

# Single Stage Cell-Based Cartilage Repair

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Defects to the articular surface of the knee in older patients often are repaired by a total joint arthroplasty (TJA). This involves the resection of the articular surfaces and the implantation of prostheses. Typically, TJA is reserved for patients with severe osteoarthritis in which their mobility and quality of life is affected by the disease. Even though TJA has evolved greatly over the past decades, it is still a significantly invasive procedure and surgeons are hesitant to prescribe this type of therapy to younger patients who have suffered traumatic cartilaginous injuries resulting in a more focal defect.

The treatment for younger patients hasn't been as clear. For the past several decades there have been numerous attempts to repair cartilaginous defects caused by trauma with fair rates of success. Unfortunately, many of these therapies are labor intensive, expensive, and require a significant recovery period. For example, a treatment such as an osteochondral autograft transfer (OATS) is somewhat cumbersome and time-consuming. It involves excising a plug of cartilage – with the aid of a coring device – approximately 1 cm in diameter, which has cortical and cancellous bone attached at the base from an area of the articular surface that is felt to be less weight bearing. A similar hole is created in the area of the articular cartilage defect and the graft plug is inserted. Although this step sounds simple, matching the hole perfectly to receive the plug, not just in diameter but also depth

## LEARNING OBJECTIVES

- ▲ Learn about the RECLAIM technique
- ▲ Review procedures to fix the defects of articular surface of the knee
- ▲ Examine the instrumentation and equipment needed for the RECLAIM technique
- ▲ Evaluate why this procedure would be ideal for certain patients
- ▲ Explain the RECLAIM procedure and highlight the differences from a TJA

and rotational position, is tedious work. The complexity is compounded further when multiple graft plugs are required to repair an asymmetrical defect. This procedure also raises questions about the usefulness of removing cartilage from one area of the knee in order to repair another. Still, even with all those laborious requirements considered, the OATS procedure is one of the more effective therapies currently being used.

According to surgeons who specialize in sports medicine such as Dr. Aaron Krych at the Mayo Clinic in Rochester, Minnesota, 66% to 91% of patients receiving current articular cartilage restoration techniques return to playing sports at their preinjury levels.<sup>3</sup> This rate of success is significant, but the process continues to be laden with the issues previously mentioned. He, and other surgeons at Mayo Clinic, such as Dr. Daniel Saris, are currently working on a new treatment that will address some of the issues for this patient population and, as of September 2019, they were in the process of trialing a technique known as RECLAIM.<sup>10</sup>

## RECLAIM

Recycled Cartilage Auto/Allo Implantation, or simply RECLAIM, is a technique used to repair the damaged cartilage of the knee. It is a single surgery procedure that involves removing the patient's own cartilage, combining it with donated stem cells, then returning the mixture into the affected area. It is a cell-based therapy and is specifically designed to treat the younger patients that engage in higher levels of activity than older patients do. Cell therapy, in general, isn't a replacement for total joint arthroplasty but more of an option for younger patients who lack comorbidities. Patients with obesity and early onset degenerative diseases such as osteoarthritis, for example, won't do well with this type of therapy.

Recycling live cartilage from donor patients during other procedures such as a TJA is an important function of this process. While the donor tissues as a functional group are damaged, many of the individual cells within the tissues are still viable. During a total knee arthroplasty (TKA), pieces of the articular surface are resected. Most of these pieces still have good cartilage on them which can be donated by that patient. Research has shown that healthy cells from a damaged area can grow if provided a healthy environment.<sup>6</sup> The viability of the donated knee cartilage is assessed using Z-stack confocal imaging with fluorescent live/dead assay. The good stem cells are separated from the bad ones and stored in a bone bank as allogeneic stem cells.

Mesenchymal stem cells (MSCs) are adult stem cells which can be isolated from human and animal sources. Human MSCs (hMSCs) are the non-haematopoietic, multipotent stem cells with the capacity to differentiate into mesodermal lineage such as osteocytes, adipocytes and chondrocytes, as well ectodermal (neurocytes) and endodermal lineages (hepatocytes).<sup>9</sup> For the purposes of this article, hMSCs may be referred to as MSCs or simply stem cells.

