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Single-Stage Autologous Chondrocyte Implantation and Lateral Meniscus Allograft Reconstruction

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At Rush-Presbyterian-St Luke's Medical Center, collaboration of clinical and research personnel and resources results in exceptional teamwork and an open exchange of ideas.



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More than 2 million US residents each year suffer cartilage injuries in the knee. The majority of these individuals are young and wish to lead active lifestyles. Not uncommonly, patients with chronic symptoms in the involved compartment will demonstrate concomitant pathology in their menisci and articular cartilage. The management of symptomatic full-thickness chondral injuries is complex and is the subject of several reviews discussing a rational approach to their treatment.¹⁻³ The interrelationship of prior meniscectomy and the development of arthritis adds to this treatment complexity.^{4,5} There are a number of reports demonstrating the efficacy of either autologous chondrocyte implantation (ACI)⁶⁻⁹ or meniscus allograft reconstruction performed as a single procedure.¹⁰⁻¹² Combining these procedures in a single stage is the subject of this case report.

Case Report

A 36-year-old male recreational athlete presented with a history of multiple sport-related right knee injuries leading to arthroscopic lateral meniscectomy and two serial debridements for a full-thickness lateral femoral condyle chondral

defect. His chief complaints were disabling lateral knee pain and activity-related knee swelling leading to complete abandonment of all activities other than walking for short distances. His most recent arthroscopy, performed just prior to referral for cartilage restoration, demonstrated a 15-mm x 50-mm full-thickness isolated chondral defect of his lateral femoral condyle and evidence of total lateral meniscectomy in the setting of otherwise intact articular cartilage. Physical examination revealed an appreciable effusion, lateral joint-line tenderness, and painful crepitus along the lateral femoral condyle during range-of-motion testing. His mechanical-axis alignment and ligament examination results were within normal limits. Flexion weightbearing posteroanterior radiographs revealed mild lateral joint-space narrowing (Figure 1). Because of his failure to improve following arthroscopic debridement, and the combination of articular and meniscal cartilage pathology, he was indicated for a single-stage ACI and lateral meniscus allograft reconstruction.

Surgical Technique

A diagnostic arthroscopy was performed to confirm the size, depth, and location of the lateral femoral condyle chondral defect, the status of the lateral meniscus, and the status of the surrounding articular surfaces (Figure 2). A 200-mg to 300-mg biopsy of articular cartilage harvested from the lateral intercondylar notch was sent for



Figure 1. Mild lateral joint-space narrowing of the right knee.



Figure 2. Lateral femoral condyle chondral defect.



Figure 3. Meniscus allograft reconstruction.



Figure 4. Periosteal patch.

invitro chondrocyte expansion. Four weeks later, a single-stage ACI with meniscus allograft reconstruction was performed through a laterally based parapatellar arthrotomy.

A size-matched cryopreserved meniscus allograft reconstruction was performed first using a keyhole technique with an inside-out meniscus repair (Figure 3). Next, a periosteal patch harvested from the anteromedial tibia was sutured with the cambium layer facing the bone using multiple interrupted 6-0 absorbable sutures (Figure 4) and sealed with fibrin glue. Just prior to definitive closure, the autologous chondrocytes were injected beneath the patch. The arthrotomy was closed with the knee in full extension.

During the first 6 postoperative weeks, the patient was not permitted to engage in weight bearing. He used continuous passive motion for 6 to 8 hours per day. Over the ensuing 10 months, the patient readily progressed through the rehabilitation protocol. A year postoperatively, second-look arthroscopy demonstrated excellent peripheral healing of the meniscus allograft with only slight shrinkage. The site of the previous autologous chondrocyte implantation was covered with white hyaline-like articular cartilage that, while slightly softer than the surrounding articular cartilage, completely filled the defect (Figure 5). Clinically, the patient had full, symmetrical range of motion and complained of only minimal joint-line or femoral-condyle tenderness. The patient was released with instructions to participate in activities as tolerated. In fact, he had resumed downhill skiing and running on a treadmill at his most recent (18-month) follow-up visit (Figure 6).

Discussion

The natural history and treatment of articular cartilage disease and meniscus deficiency in active patients are topics of great interest, with continually evolving concepts and techniques. Because many of these patients are relatively young and active, activity modification is often considered unacceptable. Inevitably, limited longterm outcomes data lead to surgical decision-making based upon a realistic synthesis of the surgeon's clinical experience, local resource availability, and his or her unique understanding of the available literature.

