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A Unique Treatment Protocol for Osteochondritis Dissecans of the Knee: A Case Report

Anna M. Napolitano, ATC, PES-NASM*; Joel Pickerman, MS, ATC, CSCS†; Marc Milia, MD‡

*Wyandotte Roosevelt High School, Dearborn Heights, MI; †University of Michigan, Ann Arbor; ‡Michigan Orthopedic Specialists, Dearborn

Address correspondence to Anna M. Napolitano, ATC, PES-NASM, Wyandotte Roosevelt High School, 6846 N. Gulley Rd., Dearborn Heights, MI 48127. Address e-mail to napolita9@yahoo.com.

Objective: Explain the benefits of using an unloader osteoarthritis knee brace for patients after osteochondral allograft replacement.

Background: A 16-year-old male presented with right knee pain during athletic activities. He had no history of injury to either knee, and physical examination revealed no ligamentous damage. The patient was referred to an orthopaedic surgeon for further evaluation, who diagnosed osteochondritis dissecans. At 20 weeks after open reduction, internal fixation with autogenous bone graft, he presented with increased pain and swelling and a locking/catching mechanism in his knee. He was immediately referred back to the orthopaedic surgeon, who performed a second open reduction, internal fixation, this time with osteochondral allograft.

Differential Diagnosis: Meniscal tear, plica irritation.

Treatment: After the first surgery, rehabilitation consisted of a return to weight-bearing status and progression of exercises. The patient was progressing well and slowly returning to sport activity until 20 weeks. After the second surgery, the rehabilitative process was more gradual, with a slow return to weight bearing.

Uniqueness: This patient underwent 2 surgeries to treat osteochondritis dissecans. The key factor in healing was the use of a custom-fit, laterally unloaded osteoarthritis knee brace.

Conclusions: Despite a conservative rehabilitation protocol, the osteochondritis dissecans lesion failed to heal after the first surgery. Therefore, osteochondral allograft replacement surgery was performed, and a slower progression of therapeutic exercises returned the patient to functional status.

Key Words: lower extremity, rehabilitation, unloader brace

Knee injuries, either acute or chronic, affect thousands of patients every year. These injuries may be common, such an anterior cruciate ligament tear, or uncommon, such as osteochondritis dissecans (OCD). Although the exact number of OCD cases is unknown, it is estimated that 15 to 29 per 100,000 people are affected.[1] Osteochondritis dissecans is a "pathologic process in which a fragment of subchondral bone becomes avascular and can separate from the surrounding tissue."[2]

The cause of OCD is usually traumatic, but ossification defects, repetitive mechanical stress, and ischemia can also be inciting factors.[2] Both males and females develop OCD; however, males are at greater risk than females, with a ratio of 5:3.[1]

The body reacts to OCD in different ways. The affected bone and its cartilage may stay in place, causing no pain, or the fragment of cartilage may become loose, separate, and cause pain. If the fragment separates, locking, weakness or giving way of the knee joint; decreased joint movement; and swelling and skin tenderness may result.[3] Athletic trainers should treat each patient with OCD individually, because neither a "cookbook recipe" nor a "gold standard" has been established for the condition.

In the following case report, we describe a high school baseball player who was diagnosed with OCD early in his junior year.

Case Report

In September 2006, a 16-year-old male baseball player presented with right knee pain. The onset of pain had been rapid, and pain increased with activities, including jump-stops, stop-and-go actions, and cutting drills. He had no history of knee injury or lower leg or ankle pain.

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On initial evaluation, the patient had a normal gait and minimal right knee effusion. His pain extended from the superior aspect of the tibial plateau and along the lateral border of the patella over the lateral joint line to the lateral tibial plateau. Full range of motion was present, with no clicking or catching of the knee. Manual muscle testing was within normal limits. Lachman, varus and Apley distraction-compression tests were negative.

