

In real life, a person is far less likely to suffer a patellar fracture at the hands of an angry mobster's goon than as an unfortunate complication following an ACL reconstruction.

In 1997, when San Francisco 49ers receiver Jerry Rice made his record-breaking return from ACL reconstruction surgery to play again in three months, sportswriters and fans took it as another sign of his superb work ethic and dedication to excellence.

Then Rice fell on the knee after catching a touchdown pass and fractured his patella. All across the country, orthopedic surgeons clucked "I told you so" in chorus.

Team orthopedist Michael Dillingham, MD, had performed the ACL reconstruction using Rice's patellar tendon, a standard technique. As a result, the patellar bone harvested along with the tendon left the kneecap weakened. This isn't a problem as long as athletes allow five or six months before undertaking strenuous training or competition.

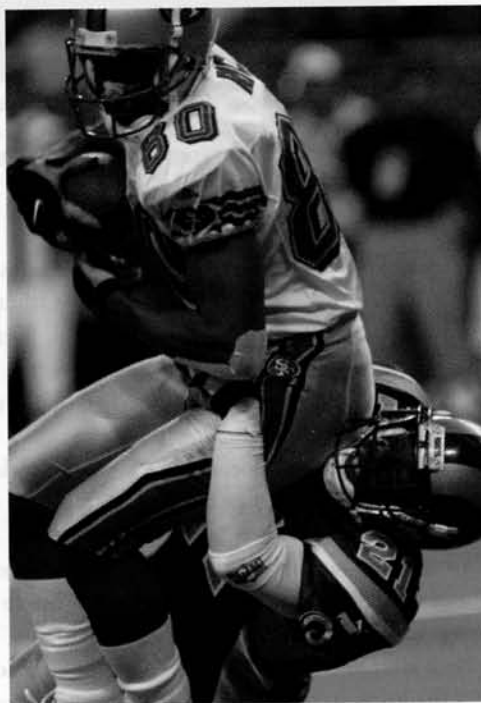
In fact, Dillingham reportedly discouraged Rice from returning so early, but star athletes and their coaches push the envelope as a way of life, and he was overruled. The result was sadly predictable.

Harvest time

An ACL reconstruction using the bone-patellar tendon-bone (BPTB) technique involves cut-

ting a wedge-shaped piece about 12 mm wide out of the kneecap to get a 10-mm strip (roughly the center third) of the patellar tendon; another bone wedge is then harvested from the tibial tubercle. Over time, both tendon and bone heal and fill in.

According to Pierce Scranton, MD, a Seattle orthopedist and an associate clinical professor at the University of Washington, the technique creates a temporary stress riser in the patella—that is, an area of bone prone to



In his first game back from ACL reconstruction surgery, 49ers receiver Jerry Rice fractured the patella in his reconstructed knee while making a diving reception for a touchdown.

Practitioners try hamstring grafts, even allografts, to decrease risk of postoperative patellar fracture.

L.G. Patterson/AP Wide World

fracture. Studies suggest that this redistribution of surface strain can reach 34% lateral to the defect.¹

Scranton has seen the same injury in other athletes, among them John Kasay, the place kicker for the Carolina Panthers, who used to play for the Seattle Seahawks. Kasay fractured his patella in August, in only his second practice with the Panthers following a December 1999 ACL injury and subsequent reconstruction. Kasay didn't even fall on his knee; he just kicked a football.

"When you have a kicker like Kasay, he has this titanic quadriceps contraction, and he just broke through the stress riser," Scranton explained. "I would never have dreamed of doing a bone-patellar tendon-bone reconstruction in a kicker. He had just (the problem that) I would have predicted."

Scranton is easier on Dillingham, whom he describes as a personal friend.

"What happened with Jerry Rice was a tragedy," he says. "Dilly was caught in the middle; he did a superior reconstruction, but he was dealing with an athlete who wasn't going to be told what to do."

