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HEALTH NEWS

## Knee Surgeries Could Soon Be More Successful Thanks to New Technique



Written by Patrick Keeffe on October 15, 2018

A new process allows surgeons to transplant cells that help a patient regrow cartilage in their knee.



A new technique could have knee surgery patients up and about earlier. Getty Images

From someone who suffers daily just walking up a stairway to a professional athlete with a severe injury, a relatively new procedure could offer significant relief from knee pain.

MACI, or membrane-induced autologous chondrocyte implantation, uses a person's own cartilage to grow more cartilage and repair a damaged knee.

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But now ACI includes a new product named MACI (autologous cultured chondrocytes on porcine collagen membrane), which was approved by the U.S. Food and Drug Administration (FDA) for use in the United States in December 2016.

The MACI membrane is manufactured by Vericel of Cambridge, Massachusetts, a leader in advanced cell therapies.

Dr. C. Benjamin Ma, an orthopedic surgeon, professor in residence, and chief of sports medicine and shoulder surgery at the University of California San Francisco (UCSF), said MACI is a second-generation product of ACI.



“MACI is a two-stage process,” Ma told Healthline. “First, they biopsy the cells and send them to the lab to grow for four to six weeks and form more cartilage. The membrane with the new cartilage is then put back into the knee.”



“The first-generation cartilage resurfacing procedure was microfracture,” Ma said. “It’s a different process. Surgeons drill tiny holes into the bone to let blood bleed into the defect and form scar tissue. It’s been used for 30 to 40 years. The results are OK, but people are always looking to possibly improve on it. ACI has been proven to provide long-lasting pain relief and to help patients regain knee function.”

“MACI has been approved only for knees, but not for hips and shoulders, because those joints are very round and the collagen is quite thin,” he added. “Results are better with MACI. It’s now commonly available and we use it at UCSF, but it’s not our primary product. Most of our work is with microfracture.”

Gerard Michel, Vericel’s chief financial officer and vice president for corporate development, told Healthline, “MACI is an improvement upon earlier generations of ACI such as Carticel, which had been on the market

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Chondrocytes are the cells responsible for the production, maintenance, and repair of cartilage.

But they don't do much repair, Michel said. Once cartilage is formed, chondrocytes don't produce much more cartilage, even when someone has an injury.

"Once you have a cartilage defect, you probably will have it for the rest of your life," he said.

"Cartilage gets damaged from repetitive injuries — if you run a lot and your knees are not perfectly aligned you may develop a defect," Michel explained.

"Or you can have an acute injury, for example, playing soccer and having your knee pushed sideways. Once you have those injuries, the cartilage is not going to repair itself."

"Another source of damage is osteoarthritis, which can lead to cartilage damage," he added. "MACI is not approved for use in cases of severe arthritis. But if you have a hole or tear due to overuse or injury, that's where it works."



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- **Purely palliative.** The goal of these treatments is to reduce pain. Untreated lesions, however, can lead to arthritis.
  - **Repair.** A surgeon fills in the cartilage “pothole” or defect by using microfracture, a procedure where small holes are drilled into the bone and the bone marrow fills the defect. The result is fibrocartilage, which Michel said can be thought of as “scar cartilage.” Chondrocytes are the cells responsible for the production, maintenance, and repair of cartilage. This scar cartilage lacks the mechanical properties of normal cartilage, and in medium to larger lesions fails over time in many patients. Microfracture was the standard of care for many years, but no longer in larger lesions. Doctors have found that it’s likely to fail in those cases.
  - **Putting cartilage back.** Osteochondral autograft transplants, or OATS, take some of the patient’s own cartilage from a non-weight-bearing area and move it to where it’s needed. But this procedure is limited to smaller lesions because only a small amount of cartilage can be moved from another area.



In some cases, osteochondral allografts, or OCAs, are performed. These are bone and cartilage grafts sourced from cadavers instead of the patient. But the supply of grafts is limited and the procedure is highly invasive. In addition, controlled clinical trials have not been run, since tissue bank products are subject to a lower level of regulation. Some physicians believe the procedure has a higher risk of failure.

The only option to regrow your own cartilage is ACI. That’s where Vericel’s product, MACI, comes in. This third-generation product uses the patient’s own chondrocytes, seeded onto a collagen membrane (similar to what is used in dentistry and other applications).