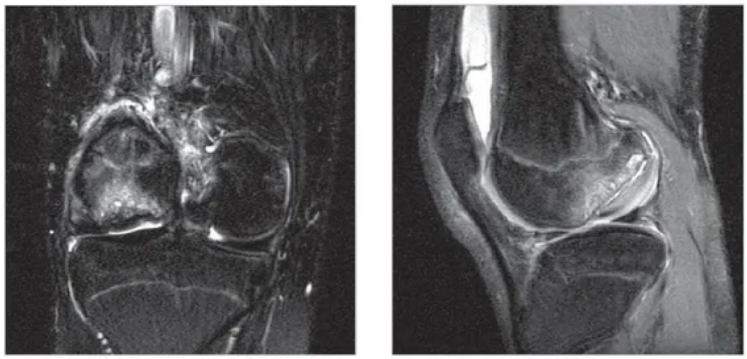
The patient was referred to an orthopaedic surgeon. After evaluation, the physician ordered a magnetic resonance imaging (MRI) scan, which revealed a breach in the lateral femoral condyle articular cartilage (a "trapdoor" OCD lesion) requiring stabilization (Figures 1A, 1B). Open reduction, internal fixation with autogenous bone graft was performed.

After surgery, the patient was placed in a knee immobilizer and remained non–weight bearing for 6 weeks. Rehabilitation began 5 days after surgery (Table 1). At 7 weeks, the immobilizer was discontinued, and closed chain exercises and proprioceptive training were initiated. At 8 weeks, the patient started cardiovascular system training with the elliptical machine. At 12 weeks, he began jogging. Throughout this time, he progressed at an appropriate pace.

At 20 weeks postsurgery, the patient presented with increased pain and swelling and a locking/catching mechanism in his knee, leading to gait abnormalities. Until this point, he had been fully functional, with no problems. No specific mechanism of injury or direct trauma preceded the sudden increase in symptoms.

Upon evaluation, the patient's pain was localized to the lateral joint line of the knee. Full range of motion was present, but pain and clicking/catching occurred at about 90° of active knee flexion. Manual muscle testing was within normal limits. The Lachman, varus, valgus and Apley distraction-compression tests were negative.

The patient was referred back to the orthopaedic surgeon, who ordered an MRI, which was inconclusive. The orthopaedist performed arthroscopic surgery and determined that the osteochondral lesion had failed to heal. The repaired articular cartilage that had originally been reattached to the tibia was no longer present, exposing the lateral femoral condyle (Figures 2A, 2B). The bone graft had become a loose body within the joint space, causing the catching/clicking mechanism. The patient was referred by his orthopaedic sur-



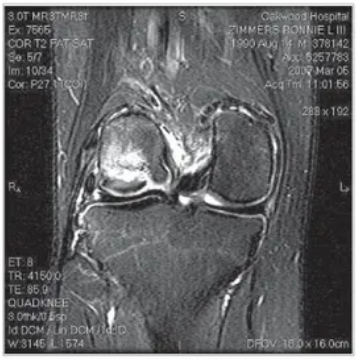
Figures 1A-1B. Preoperative magnetic resonance imaging scan of lesion in articular cartilage of the lateral femoral condyle of the right knee, showing (A), frontal view, and (B), sagittal view.

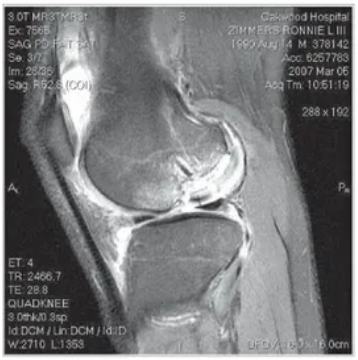
Time Frame (weeks)	Weight Bearing and Other Activities	Goals	Therapeutic Modalities and Exercises
1-6	Non–weight bearing with knee immobilizer	– Edema and pain control, decrease swelling and inflammation – Work toward full range of motion – Quadriceps and hip muscle strengthening	– Electric stimulation, ice – Hamstrings and calf stretches, heel slides, recumbent biking without resistance – Quadriceps sets, straight-leg raises, open kinetic chain hip strengthening
7-12	– Discontinue crutches and immobilizer; begin gait training – Begin cardiovascular training – Continue strength training – Begin proprioceptive training	– Ambulate without any gait deviations – Maintain range of motion – Biking/elliptical machine for 30 min – Increase muscle strength to 4/5 – Hold single-leg stance with eyes open, then eyes closed for 30 s	– Walk on indoor track, working on heel-toe strike – Continue flexibility and stretching exercises – Cardiovascular training for 10 min/d, building to 30 min/d – Leg presses, lunges, body-weight squats, step-ups, calf raises, hamstrings curls, Theraband[a] exercises, core training – Single-leg balance training using a variety of surfaces
13-17	– Begin walk-jog sequence – Begin return to sport	– Run 1 mi (1.6 km) – Increase muscle strength to 5/5 – Full return to sport	– Walk/jog on track – Leg presses, variety of lunges, free squats, step-ups on plyometrics boxes, hamstring strengthening, core training – Plyometrics, agility drills, sport-specific activities

