

New Horizons in the Treatment of Osteoarthritis of the Knee

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OSTEoARTHRITIS IS NOT SIMPLY A degenerative disorder. Rather, it is a complex derangement of articular surfaces that involves the loss of normal collagen architecture followed by an attempt by chondrocytes to produce replacement cartilage. The replacement surface is less resistant to wear than the original. Over time, full-thickness cartilage loss may develop on the articular surfaces. Symptoms of osteoarthritis include joint pain, typically worse with use and eased with rest, and joint stiffness after nonuse. The pain can become persistent.

In the past, failure of symptomatic treatment, such as nonsteroidal anti-inflammatory drugs and physical therapy, has left joint replacement as the principal option in the care of more severely affected patients. However, in recent years, 3 new intra-articular procedures have shown promise for some patients with articular cartilage defects of the knee. Multiyear follow-up has shown encouraging results for these treatments of diffuse osteoarthritis and focal articular defects of the knee. Focal articular cartilage defects, often found in young adults, have been increasingly recognized as a cause of functional problems. To date, only lesions on the femoral condyles and trochlear groove have been effectively treated. Two techniques to treat these lesions, autogenous cartilage implantation (ACI) and autogenous osteochondral grafting, improved knee function in 2- to 5-year follow-ups in carefully selected patients. Patients most likely to benefit are those with normal knee alignment, no evidence of ligamentous instability, and no evidence of arthritis on

the corresponding tibial surface. In general, the radiographs of these patients' knees are normal or near normal, with little evidence of joint space narrowing or osteophyte formation in weight-bearing radiographs.

For the more common condition of diffuse osteoarthritis of the knee, the Food and Drug Administration has approved the intra-articular injection of forms of hyaluronic acid in more advanced cases. Technically classified as a device rather than a drug, hyaluronic acid compound injection has been used outside the United States, with functional improvement in up to 77% of patients.¹

Autogenous Cartilage Implantation

Patients with focal articular defects or osteochondritis dissecans of the femoral condyles or trochlear groove may be candidates for ACI. It is especially useful for large (up to 15 cm²) or multiple defects of the femoral condyles.² Following a thorough evaluation to rule out ligamentous instability and other anatomic abnormalities and to show that there is no radiographic sign of limb misalignment or bipolar (on both sides of the joint) arthritis, the patient may be a candidate for ACI. First, an autogenous cartilage biopsy specimen of approximately 200 to 300 mg of articular cartilage is obtained arthroscopically. The specimen is then enzymatically digested, and the chondrocytes are cultured in the laboratory. Currently, ACI techniques require an opening arthrotomy of the knee joint to expose the lesion. At surgery, the focal area of arthritis on the femoral condyle or trochlear groove is debrided to a rim of normal healthy cartilage, and a template of the defect is made. The template is then used to obtain a periosteal

graft, usually from the proximal tibia, which is sutured to the edges of the articular cartilage defect. Once a watertight seal has been verified, the suture repair is reinforced with autogenous or commercially prepared fibrin glue, and the cultured chondrocytes are injected under the periosteal graft.³ Postoperatively, patients are required to pursue a specific rehabilitation program and are generally allowed to return to full activities 1 year after surgery.

Two-year outcome studies in the United States³ have revealed significant improvement in patient function and symptoms compared with their baseline condition. Clinician ratings of patients treated with ACI for femoral condyles report 86% of patients improved from their baseline.³ The incidence of failure is 5.8% after 2 years.

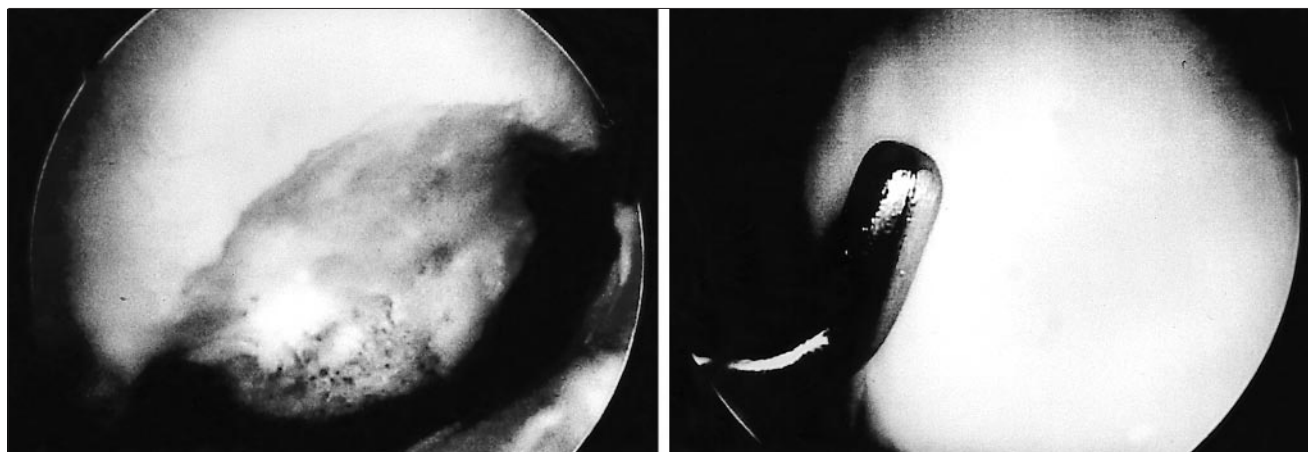
Peterson⁴ has reported a 2- to 10-year follow-up of 219 patients after ACI. Patients reported an 89% improvement for isolated femoral lesions, 88% improvement for osteochondritis dissecans, and 58% improvement for trochlear lesions, compared with their preoperative functional levels. Second-look arthroscopies (FIGURE 1) and biopsy specimens revealed a repair tissue of hyalinelike cartilage in 74% of patients. Peterson reported a strong correlation between repair tissue that appeared hyalinelike on histologic evaluation and a good clinical out-

