

Knee Arthroscopic Allograft Cartilage Replacement: A Case Report

Dr. James Slauterbeck, Chair of Orthopaedic Surgery at the University of South Alabama College of Medicine, Mobile, Alabama

INTRODUCTION

This case report describes the indications and short term clinical/imaging outcomes for ProChondrix CR, a cryopreserved viable cartilage transplant, in a difficult cartilage repair case with complex anatomy and decision making.

Case History and Physical Exam

A 19-year-old club soccer athlete injured his knee in September of 2017. When he was struck from behind by another player, he twisted his knee and felt a pop. The patient noted immediate swelling and could not straighten his knee to full extension. The patient previously experienced patellar dislocation of the opposite knee but did not require surgery and returned to full strength following rehab.

Physical exam of the patient's knee is summarized as follows:

- Moderate knee effusion with a range of motion of 5° to 90°
- Tenderness at Medial Patellofemoral Ligament (MPFL) at the medial femur
- Patella-femoral exam showed mild peri-patella tenderness
- Medial and lateral glide of 30%
- Tilt in the negative position by 5°
- Seated Q angle of 25°

The patient was very apprehensive with patella mobilization and X-rays showed a small effusion and Insall Salvatti ratio of 1.2. (**Figures 1, 2**) Normal Insall Salvatti ratio is 0.8–1.2.¹

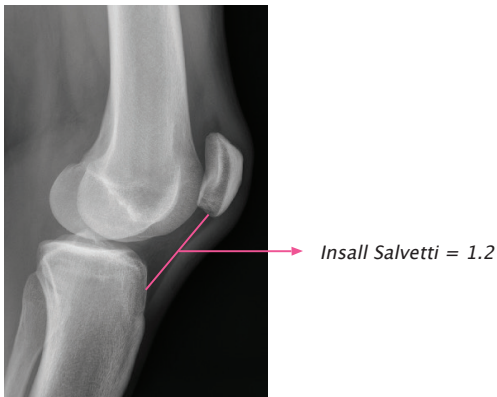


Figure 1. Lateral radiograph.



Figure 2. Index AP radiograph.

Magnetic resonance imaging (MRI) showed bone contusions on the lateral femur and lateral patella with a large intra-articular loose body. A significant patella defect measuring 1cm in diameter with additional delamination was also observed. (**Figure 3**)

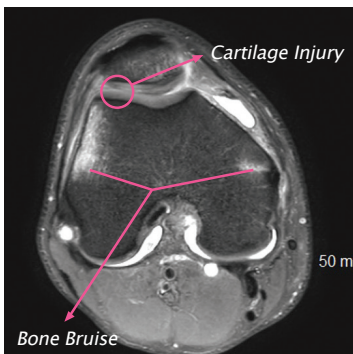


Figure 3. Axial View MRI, T2.

Operative and non-operative interventions were discussed, and the patient did not want any surgical procedure that would interfere with the remainder of the ski season. Loose bodies were removed to provide immediate relief and unlock his knee.

In October 2017, 5 cartilaginous loose bodies were removed. During the arthroscopy a well-shouldered, 1cm round, full-thickness cartilage defect and a small area of cartilage delamination were identified. The defect was debrided.

After 2 months of physical therapy the patient returned to skiing with a neoprene sleeve. During the ski season the patient's patella dislocated four times, but he was still not interested in surgical management because he only had knee pain following each patella dislocation. Shortly after each dislocation he returned to skiing.

In October 2018, (13 months after injury) the patient reported that he continued having patella dislocations and had developed patella-femoral pain. MRI and computerized tomography (CT) Fulkerson series showed a large loose body, a 20mm diameter, well-circumscribed patella defect, significant lateral patella tilt, slight patella subluxation and the tibia tubercle distance of 25mm. The patella femoral joint was dysplastic. (**Figures 4-8**)

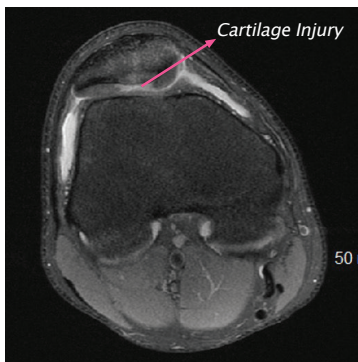


Figure 4. MRI Axial Image, T2.