## SURGICAL PREP AND POSITIONING

A basic, minor orthopedic instrument set should be adequate for this procedure along with a special RECLAIM set. Preferences will vary, but the Certified Surgical Technologist should have at least an extremity drape, impervious stockinette, self-adherent wrap, suction, Bovie, #10 and #15 blades on #3 knife handles, Senn retractors, rakes, Army/Navy retractors, small Hohmann retractors, a small Weitlaner self-retaining retractor, Adson forceps, Ferris Smith forceps, hemostats, Kochers, and needle drivers on the back table along with the special RECLAIM instrument set. The Certified Surgical First Assistant will position the patient similar to a knee procedure such as an arthroscopy: supine with the ability to flex the leg and manipulate the knee in a way that exposes the articular surface. Hair may be removed with clippers as needed and a tourniquet should be applied around the thigh proximally. The skin will be prepared with a surgical prepping solution from the incision site at the knee proximally to the tourniquet then distally to the foot including the toes.

## THE PROCEDURE

The RECLAIM procedure itself begins with a small incision in the knee and the affected area is exposed with retractors. Once identified, the focal cartilage defect is outlined using an instrument known as a cookie cutter and a mallet. The area is then debrided with curettes. If the cookie cutter instrument is not available, then the defect can be debrided by other means such as with a #15 blade.

The chondral tissue is collected for the lab where it is enzymatically dissolved until single chondrocytes are available. The viable autologous cartilage cells are identified as described previously and combined with the donated allogeneic mesenchymal stem cells in a ratio of approximately one to ten<sup>6</sup>; one-part autologous cells to 10 parts allogeneic.

The auto/allograft is then returned from the lab to the operating room, combined with a fibrin glue to create an

implantable mixture, and prepared for implantation. This part of the process is simple, especially when compared to treatments of the past. The surgeon fills in the debrided area with the mixture and waits for the glue to cure. Then, after cycling the knee several times and confirming that the mixture is set, the wound is closed. The typical closure for this procedure will be an interrupted 0 polyglactin 910 for fascia, interrupted 2-0 polyglactone 25 or undyed 2-0 polyglactin 910 for the deep dermal layer, and a running poliglecaprone 25 for the skin. The incision will be covered with sterile dressings and a brace will be applied with the leg set in full extension.

After implantation, the donated mesenchymal stem cells will eventually differentiate themselves into the tissues they will ultimately identify as. Once this occurs, they seem to simply die off. The key to the success of this procedure is what occurs before that happens. The common consensus is that cartilage cannot repair itself, but when stem cells are present, they create an environment which promotes tissue growth. This is something the body does on its own; however, in large cartilaginous defects, the body simply cannot keep up with the amount of tissue that needs to be replaced. The combination of autologous cartilage with donated human mesenchymal stem cells creates an environment where the cartilage can grow. Studies show that HMSCs in synovial fluid increase in the knee with degenerated cartilage and osteoarthritis, which suggests that the body is attempting to treat the defect with HMSCs.<sup>8</sup>

#### POST-OPERATIVE

Physical therapy is the final step in the RECLAIM procedure. The recovery period for this procedure has shown to be shorter than other procedures. According to Dr. Daniel Saris, who has previously performed the surgery in Europe, patients achieve normal function about six months quicker than comparable therapies.<sup>6</sup> Patients also seem to show no signs of an inflammatory immune response. This may be due to the use of their own cells in the graft. Biopsies of the affected area one year after the operation have shown that not only has the implanted tissue completely integrated into the body but that the donor allograft cells have disappeared.

All that remains in the area are the patient's own cells. If the transplant takes, the results can be good for 13 to 20 years.<sup>6</sup>

The RECLAIM surgery is a one-step operation. Unfortunately, current Food and Drug Administration (FDA) regulations require that implanted tissues must be cultured for

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weeks before they can be implanted into a patient which, in this case, would require a second procedure. The surgeons at Mayo Clinic believe they can shorten this time to less than two hours and require only one procedure saving time and money. The promising results of the trials being conducted by Dr. Saris and Dr. Krych will ultimately compel the FDA to amend the requirement for this procedure.

RECLAIM is a much simpler procedure, less expensive, and has a shorter return to normal activity levels than its predecessors. It is also reasonable to extrapolate from this process that the same technique can be used on other tissues, such as cardiac, and applied to use in their respective therapies.



#### ABOUT THE AUTHOR

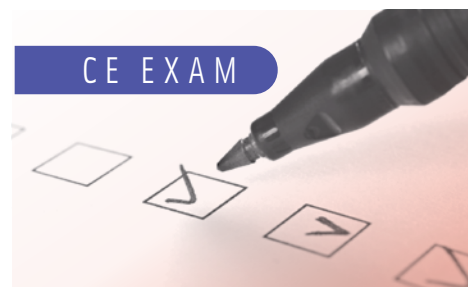
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He wishes to thank Dr. Daniel Saris.

