

MACI (MATRIX-INDUCED AUTOLOGOUS CHONDROCYTE IMPLANTATION)

Damage to the hyaline articular cartilage in the knee may lead to the accelerated onset of osteoarthritis. Lesions of the articular cartilage affect millions of people worldwide, but treatment is hampered by the fact that in adult life hyaline articular cartilage is limited in its ability to regenerate. This handout briefly outlines the structure and function of hyaline articular cartilage and an innovative new treatment known as matrix-induced autologous chondrocyte implantation (MACI).

WHAT IS HYALINE ARTICULAR CARTILAGE AND WHAT FUNCTION DOES IT SERVE?
Hyaline articular cartilage covers the ends of the bones in movable joints. Healthy hyaline articular cartilage has a pale and glistening appearance, and a firm and smooth texture. It serves as a load-bearing elastic material that is responsible for the frictionless movement of the surfaces of joints. It is also capable of withstanding loads up to seven times the weight of the body.

WHAT HAPPENS IF THIS CARTILAGE IS DAMAGED?

Despite its durability, hyaline cartilage does not have a blood supply and consequently has a limited capacity for regeneration. Once damaged, the human body forms fibrocartilage to take its place, but this surrogate tissue is very soft and does not possess the appropriate structural properties needed to dissipate the forces stimulated by the body during day to day life. Patients with significant cartilage defects frequently have persistent joint pain, swelling, and "catching" in the knee. Full thickness cartilage defects will never heal of their own accord and ultimately lead to osteoarthritis.

WHAT IS MACI AND HOW DOES IT WORK?

MACI is an innovative new method of autologous chondrocyte implantation for treating defects in the articular cartilage and for filling them with regenerative tissue. It offers an effective treatment by isolating and growing the patient's own cartilage building blocks, known as chondrocytes, and re-implanting these cells into the damaged area within the knee joint via surgery using a specialised collagen membrane.

WHAT DOES MACI INVOLVE?

The procedure is performed in two stages. Firstly as a day patient, a sample of cartilage cells is removed arthroscopically from the non-weight bearing part of the knee. The chondrocyte cells are then isolated and grown in a special laboratory using highly developed tissue engineering procedures that take approximately four weeks. The second stage involves implanting the chondrocyte cells that have been seeded onto the collagen membrane into the defect in the knee via specialised knee surgery. A post operative hospital stay of approximately 2-4 days will generally be required following surgery. The patient is then discharged wearing a protective knee brace and using two crutches.

HOW CAN I BEST PREPARE FOR SURGERY AND MY POST OPERATIVE RECOVERY?

The rehabilitation process for MACI should begin prior to surgery, as patients need to be physically and mentally prepared for their operative procedure and the lengthy rehabilitation process. Patient education is essential, as the integrity of the chondrocyte repair must be protected.



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WHAT DOES RECOVERY FROM MACI INVOLVE?

Following surgery it is necessary to undergo a three month rehabilitation program so as to stimulate the implanted chondrocytes to adapt to their natural function. Patients are required to protect the repair from weight bearing stresses and are restricted to toe-touch ambulation with 2 crutches for the first 6 post operative weeks. Over the following 6 weeks a stepwise increase in weight bearing occurs so that by 12 weeks post surgery the patient is ready to fully bear weight. Immediately after surgery the amount of knee bend (flexion) is restricted and a brace must be worn to ensure the protection of the cartilage repair. As a rough guide, patients should achieve between 60–90° knee flexion by 3 weeks, 90–120° knee flexion by 6 weeks and have returned to a normal range (approx 130–160°) by 12 weeks post surgery. At the 12 week time-point compressive and decompressive forces, provided by full weight bearing, further stimulate the chondrocytes to synthesise the correct matrix molecules. However, return to work and sport and recreational activities should be carefully controlled and gradually progressed. Although the cartilage defect may well have been filled with hyaline-like cartilage within the first few months, it is not advisable to undertake stressful extension or weight bearing activities, such as squats or running before 12 months. Maturation and hardening of the new-formed cartilage will not be complete until 11–24 months have elapsed.

IF I HAVE SEVERE OSTEOARTHRITIS AND HAVE BEEN SCHEDULED FOR A KNEE REPLACEMENT, IS MACI SUITABLE FOR ME?

No. It is likely that if you are scheduled for a knee replacement that the arthritis in your knee has gone too far to be addressed by cartilage implantation.

IF THIS PROCEDURE IS PERFORMED SUCCESSFULLY, WILL IT PREVENT KNEE REPLACEMENT?

In all likelihood this procedure may reduce your chance of knee replacement but as this is a relatively new technique, we require more long-term information to answer this question.

IS THIS TECHNIQUE SUITABLE FOR TREATING RHEUMATOID ARTHRITIS?

No. Progressive inflammatory or rheumatoid arthritis would simply continue to erode the area of enhanced repair.

WHY ISN'T MACI RECOMMENDED FOR PEOPLE OVER THE AGE OF 55?

The chondrocyte cells of older patients do not grow as those from young patients. In addition the articular cartilage within the knees of patients over 55 years is usually too damaged for the procedure to be beneficial.

IS THIS TECHNIQUE SUITABLE TO REPLACE TORN CARTILAGE?

There are two types of cartilage in the knee, firstly the joint lining and secondly the menisci, which act as shock absorbers between the two joint surfaces. It is the joint lining that is suitable for autologous chondrocyte implantation. The so called "torn cartilage" or meniscus is not suitable for this kind of technique although work is currently being conducted on transplant menisci and this technology may be available in years to come.

IS MACI SUITABLE TO TREAT CARTILAGE DEFECTS IN OTHER JOINTS IN THE BODY?

Whilst currently MACI is restricted to treatments of defects within the knee, ankle and shoulder joint, the use of MACI for local cartilage defects in other joints is currently under investigation.

WHEN SHOULD PATIENTS COMMENCE DRIVING FOLLOWING MACI?

Approval needs to be obtained from your operating surgeon; however, clearance is usually given approximately 4 to 6 weeks following implantation.

WHEN SHOULD PATIENTS RETURN TO WORK FOLLOWING MACI?

Again, approval needs to be obtained from your operating surgeon but also depends on the demands of the job. Most patients with desk jobs return after approximately 3 weeks.

WHAT IS THE LENGTH OF HOSPITAL STAY FOLLOWING MACI?

This depends on whether there are any post surgery complications as well as the extent of the surgery, however, patients are generally discharged after 3 to 4 days.

WHEN SHOULD PATIENTS RECOMMENCE HIGH IMPACT SPORT AND RECREATIONAL ACTIVITIES?

Return to heavy manual work, sport and recreational activities should be carefully controlled and gradually progressed. Although the cartilage defect may well have been filled with hyaline-like cartilage within the first few months, it is not advisable to undertake stressful extension or weight bearing activities, such as squats or running before 12 months post surgery. Maturation and hardening of the new-formed cartilage will not be complete until this time.