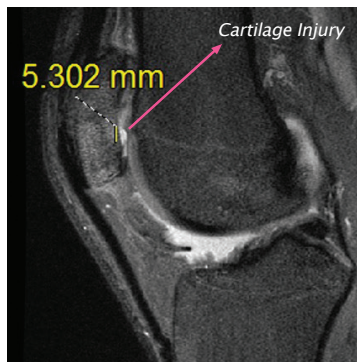


Figure 5. MRI Sagittal Image, T2.

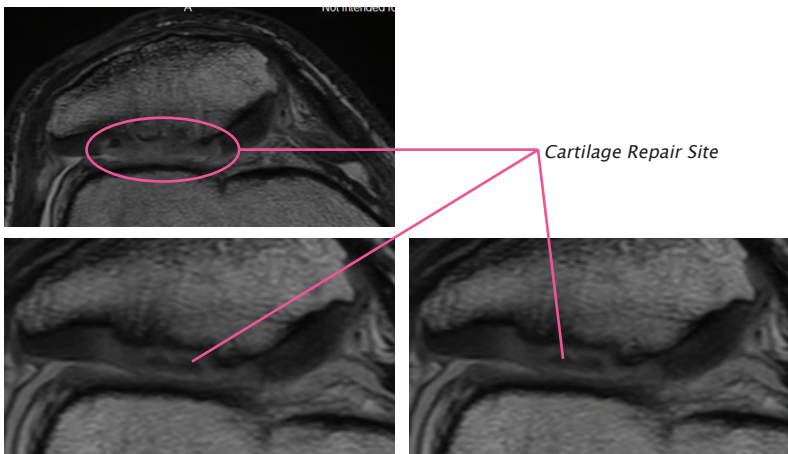


Figure 6. MRI Axial, T2. Figure 7. MRI Axial, T2. Figure 8. MRI Axial, T2.

Non-Operative Management

The non-operative plan included patella taping, patella bracing, strengthening, modifying activities (decreasing skiing) and taking non-steroidal anti-inflammatory drugs (NSAIDs). Despite aggressive non-operative management the patient's patella continued to dislocate and was painful with activities of daily living.

Operative Options for Patella Dislocation

Operative planning was complex and focused on treating the chondral and multiple patella dislocations. Patella dislocation management is beyond the discussion of this case report, but is important to briefly consider because it plays into the indications for the use of a ProChondrix CR cartilage graft. The multiple patella dislocations were addressed by a Fulkerson procedure. The procedure included: an anterior medial tibia tubercle osteotomy, which addressed the excessive lateral position of the tibia tubercle; the lateral release, which decreased the patella tilt; and proximal medial retinacular reefing to decrease the patella subluxation.

Operative Options for Cartilage Defects

The patella defect discussion focused on several options including osteochondral autograft, osteochondral patella allograft, fresh osteochondral allograft, cell-based therapy, and a ProChondrix CR cartilage graft. Consideration of treatment options focused on: the size of the defect (20 mm), location of the defect (on patella surface involving the patella ridge), depth of injury (cartilage only with intact bone) and the availability of the tissue needed for transplant.

- **Osteochondral Autograft:** The diameter of the lesion was not reasonably amenable to any cartilage autograph procedure without significant risk of creating painful donor site morbidity and a significant cartilage thickness mismatch. Femoral articular cartilage thickness is several millimeters less than patella cartilage surface.
- **Osteochondral Patella Allograft:** Patella allograft was not a good option because there was no bone involvement.
- **Osteochondral AlloGraft:** Fresh femoral articular cartilage transplantation was another option, but geometric matching can be difficult on the patella. The patella articular surface is shaped much like the keel of a sailboat and the femoral surface is round or ellipse making surface matching difficult. Cartilage thickness matching of the donor graft is another complex problem because femoral articular cartilage is only 3-4mm thick compared to the 6mm cartilage thickness of the patella. A cartilage thickness mismatch may lead to cartilage durability problems over time and the patella-femoral joint may wear out the thinner femoral graft.
- **Cell-Based Therapy:** Autologous cultured chondrocytes were also discussed as an option, but the high cost and second surgery were not acceptable for the patient.
- **ProChondrix CR Cartilage Allograft:** The advantages of ProChondrix CR include the immediate graft availability, high number of living chondrocytes, filling the defect with living hyaline cartilage, possibility of reconstituting the complex articular surface, low risk of graft induced infection, and the need for only one surgery.