## REFERENCES

1. Baxter. Retrieved from <https://advancedsurgery.baxter.com/products/tis-seel>
2. Caffey, S; McPherson, E; Hedman, B; Vangsness, T. (2005). Effects of Radio-frequency Energy on Human Articular Cartilage: An Analysis of 5 Systems. *The Amer J of Sports Med.* 33. 1035-9. 10.1177/0363546504271965.
3. Camp, CL; Stuart, MJ; Krych, AJ. (2014). Current Concepts of Articular Cartilage Restoration Techniques in the Knee. *Sports Health.* 6(3), 265-273. doi:10.1177/1941738113508917. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4000472/>
4. Hevesi, M; Krych, A; Saris, D. (2019). Treatment of Cartilage Defects with the Matrix-Induced Autologous Chondrocyte Implantation Cookie Cutter Technique. *Arthroscopy Techniques.* 2019; 8(6)591-596. Retrieved from [https://www.arthroscopytechniques.org/article/S2212-6287\(19\)30030-1/pdf](https://www.arthroscopytechniques.org/article/S2212-6287(19)30030-1/pdf)
5. Mayo Clinic Radio. (2019). Regenerative cartilage repair. Retrieved from <https://www.youtube.com/watch?v=veklKjzO0w>
6. Novel stem cell therapy for repair of knee cartilage. (2018). Retrieved from <https://www.mayoclinic.org/medical-professionals/orthopedic-surgery/news/novel-stem-cell-therapy-for-repair-of-knee-cartilage/mac-20450891>
7. Sekiya, I; Ojima, M; Suzuki, S; Yamaga, M; Horie, M; Koga H; Tsuji K; Miyaguchi K; Ogishima, S; Tanaka, H; Muneta, T. (2012). Human mesenchymal stem cells in synovial fluid increase in the knee with degenerated cartilage and osteoarthritis. *J Orthop Res.* 2012. Jun;30(6):943-9. doi: 10.1002/jor.22029.
8. Ullah, I; Subbarao, RB; Rho, GJ. (2015). Human mesenchymal stem cells - current trends and future prospective. *Bioscience Reports.* 35(2), e00191. doi:10.1042/BSR20150025
9. US National Library of Medicine. (2018). REcycled Cartilage Auto/Allo IMplantation. *Clinical Trials.* Retrieved from <https://clinicaltrials.gov/ct2/show/NCT03672825>



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1. \_\_\_\_\_ is a single surgery procedure that involves removing the patient's own cartilage, combining it with donated stem cells, then returning the mixture into the affected area.
  - a. TJA
  - b. RECLAIM
  - c. OATS
  - d. MSC
  
2. The viable autologous cartilage cells are identified as described previously and combined with the donated allogeneic mesenchymal stem cells in a ratio of approximately \_\_\_\_\_ part(s) autologous cells to \_\_\_\_\_ part(s) allogeneic.
  - a. 1 to 10
  - b. 2 to 7
  - c. 3 to 10
  - d. 1 to 5
  
3. According to surgeons at the Mayo Clinic, what percentage of patients return to play at their pre-injury levels?
  - a. 77%
  - b. 91%
  - c. 66%
  - d. 80%
  
4. Who isn't the ideal candidate for the RECLAIM procedure?
  - a. Overweight athletes
  - b. Younger athletes
  - c. Older athletes
  - d. A and c
  
5. \_\_\_\_\_ are adult stem cells which can be isolated from human and animal sources.
  - a. hMSCs
  - b. OATS
  - c. MSCs
  - d. None of the above
  
6. The patient positioning for this procedure is:
  - a. Supine
  - b. Supine with flex positioning
  - c. Lateral
  - d. Distal
  
7. The focal cartilage defect is outlined using an instrument known as a \_\_\_\_\_ and a mallet.
  - a. Mallet
  - b. Cookie cutter
  - c. Allis
  - d. Army retractor
  
8. The \_\_\_\_\_ is combined with fibrin glue to create an implantable mixture.
  - a. Auto/allograft
  - b. Suture
  - c. Chondral tissue
  - d. Cartilage cells
  
9. The skin is prepped from the knee proximally to the tourniquet to \_\_\_\_\_ to the foot.
  - a. Laterally
  - b. Proximally
  - c. Distally
  - d. Both b and c
  
10. According to the article, the last step for this procedure is \_\_\_\_\_.
  - a. Surgeon's clearance
  - b. Wound closure
  - c. Physical therapy
  - d. Being released from the ICU

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