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Figure 1. Arthroscopic View of Left Knee Lateral Femoral Condyle in a 41-Year-Old Man

Left, Preoperative view. Right, Arthroscopic appearance 1 year following autogenous cartilage implantation. Photographs courtesy of Scott D. Gillogly, MD.

come for patients. Thirty-one patients who initially had good or excellent results at 2 years of follow-up were reevaluated an average of 7.4 years postoperatively. Thirty (96%) of these patients maintained their good or excellent results.⁴

While the results of ACI appear promising, they must be tempered with the understanding that longer follow-up and double-blind comparisons with other techniques are necessary to determine the long-term efficacy of ACI in treating focal articular cartilage defects of the knee. In addition, a prospective study of the natural history of these lesions without intervention is lacking.

Autogenous Osteochondral Grafting

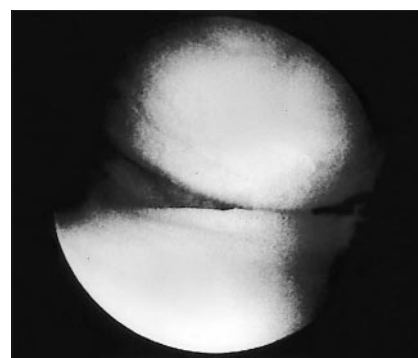
Autogenous osteochondral grafting is a technique whereby cylinders of bone and autogenous cartilage from a lesser weight-bearing position on the distal femur are transferred into prepared tunnels on the articular surface defect of the femur.^{5,6} While small lesions can be repaired arthroscopically, larger lesions require an opening arthrotomy. Second-look arthroscopies (FIGURE 2) and biopsy specimens have demonstrated that the transplanted cartilage remains hyaline-like in nature and that fibrocartilage bonding, which consists of organized scar tissue between the hyaline cartilage plugs, occurs at the native articular cartilage transition sites. Fifty-seven patients have been

followed up for more than 3 years and evaluated using the modified Hospital for Special Surgery knee scoring system, and 90.7% have been rated to have good or excellent clinical results.⁶

Because of concerns about donor site morbidity,⁷ autogenous osteochondral grafting procedures are usually limited to articular cartilage lesions no larger than 2 cm². For lesions that are larger than 2 cm², strong consideration should be given to an ACI procedure.

Hyaluronic Acid Injection

The treatment of patients who have osteoarthritis pain with intra-articular viscosupplementation, using cross-linked hyaluronan (hyaluronic acid), has been available in Europe for over a decade, in Canada since 1992,¹ and in the United States since late 1997. This therapeutic approach is based on the observation that synovial fluid in osteoarthritic knees has decreased viscosity and elasticity, and its native hyaluronan has a lower molecular weight than that found in normal healthy knees. The principle of hyaluronic acid injections is to restore the normal viscoelastic properties of synovial fluid to relieve the signs and symptoms of osteoarthritis. In addition, these injections may serve a short-term role by providing mechanical improvement in joint motion. Viscosupplementation may also decrease the medical costs of gastrointestinal, neurologic, cardiac, and res-

Figure 2. Arthroscopic Second-Look View of Medial Femoral Condyle in a 36-Year-Old Man After Autogenous Osteochondral Grafting

This view was taken 6 years after mosaicplasty procedure. Photograph courtesy of Laszlo Hangody, MD, PhD.

piratory comorbidity associated with nonsteroidal anti-inflammatory drugs by allowing patients to use less medication as they improve functionally.^{8,9}

In a multicenter clinical trial in Canada,¹ 458 knees in 336 patients were evaluated for their response to viscosupplementation with a hyaluronan derivative. Seventy-seven percent of patients had improved function for a mean (SD) duration of 8.2 (0.5) months after treatment.¹ The best response to treatment was seen in patients with mild osteoarthritic changes on radiographs (type I radiographic grade of medial knee compartment, 91% improved). Even patients with

severe type IV radiographic changes of the medial (58% improved) and lateral (53% improved) compartments of the knee demonstrated some response to treatment. Among those patients who required a second course of treatment, 87% were found to have better or much better response to treatment.

There have been no reported systemic reactions with hyaluronic acid injections, but local reactions consisting of increased pain and local swelling were found in 7.0%

of joints.¹ These reactions were transient, self-limited, and not predictive of the ultimate success of the procedure.

Conclusions

These new procedures for arthritis of the knee have shown persistence of the improvement in short- to medium-interval follow-up. The techniques of ACI and autogenous osteochondral grafts look promising to relieve pain and improve function for carefully selected patients with

focal articular cartilage defects of the femoral condyles. Early diagnosis and treatment of these patients is recommended prior to the advancement of more advanced osteoarthritis. Viscosupplementation with hyaluronic acid in arthritic knees also has been shown to improve function in a majority of patients. Each technique needs further follow-up and comparison testing to evaluate its long-term efficacy in the treatment of arthritis of the knee.

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The human body . . . indeed is like a ship; its bones being the stiff standing-rigging, and the sinews the small running ropes, that manage all the motions.
—Herman Melville (1819-1891)