The optimal indications for ACI include isolated, symptomatic, full-thickness defects of the weight-bearing portion of the femoral condyles or trochlea and osteochondritis dissecans in younger active patients 15 to 50 years old. The full-thickness defect should be unipolar, grade III to IV (Outerbridge classification) chondral injuries of less than 10cm² with minimal subchondral bone involvement. Additional requirements include a compliant patient, ligamentous stability, appropriate mechanical alignment, and an intact or relatively intact meniscus. Results following ACI in the United States after a minimum of 3 years' follow-up care show significant clinical improvement in 85% of patients⁷. In Sweden, preliminary results for the first 100 patients after a minimum follow-up period of 2 to 9 years revealed that approximately 90% reported improvement.^{8,9}

The optimal candidates for allograft meniscus reconstruction include the relatively young (less than 55 years old), active patient who has pain in a previously meniscectomized compartment with, ideally, chondromalacia no greater than grade II or early grade III. As with ACI, the patient must be compliant, must have ligamentous stability, and must demonstrate appropriate mechanical-axis alignment. The changes of significant articular disease (late grade III or grade IV) are generally associated with inferior results. Results following allograft meniscus reconstruction approach 85% good or excellent after a minimum of 3 years' follow-up care when these indications are respected.^{3,10-12}

A relatively young, active patient with a symptomatic focal chondral defect in association with ipsilateral meniscus deficiency is an exceptionally challenging clinical and technical problem. In this instance, performing either ACI or allograft meniscus reconstruction in isolation would otherwise be contraindicated.

Performed simultaneously, ACI and meniscus reconstruction complement one another and effectively eliminate their respective contraindications. Long-term data are lacking for this single-stage procedure. Short-term follow-up care of this patient (for 18 months), however, demonstrates a clinically excellent result. Combining these procedures mandates the exercise of increased awareness of, and sensitivity to, their respective indications. Ultimately, patient selection is critical to the achievement of a successful result.

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References

1. Cartilage restoration: alternative techniques for the management of articular cartilage disease. In: Cole BJ, section ed. *The Arthritic Knee* [book on CD-ROM]. Rosemont, Ill: American Academy of Orthopaedic Surgeons Electronic Media; 2000. In preparation.
2. Cole BJ, Frederick RW, Levy AS, Zaslav KR. Management of a 37-year-old man with recurrent knee pain. *Journal of Clinical Outcomes Management*. 1999;6:46-57.
3. Cole BJ, Harner CD. Degenerative arthritis of the knee in active patients: evaluation and management. *Journal of the American Academy of Orthopedic Surgeons*. 1999;7:389-402.
4. Burks RT, Metcalf MH, Metcalf RW. Fifteen year follow-up of arthroscopic partial meniscectomy. *Arthroscopy*. 1997;13:673-679.
5. Jorgenson U, Sonne-Holm S, Lauridsen F, Rosenklint A. Long-term follow-up of meniscectomy in athletes. *J Bone Joint Surg Br*. 1987;69:80-83.
6. Brittberg M, Lindahl A, Nilsson A, Ohlsson C, Isaksson O, Peterson L. Treatment of deep cartilage defects in the knee with autologous chondrocyte transplantation. *N Engl J Med*. 1994;331:889-895.
7. Cartilage Repair Registry. *Genzyme Tissue Repair*. Cambridge, Mass: ABT Associates; 1999.
8. Menche DS, Vangness CT, Pitman M, Gross AK, Peterson L. The treatment of isolated articular cartilage lesions in the young individual. *Instr Course Lect*. 1998;47:505-515.
9. Minas T. The role of cartilage repair techniques, including chondrocyte transplantation in focal chondral knee damage. *Instr Course Lect*. 1999;48:629-643.
10. Kuhn JE, Wojtys EM. Allograft meniscus transplantation. *Clin Sports Med*. 1996; 15:537-556.
11. Garet JC. Meniscal transplantation. A review of 43 cases with two to seven year follow-up. *Sports Med Arthrosc Rev*. 1993;2:164-167.
12. Carter TR. Meniscus allograft transplantation. *Sports Med Arthrosc Rev*. 1999;7:51-62.

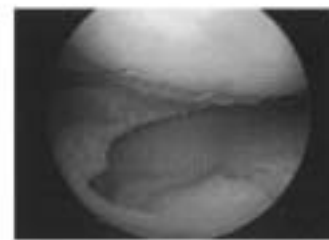


Figure 5. Filled defect, viewed a year after surgery.



Figure 6. Patient running 18 months after surgery.