The goal of cartilage restoration procedures is to stimulate new cartilage growth or implant new cartilage in the damaged area — either hyaline cartilage or fibrocartilage (a different and somewhat less durable form of cartilage).

Identifying Cartilage Damage

In many cases, patients who have joint injuries, such as meniscus tears or ligament tears, will also have cartilage damage. This damage may be hard to diagnose because hyaline cartilage does not contain calcium and cannot, therefore, be seen on an X-ray.

If other injuries exist with cartilage damage, doctors will address all problems during surgery.

Patient Eligibility

Most candidates for articular cartilage restoration are young adults with a single injury, or lesion. Older patients, or those with many lesions in one joint, are less likely to benefit from the surgery.

The knee is the most common area for cartilage restoration. Ankle, shoulder, and elbow problems may also be treated.

Articular cartilage in the knee damaged in a single, or focal, location.

Surgical Procedures

Many procedures to restore articular cartilage are done arthroscopically. During arthroscopy, your surgeon makes two or three small, puncture incisions around your joint using an arthroscope.

Some procedures require the surgeon to have more direct access to the affected area. Longer, open incisions are required. Sometimes it is necessary to address other problems in the joint, such as meniscal or ligament tears, when cartilage surgery is done.

In general, recovery from an arthroscopic procedure is quicker and less painful than a traditional, open surgery. Your doctor will discuss the options with you to determine what kind of procedure is right for you.

The most common procedures for cartilage restoration are:

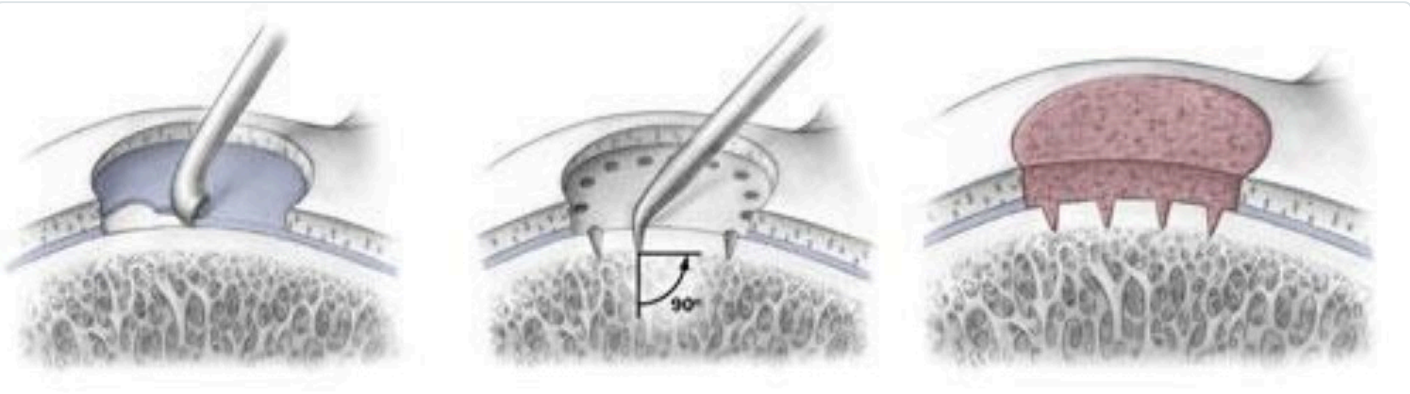
- Microfracture
- Drilling
- Abrasion arthroplasty
- Matrix-induced autologous chondrocyte implantation
- Osteochondral autograft transplantation
- Osteochondral allograft transplantation

Microfracture

The goal of microfracture is to stimulate the growth of new articular cartilage by creating a new blood supply.

The procedure can be done with an arthroscope. A sharp tool called an awl is used to make multiple holes in the exposed bone surface, called subchondral bone. This action creates a healing response. New blood supply is able to reach the joint surface, bringing with it new cells that will form the new cartilage.

Microfracture generates fibrocartilage. While not as durable as the normal hyaline cartilage of the joint surface, fibrocartilage can be helpful for repairing smaller lesions (areas of damage).