After considering all the options above, the cartilage defect was treated with a ProChondrix CR cartilage allograft. The graft is immediately available, can be placed into a contained defect, has >90% living chondrocytes², and has the potential to reconstitute the articular cartilage thickness and complex shape of the patella due to its flexibility.

Surgical Treatment

In December 2018, a lateral release and tibia tubercle osteotomy were performed, which permitted full eversion of the patella. A small defect (≤ 1 cm) on the lateral trochlea was identified and treated with a micro-fracture procedure and the patella defect (20mm diameter) was identified. Instruments for a 20mm ProChondrix CR graft were used to clear the defect and make the cartilage walls perpendicular and circumferentially intact. Small curettes and osteotomes were used to prepare the bone bed and a micro fracture was performed with a small K-wire. The bone bed was irrigated and dried with suction. The fibrin glue (TISSEEL, Baxter, Deerfield, IL) was injected over the exposed bone and the excess glue was cleared by suction. After letting the glue cure for 1 minute, the graft was placed into the defect and fibrin glue was placed on top of the graft to complete the fixation. When achieving fixation, it is important to make sure no fibrin adhesions are attached from the surrounding structures. After waiting 10 minutes for the glue to dry, full range of motion for the knee was confirmed and the Fulkerson procedure was completed.

Rehabilitation

The knee was placed in a brace and locked in extension for 48 hours. The brace was removed and continuous passive motion (CPM) was initiated with range of motion 0–90 degrees for 10 hours per day for four weeks.

Immediate 50% weight-bearing in full extension and non-weight bearing during the gait cycle was allowed. At 6 weeks the patient's range of motion was 0 to 130 degrees and radiographs confirmed good healing at the osteotomy site. He progressed to full weight-bearing and full range of motion (ROM).

In 6 months the patient was back to running, jogging, and weight training with light squats without pain. His ROM was full and equal to the other side.

Seven months after surgery that patient had no pain with daily living at work or casual life activities. He was able to walk, jog, and play recreational sports without any difficulties. After several days in a row of skiing, the patient would get a small effusion that would go away within 24 hours with ice, rest, and activity modification.

The patient's KOOS³ scores were good: Symptoms 79, Pain 81, ADL 96, Sports 55, QOL 50 and an MRI showed good incorporation of the graft site. (**Figures 6–8, previously cited**) The cartilage surface and subchondral bone surface were aligned with no subchondral bone marrow edema and normal adjacent cartilage. It should be noted that the correlation between MRI changes and clinical outcomes is not yet clear.

CONCLUSION

A ProChondrix CR cartilage allograft is an excellent option in many cases especially when patients desire only one surgical procedure and when the defect size is large enough that one does not want to injure too much normal cartilage when taking autograft for the transplant tissue. The shelf life for the ProChondrix CR is 2 years and cell viability for the graft is over 90%.² It also replaces the missing full thickness cartilage with normal living tissue, which heals to the host. The outcome of this patient was excellent, and the patient MRI images were good. This surgical procedure shows encouraging early results and a prospective study and ongoing registry are underway.

REFERENCES

1. Insall J, Salvati E. Patella position in the normal knee joint. Radiology. 1971 Oct; 101(1):101–4
2. Rorick CR, et al. Cryopreserved, thin, laser-etched osteochondral allograft maintains the functional components of articular cartilage after 2 years of storage. Journal of Orthopaedic Surgery and Research. 2020; 15:521
3. Roos Ewa M, et al. Knee Injury and Osteoarthritis Outcome Score (KOOS)—development of a self-administered outcome measure. J Orthop Sports Phys Ther. 1998 Aug; 28(2):88–96