“One side of the membrane is fairly smooth and the other fairly porous, allowing significant area for the chondrocytes to seed and adhere to,” Michel said. “Prior to seeding the membrane, we expand the

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“The physician makes a small incision in the knee and cuts a template to fit the size of the defect. Once the doctor is satisfied with the fit, the MACI membrane is glued into place. The cells migrate onto the bone, adhere to it, start to replicate, and initiate cartilage production to fill in the defect.”

The FDA has approved MACI for first-line treatment of any cartilage defects of the knee, but not for the meniscus (the thin fibrous cartilage between the surfaces of the knee), Michel said.

### One surgeon’s view

One California team physician who uses MACI has achieved gratifying results with some of his patients, who include college and professional athletes.

Dr. Kristofer Jones, an orthopedic surgeon and sports medicine specialist at University of California Los Angeles (UCLA), is team physician for the UCLA Bruins and assistant team physician for the Los Angeles Lakers.

“MACI is currently FDA-approved only for symptomatic cartilage defects of the knee,” Jones told Healthline. “This includes the femur (thigh bone), tibia (shin bone), and the patella (kneecap). Any use of the implant outside of the knee joint would be considered an ‘off-label’ application.”

“I’ve used MACI for athletes at all levels of participation from high school to professional,” he added. “I’ve also used it with patients that simply have pain with routine activities of daily living — climbing stairs, squatting, or walking for extended periods of time.

“The expected timeline for unrestricted return to high-level athletic activities is approximately 12 months. Patients can expect to return to pain-free simple activities of daily living within four to six months.”

Jones began performing the MACI procedure when it first received FDA

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cartilage repair techniques, **healthline**

“Given this documented success, I felt confident providing this surgical option to my patients,” he said. “Thus far, I have had a similar type of experience as my European colleagues and have found reliable pain relief with improved physical function at a minimum of 12 months follow-up in my patients.”

Jones was the first UCLA surgeon to adopt the technique. He has performed nearly 50 MACI surgeries in his high-volume cartilage surgery practice.

He follows all his patients that undergo the MACI procedure and administers routine patient-reported outcome questionnaires to monitor their outcomes, he said.



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## Success elsewhere

Favorable MACI outcomes have been demonstrated in several significant studies. The most notable, Jones said, was [published](#) this year in the American Journal of Sports Medicine. It's a randomized controlled trial from the SUMMIT study group, comprising 14 study sites across Europe.

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The improvements that were noted in patients that underwent MACI were sustained at two and five years, demonstrating promising durability of the cartilage repair tissue that we obtain with the MACI technique.

“We had significantly better results with MACI vs. microfracture,” based on the Knee Injury and Osteoarthritis Outcome Score (KOOS) for pain and function as the primary outcomes, Dr. Mats Brittberg, a lead study author from the University of Gothenburg in Sweden, [told](#) the journal *Orthopaedics Today Europe*.

“The most important part is to have the patients experience pain relief and longtime durability,” he said. “All other KOOS subscales were also statistically superior for the MACI implant.”



### Who should get the surgery?

Does MACI work for every patient?

Jones said MACI should be used for any patient with a symptomatic cartilage defect of the knee that has failed a trial of nonoperative management, including NSAIDs and supervised physical therapy.

“Currently, the procedure seems to benefit patients with a single, isolated area of cartilage damage within the knee,” he said. “When the cartilage damage appears to be more diffuse, or affects multiple areas of the knee, the clinical results are much less predictable.

“Additionally, patients that have been diagnosed with knee osteoarthritis (i.e., diffuse cartilage degeneration within the knee) are not suitable candidates for the MACI procedure.”

Jones and Michel are optimistic about the future of MACI

“I have been extremely encouraged by my own personal observations for

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“It is my hope that the early clinical improvements that we are observing at two and five years after surgery are maintained at 10 and 15 years.”

Michel said he hopes MACI will have more widespread use, and Vericel is evaluating improved versions of the product for development in the coming years.

“We want to investigate the utility of using this in other joints, possibly ankles,” he said. “We may try to develop a way to do it without opening the knee, maybe arthroscopically.”

“Also, currently, MACI is a two-step procedure and we are exploring options to make it a one-step procedure, without an initial surgery to take a biopsy.”



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