(Neither Kasay nor Dillingham returned calls requesting comment.)

In any case, Scranton emphasized, time and proper rehab are the best healers.

"Bone remodels partly in response to stress," he said. "You want to give the kneecap enough time to remodel and fill in that defect. You can't hurry Mother Nature; she will only go at her own speed."

Easy does it

Patellar fracture appears to be a fairly rare complication of BPB reconstruction (estimates run between 0.2% and 0.5%^{2,3}), though some suspect the problem is severely underreported. In any case, Scranton said, it's imperative for surgeons to perform the harvest with utmost care.

"It requires great technical skill to take the bone wedge properly," he explained. "It has to be in the very center of the patella, and you need an x-ray of the kneecap in the operating room so you know what your degree of freedom is. If you make a surgical error to one side or the other, part of the kneecap can fracture off during surgery."

Scranton prefers a tiny oscillating saw with a blade just 0.4 mm in diameter to minimize the risk of such mishaps.

In fact, according to Peter Simonian, MD, chief of sports medicine at the University of Washington and a colleague of Scranton's, patients risk three distinct kinds of fracture when they have BPB autografts.

The type experienced by both Rice and Kasay usually occurs laterally across the kneecap, several weeks or months after the surgery, and typically (Kasay excepted) as a result of direct trauma. The second type, as described, happens during surgery. In the third category, stellate fractures may occur in patients who stumble or slip during the immediate postoperative period but don't actually fall on the knee.⁴

And although surgeons prefer different methods of removing the bone plug, Simonian and his colleagues have recently concluded a study suggesting that the actual shape of the cut (e.g., if the surgeon uses a reamer that makes a more circular cut, like a valley formed by a glacier instead of by a river) has little effect on the risk of subsequent fracture.

Preventive techniques

Simonian did find, however, that finishing the cuts correctly is important.

"You want to make your cuts complete enough that you don't have to use an osteotome—essentially a gouge you hit with a mallet," he said. "It's not healthy for the cartilage under the patella, and you can't control the way the bone fragment fractures when it

comes out."

Other approaches can prevent problems, as well, Simonian said. Some doctors remove extra bone from the tibia and use it to graft the patellar cut, and some have used bone cement (which has compressive but not tensile strength) to fill in the area.

Charles Strotz, MD, an orthopedic surgeon in Berkeley, CA, typically uses bone grafts in his BPB ACL reconstructions.

"I do it to help the healing, but even if you don't, over time the kneecap strengthens and re-forms," he said.

Strotz hasn't seen any cases of patellar fracture in his athlete patients, he said, because all of them have waited long enough before competing again. He has had three or four cases in nonathlete patients who fell on their knees within the first couple of months after surgery, however.

In any case, the standard remedy is internal fixation of the patella with wire and screws.



Chuck Burton/AP Wide World

Panthers place kicker John Kasay fractured his patella in August, in only his second practice with the team following a December 1999 ACL injury in the same knee. Kasay didn't even fall on the knee; he just kicked a football.

Other approaches

Some practitioners, however, question whether BPB is the best method to use in athletes. For one thing, a broken kneecap isn't the only complication of the procedure.

"The patellar tendon can rupture, the whole thing can turn into a mass of painful scar tissue, and you can wind up with severe chondromalacia patella from altering the patellofemoral mechanics," Scranton said.

Scranton prefers using a quadruple strand of hamstring tendon to replace the torn ACL when he feels it's warranted.

"We know that accelerated rehab is extremely important in professional sports, and that these people will return to a high level of competition as soon as possible," Scranton said. "So why aren't more NFL doctors doing hamstring reconstruction?"

He asks the question almost rhetorically, but there are real reasons.

"Pierce has been very happy with his success with the hamstring graft," Strotz said. "I haven't been, so I've stayed with the patellar tendon. With the hamstring, you have to attach soft tissue to bone, which is more difficult—though I know he's using new techniques that he feels give him a solid attachment. Essentially, it's dealer's choice."