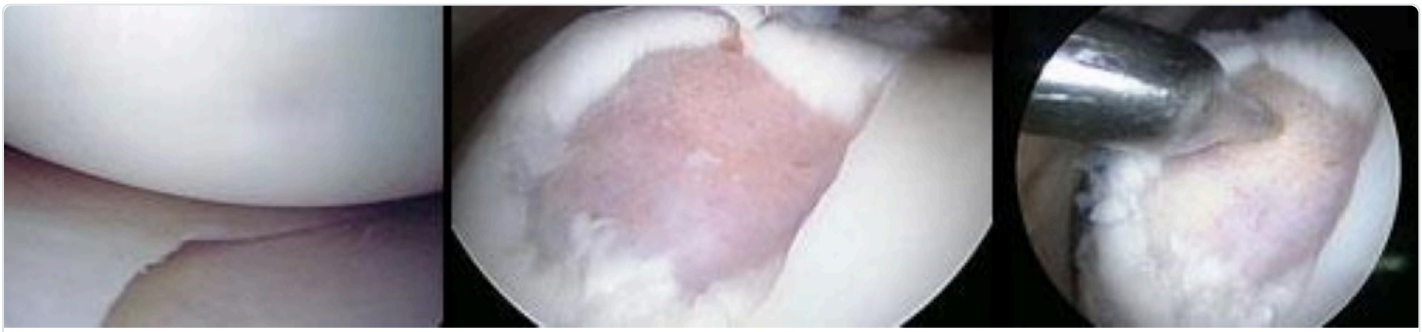


Steps of the microfracture technique. **(Left)** Damaged cartilage is removed. **(Center)** Awl is used to make holes in the subchondral bone. **(Right)** Healing response brings new, healthy cartilage cells.

Reproduced from Mithoefer K, Williams RJ III, Warren RF, et al: Chondral resurfacing of articular cartilage defects in the knee with the microfracture technique. J Bone Joint Surg Am 2006;88(suppl 1):294-304.

The best candidates for microfracture are lower demand (less active) patients with single and smaller lesions and healthy subchondral bone. Larger lesions in very active patients may require other procedures that provide more durable hyaline cartilage.

Additionally, previous microfracture can worsen the results of a future cartilage restoration procedure; it should therefore be reserved for small lesions in lower demand patients.



Normal healthy articular cartilage in the knee (left). A large cartilage defect in the knee joint surface (center). During microfracture, an awl is used to penetrate the defect (right).

Images courtesy of Stuart J. Fischer, MD, FAAOS

Drilling

Similar to microfracture, drilling stimulates the production of healthy cartilage.

The procedure can be done with an arthroscope. Multiple holes are made through the injured area in the subchondral bone with a surgical drill or wire. The subchondral bone is penetrated to create a healing response. Like microfracture, drilling yields fibrocartilage, not hyaline cartilage.

Potential disadvantages of drilling:

- It is less precise than microfracture.
- The heat of the drill may cause injury to some of the tissues.
- It can potentially affect the outcomes of future cartilage restoration procedures in young active patients.

Abrasion Arthroplasty

Abrasion arthroplasty is similar to drilling. It can be done with an arthroscope, but instead of drills or wires, high-speed burrs are used to remove the damaged cartilage and reach the subchondral bone.

Abrasion arthroplasty also produces fibrocartilage, not hyaline cartilage, so it, too, is most beneficial for treating smaller lesions in lower demand patients.

Matrix-induced Autologous Chondrocyte Implantation (MACI)

MACI is a two-step procedure in which new cartilage cells are grown and then implanted in the cartilage defect.

First, healthy cartilage tissue is removed from a non-weightbearing area of the bone. This step is done as an arthroscopic procedure. The tissue which contains healthy cartilage cells, or chondrocytes, is then sent to the laboratory. The cells are cultured on a collagen matrix (a biologic scaffold) and increase in number over a period of 1 month.

An open surgical procedure, or arthrotomy, is then done to implant the newly grown cells onto another collagen matrix, which is secured within the defect using fibrin glue (a biologic adhesive).

MACI is most useful for younger patients who have single defects larger than 2 cm in diameter.

Advantages of MACI:

- It provides more durable hyaline cartilage.
- By using the patient's own cells, there is no danger of a patient rejecting the tissue.