[a] *The Hygenic Corporation, Akron, OH.*

Table 1: Rehabilitation Protocol for Osteochondritis Dissecans After Open Reduction, Internal Fixation With Autogenous Bone Graft

Table 2 (at right): Rehabilitation Protocol for Osteochondritis Dissecans After Open Reduction, Internal Fixation With Allograft





Figures 2A-2B. MRI scan 5 months after the first surgery, showing articular cartilage lesion of the lateral femoral condyle of the right knee had failed to heal.

Time Frame (weeks)	Weight Bearing and Other Activities	Goals	Therapeutic Modalities and Exercises
1-6	Non–weight bearing with knee immobilizer	– Edema and pain control, decrease swelling and inflammation – Increase ROM – Quadriceps and hip muscle strengthening	– Electric stimulation, ice – Hamstrings and calf stretches, heel slides, recumbent biking without resistance – Quadriceps sets, straight-leg raises, open kinetic chain hip strengthening
7-12	– Weight-bearing progression – Begin pool therapy – Improve ROM – Begin strength training	– Decrease swelling & inflammation – Begin gait training – Increase ROM – Increase muscle strength to 3/5 – Increase muscle strength to 4/5	– Electric stimulation, ice – Forward/backward/ lateral walking in pool – Hamstrings, calf stretches, recumbent biking – Open kinetic chain hip strengthening in standing, squats, marching; hamstring strengthening
13-16	– Discontinue crutches – Progress to weight-bearing exercises – Begin cardiovascular training – Begin proprioceptive training	– Pain management – Increase muscle strength to 4/5 – Biking/elliptical machine for 30 min. – Hold single-leg stance with eyes open, then eyes closed for 30 sec.	– Ice after activity – Cardiovascular training for 10 min/d, building to 30 min/d – Leg presses, lunges, body-weight squats, step-ups, calf raises, hamstring curls, Theraband exercises, core training – Single-leg balance training using a variety of surfaces
17-36	– Begin use of osteoarthritis brace – Begin jogging – Continue to improve functional strength – Begin return to sport	– Wear brace during all rehab and athletic activities – Run ≤0.25 mi (0.40 km)/wk – Increase muscle strength to 5/5 – Return to full sport activity	– Walk/jog on track, elliptical sprints – BOSU exercises, step-ups on 12- to 18-in (31- to 46-cm) plyometrics box, variety of lunges, free squats, core training – Agility relays, sport-specific activities, jump rope, agility ladder, balance drills

[a] *The Hygenic Corporation, Akron, OH.*
[b] *Team BOSU, Canton, OH.*

geon to a tertiary orthopaedic center specializing in osteochondral allograft replacements, and he underwent his second open reduction, internal fixation, this time with osteochondral transplantation using allograft tissue.

After surgery, the patient remained non–weight bearing for 6 weeks but was not placed in an immobilizer. Rehabilitation was initiated 2 days after surgery (Table 2) and consisted of basic range-of-motion and quadriceps strengthening exercises. At 7 weeks, the patient was allowed to start adding 25 lbs (11 kg) of body weight to the right knee each week until full weight bearing was achieved. Pool therapy was also begun at this time and included gait training and hip and quadriceps range-of-motion and strengthening exercises. At 13 weeks, closed chain exercises were implemented. The varied exercises allowed the tensile strength in the bone and surrounding muscles to improve. Thus, the joint was constantly stressed to provide the best possible healing environment. The patient had some complaints of discomfort and pain along the lateral aspect of the right knee but only while performing the closed chain exercises. Therefore, we investigated options to relieve the pressure he was feeling over the surgical area.

A custom-fit, laterally unloaded osteoarthritis (OA) knee brace was applied. The patient used the OA brace during all rehabilitation protocols and was instructed to use it during all other athletic activities, including baseball and bowling. Theoretically, the basis for using this brace was to unload the lateral compartment and relieve joint stress during healing, as the patient safely increased strength and neuromuscular function.