And although Simonian sometimes uses hamstring tendons, he doesn't let athletes return to sports for nine months afterward, versus six months with the PBP graft.

"I think it takes longer for the interface to become secure between bone and tendon than between bone and bone," Simonian said.

He acknowledged, though, that new fixation devices, carrying such exotic names as "closed-loop endobuttons," are changing the picture. Nevertheless, any such device is just a temporary solution designed to help the tissue heal.

Simonian sometimes even recommends allografts, on the assumption that nothing but an ACL is really designed to function as an ACL. Allografts, which come from cadavers, carry their own set of risks, however, primarily transmission of serious retroviral illnesses such as hepatitis and AIDS. As a result, many surgeons—Strotz among them—refuse to use them.

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—Pierce Scranton, MD

Simonian believes that quality-control measures in tissue banks make all the difference, and said he has never had a case of disease transmission among his patients. He sometimes uses allografts in professional athletes who don't want to risk compromising their hamstring strength or having patellar complications. William Floyd, a former 49ers fullback who now plays for the Carolina Panthers, had an allograft reconstruction after rupturing his ACL in 1995.

Simonian noted, however, that if the patient is willing to wait a little longer to heal, using his or her own tissue is optimal, and using the hamstring causes less morbidity than using the patellar tendon.

"If somebody needs to get back sooner, and they're willing to deal with tendinitis, then they usually choose to use their patellar tendon," he said.

Simonian noted, moreover, that he would not recommend hamstring tendon reconstruction to a world-class sprinter because the technique could take two-tenths of a second off the runner's time in the 100 meters, which in today's world represents a career-ending disability.

Breaking habits instead of knees

Scranton, ever the cheerful iconoclast, suggests that one reason hamstring tendon grafts have been slow to catch on is that for many years orthopedists based their idea of the gold standard technique—that is, BPB—on a flawed 1984 study by Noyes et al.⁵

"Noyes stressed to failure a 15-mm cadaver graft of bone-patellar tendon-bone, then broke an ACL, then broke a single strand of hamstring tendon," Scranton said.

The study concluded that patellar tendons were the only way to go.

"It was all unrealistic," Scranton said. "Nobody uses a 15-mm patella graft, and no one uses just one strand of hamstring."

A more recent (and better) study presented at a medical meeting, Scranton continued, compared a 10-mm patellar tendon graft with a quadruple hamstring construct and found the latter slightly stronger.⁶

"Hamstring reconstructions are controversial," Scranton acknowledged. "But based on a flawed study, 10 years' worth of orthopedic surgeons across the country were taught one operation, believing that the other was no good. It's worth asking why more high-level athletes aren't having hamstring reconstructions when we see them break their kneecaps on television. It boils down to the fact that there are many ways to do things right."

Hope on the artificial front

As reported in the May 1998 issue of *BioMechanics*,⁷ artificial ACLs have so far proved disappointing. However, a Montreal company called Nexia Biotechnology has recently developed a bioengineered version of spider silk, by far the strongest fiber known. Ideally, such an artificial ligament would obviate surgical

strategies that require taking tissue from the patient's own body or from a cadaver.

According to company founder and CEO Jeffrey Turner, PhD, the fiber, dubbed with the heroic name BioSteel, shows tremendous promise for uses including soft body armor, sutures for ocular surgery, and artificial ligaments. Studies have not been completed, but orthopedic surgeons will no doubt be interested in their outcomes.

Of course, there's always the chance that they'll continue to disagree. With self-mocking bravado, Pierce Scranton expressed perfectly what could be the archetypical surgeon's credo: "Everybody is an expert," he said. "It's just that I know more than they do!"

Such attitudes—even in jest—may actually help, in the long run. As surgeons pioneer new methods and learn from one another's successes and mistakes, the clinical compromises that now lead to patellar fractures and other problems may eventually become a thing of the past. ■

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