Potential disadvantages of MACI:

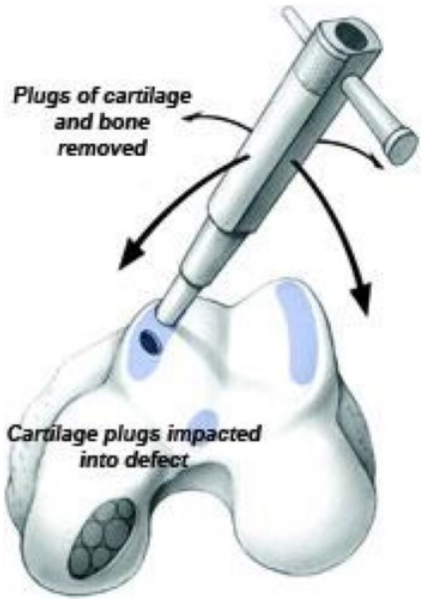
- It is a two-stage procedure that takes several weeks to complete.
- It requires an open incision.

Osteochondral Autograft Transplantation

In osteochondral autograft transplantation, cartilage is transferred from one part of the joint to another.

The procedure, which can be done with an arthroscope or using an open approach, provides more durable hyaline cartilage to the defect area. A cylinder-shaped plug (graft) of healthy cartilage tissue and subchondral bone is taken from an area of the bone that does not carry weight (non-weightbearing). The graft is then matched to the surface area of the defect and pushed into place. This leaves a smooth cartilage surface in the joint.

A single plug of cartilage may be transferred, or the surgeon may perform a procedure using multiple plugs, called mosaicplasty.



Mosaicplasty type osteochondral autograft transplantation procedure.

Reproduced from Hangody L, Rathonyi GK, Duska Z, et al: Autologous Osteochondral Mosaicplasty. Surgical Technique J Bone Joint Surg Am 2004;86 (suppl 1):65-72.

Osteochondral autograft is used for smaller cartilage defects. This is because the healthy graft tissue can be taken only from a limited area of the same joint.

This procedure is also helpful when an MRI reveals that the bone under the cartilage defect shows signs of stress or wear.

Osteochondral Allograft Transplantation

If a cartilage defect is too large for an autograft, an allograft may be considered.

Like an autograft, an allograft is a graft composed of cartilage and bone. Allografts, however, are taken from a cadaver donor instead of the patient's own body. In the laboratory, the allograft tissue is sterilized, prepared, and tested for any possible diseases that might be transmitted to the recipient.

An allograft is typically larger than an autograft, but like autografts, allografts provide hyaline cartilage to the defect. The benefit of an allograft is that it can be shaped to fit the exact contour of the defect and then press fit into place.

Allografts are typically done through an open incision.

Stem Cells and Tissue Engineering

Current research is focused on new ways to make the body grow healthy cartilage tissue. This is called tissue engineering. Growth factors that stimulate new tissue may be isolated and used to stimulate new cartilage formation.

The use of mesenchymal stem cells is also being investigated. Mesenchymal stem cells are basic human cells obtained from living human tissue, such as bone marrow. When stem cells are placed in a specific environment, they can give rise to cells that are similar to the host tissue. For example, if implanted in bone, they will stimulate the creation of bone cells.

The hope is that stem cells placed near a damaged joint surface will stimulate hyaline cartilage growth.

Tissue engineering procedures are still at an experimental stage. Most tissue engineering is performed at research centers as part of clinical trials.

Rehabilitation

After surgery, the joint surface must be protected while the cartilage heals. If the procedure was done on your knee or ankle, you may not be able to put weight on the affected leg. You will need to use crutches to move around for the first few weeks after surgery, or possibly longer depending on the type of procedure and location of the lesion.

Your doctor may prescribe physical therapy. This will help restore mobility to the affected joint. During the first weeks after surgery, you may begin continuous passive motion therapy. A continuous passive motion machine constantly moves the joint through a controlled range of motion.

As healing progresses, your therapy will focus on strengthening the joint and the muscles that support it. It may be several months before you can safely return to sports or other strenuous activities.

Last Reviewed

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