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Figures 3A-3B. Magnetic resonance imaging scan 7 months after the second surgery, showing the healing osteochondral allograft. The articular cartilage of the allograft has healed smoothly to the patient's articular cartilage, but the bone graft continues to heal and conform to the patient's femur. (A), frontal view. (B), sagittal view. The screw from the initial surgery is still present.

The patient began his return to athletic activity when he was named to the varsity bowling team 6 months after the second surgery. A final MRI was performed the next month to show the degree of healing and help to determine whether the athlete could safely increase his activity level. The articular cartilage graft had healed properly, but the bone graft was not yet completely healed (Figures 3A and 3B). Hence, the patient was cleared for jogging only short distances (less than -.25 mi [0.40 km]) and, 1 month later, for baseball reconditioning. His senior baseball season began 2 months afterward, and he participated without difficulty.

Discussion

Two types of treatment options exist for OCD: nonsurgical (ie, conservative) and surgical. Conservative methods include rest, joint immobilization and nonsteroidal anti-inflammatory medications, avoiding competitive sports and intense physical activity, and rehabilitation.[3] Surgical options vary from open procedures to arthroscopic methods, depending on the severity of the OCD lesion.4 Allograft (transplant of bone and cartilage from a cadaveric donor) and autograft (transplant of the patient's own tissue) procedures are commonly used to treat OCD.[4] Either

option must be followed by an appropriate rehabilitation program. Use of an unloader brace may also be beneficial to the patient's return to functional status, but we were unable to locate any research regarding the benefits of unloader bracing after osteochondral allograft replacement. According to Kocher et al,[1] "the value of adjunctive immobilization, protected weight bearing and unloader bracing has not been established."

Unloader braces were developed in the mid 1990s and are popular among patients with OA, who generally complain of pain over the medial or lateral compartment of the knee.[5] Unloader braces are designed to apply either a valgus or varus force, depending on the affected compartment. The applied force decreases the load on that compartment, thereby decreasing pain and improving joint proprioception.[6] Some authors[6] have found unloader braces to decrease pain and improve overall knee function. Barnes et al[7] noted that after 8 weeks of continual brace use, patients reported decreased pain, decreased use of nonsteroidal anti-inflammatory medication, and increased ability to perform work and other functional activities. Dowdy et al[8] showed that unloader braces help to decrease pain and return patients to functional activities.

Although separate diagnoses, OA and OCD have similarities. Both conditions affect either the medial or lateral compartment of the knee and the weight-bearing status of the patient. Weight bearing is the physical state of supporting an applied load. All stresses from ground forces are transmitted through the lower leg and knee. Therefore, the patient feels pain with basic weight-bearing activities, including walking (on both level ground and inclines) and standing for long periods, which can disrupt activities of daily living. Studies have shown there are benefits of using an unloader brace on OA patients. Thus, after autogenous bone graft or osteochondral allograft, OCD patients might also benefit from unloader braces.

Despite the conservative approach taken with our patient during the postoperative rehabilitation process, the OCD lesion failed to heal. To further protect the surgical site after the second surgery, we followed a slower progression to weight-bearing status. However, when he initiated weight-bearing activities at 4 months, he experienced pain with closed chain exercises. At 5 months, we placed him in a custom-fit, laterally unloaded OA brace, which resulted in an immediate decrease in pain and discomfort. Our goal was to take stress off the surgical site in the lateral compartment, increasing the chances of complete healing. The patient wore the brace during rehabilitation exercises and all athletic activities, including strength training, bowling, and baseball. He was able to complete his senior year of baseball without problems, earning many postseason honors and offers to continue playing at higher levels.

Conclusions

Osteochondral allograft transplants are common procedures for individuals diagnosed with OCD. The rehabilitation process, including weight-bearing progression, must be conservative.

Exercises should include closed chain activities as often as possible but with varied ground surfaces.

If the patient is experiencing pain over the surgical site while pursuing rehabilitation or normal activities of daily living, then an unloader brace is an option.

The custom-fitted brace has the potential to unload the joint over the surgical site and reduce symptoms, which can permit increased activity, including exercise progression in the rehabilitation process.

The patient can continue to improve neuromuscular strength and should be able to return to normal sport activity.

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