RESTORING CARTILAGE

New treatment methods offer options for patients with knee damage

By D. Andrew Parker, MD

Athletes use the flex and strength of the knee to compete, and they depend on knee cartilage — the buffer of tissue between articulating surfaces — to do so without pain. Healthy cartilage is elastic, springing back in response to pressure. When chondrocytes, or cartilage cells, are damaged, friction builds and pain is sometimes severe.

During the last decade, a number of highly technological options for treating patients with cartilage damage have developed. They add to a growing spectrum of choices for treatment.

Injuries to the Knee

In general, younger patients sustain knee cartilage damage from a traumatic event, while older patients are more likely to experience degeneration of knee cartilage as a result of osteoarthritis. But there are many exceptions.

A 40-year-old runner may have early symptoms of osteoarthritis. At the same time, he may experience a knee injury that damages cartilage as well as other structures, most typically ligaments.

Football fans certainly have heard of the anterior cruciate ligament (ACL), which is the most commonly injured knee ligament. Collisions on the field sometimes twist the knee, snapping or tearing the ACL.

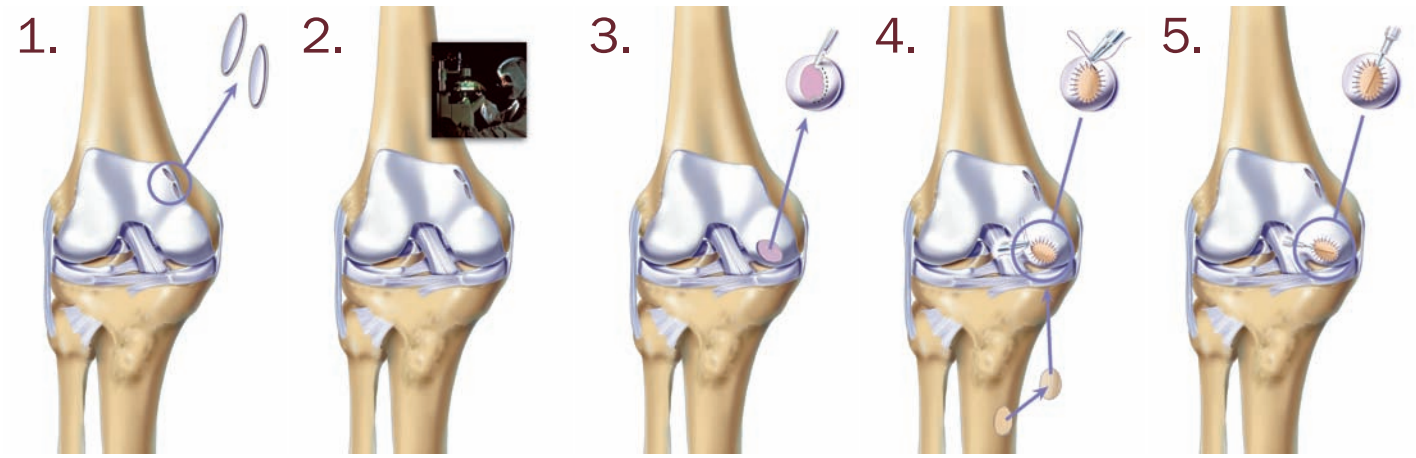
One in six people with an ACL injury also has an injury in another ligament or in the meniscus, a defined pad of knee cartilage known as fibrocartilage that fills the space where the femur (thighbone) and the tibia (shinbone) meet. And closer to the bone is hyaline cartilage, the real shock absorber in the joint.

Damaged fibrocartilage or hyaline cartilage can cause significant pain. Consequently, when we treat a patient with a knee injury, cartilage restoration is often part of the protocol.

Cartilage Implantation

Swedish researchers were able to culture hyaline cartilage cells outside the body for the first time

Five Steps of Carticel



1. An initial biopsy of normal joint surface is removed from the non–weight-bearing portion of the knee. **2.** The biopsy is sent to a Genzyme lab, where it is cultured and grown into a solution of the patient's cartilage cells. **3.** During the second procedure, the surgeon makes an incision in the knee and removes any damaged cartilage. **4.** A piece of lining is then removed from the adjacent upper tibia bone and sewn over the defect. **5.** This creates a water-tight membrane to contain the cultured cartilage cells. The patient's cells are then injected into the defect. Images courtesy of Genzyme Corporation.

in 1994. Their effort led to autologous chondrocyte implantation (ACI), a technique for stimulating hyaline cartilage growth in areas of focal articular cartilage damage, whether the focal defect stems from trauma or an acquired condition.

In ACI, hyaline cartilage cells are harvested from the patient and then grown in a laboratory in vitro until they have multiplied. Anywhere from 5 million to 12 million cells grown in vitro are then implanted in the area of the knee with focal articular cartilage damage.

ACI is an attractive procedure because by restoring hyaline cartilage, it can help prevent degenerative lesions from developing in articular cartilage, thus it aims to help prevent the need for a knee replacement. It is the most sophisticated cartilage-restoration method available, but it still falls short of the ideal: finding a way to stimulate the body to regenerate hyaline cartilage.

Short of ACI, fibrocartilage, which is less shock proof, can be encouraged to grow and take over some of the function of hyaline cartilage with various methods. In the simplest procedure, fibrocartilage is stimulated to grow by abrasion. It grows haphazardly, but it can fill a small space (a focal injury) where hyaline cartilage has been depleted.

Although ACI is often accomplished through arthroscopy, a minimally invasive technique, it ranks among the least conservative methods for cartilage restoration. It is relatively costly, and patients must be in good health with no potential complicating factors. Still, ACI is illustrative of the many advances in the treatment of damaged cartilage that have developed very recently. Genzyme Biosurgery, for instance, won Food and Drug Administration (FDA) approval for its ACI technique (Carticel®) in 1997.

Getting Back into the Game

Choosing carefully among the less conservative procedures is important. These treatments involve fewer surrounding tissues and structures and are almost always preferred. Saving healthy tissue and encouraging it to repair itself at least partially is a fundamental dimension of conservative treatment. The approach helps get athletes back on the field faster and gardeners out in the flower bed sooner.

Because the knee is large — the largest joint in the body — and such a crucial player in mobility, it has received an enormous amount of attention in terms of cartilage restoration. But much of what we have learned about cartilage repair in the knee also informs repair at other sites in the body.

Indeed, methods for moving healthy cartilage from one site to another site (autogenous osteochondral implantation) now have been perfected for smaller joints as well as for the knee. Some procedures, such as ACI, continue to be limited by the FDA to the knee.

Technological advances in imaging have made all efforts at restoring cartilage more precise. Magnetic resonance imaging (MRI) is a tool that enables us to get a good look at cartilage without making an incision, and it helps us determine whether there is degenerative cartilage disease compounding an injury to the knee. With other technological improvements on the horizon, we expect cartilage restoration procedures to advance by leaps and bounds. CO

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Cartilage Restoration Options

The most common treatment options for damaged cartilage, listed from most conservative to least conservative:

Chondroplasty: The debridement of damaged or degenerative cartilage is still performed on a routine basis but does not predictably stimulate or encourage the growth of new cartilage.

Abrasion arthroplasty: The process of scraping the bone underlying cartilaginous defects in an effort to stimulate fibrocartilaginous growth is no longer in favor and is rarely performed in the sports medicine arena.

Microfracture: Gently perforating the bone to encourage cartilage growth has replaced abrasion arthroplasty as the least extensive procedure designed to predictably stimulate fibrocartilage growth in focal articular cartilage defects.

Autogenous osteochondral implant: Cartilage and bone cells from a different part of the body moved to site of knee damage (methods include OATS™ from Arthrex, Inc., and MosaicPlasty™ from Smith & Nephew)

Autologous chondrocyte implantation (ACI): Healthy cartilage cells removed from a person and cultured in a laboratory setting until there are millions of them to reintroduce to the person's knee (Carticel® refers specifically to the ACI method/product of Genzyme Biosurgery)

Knee replacement (prosthesis): Knee replaced with artificial surfaces