Management of Osteochondritis Dissecans of the Knee
Current Concepts Review

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Osteochondritis dissecans of the knee is being seen with increased frequency in pediatric and young adult athletes and is thought to be, in part, owing to earlier and increasing competitive sports participation. Despite much speculation, the cause of both juvenile and adult osteochondritis dissecans remains unclear. Early recognition is essential. Whereas adult osteochondritis dissecans lesions have a greater propensity to instability, juvenile osteochondritis dissecans lesions are typically stable, and those with an intact articular surface have a potential to heal with nonoperative treatment through cessation of repetitive impact loading. The value of adjunctive immobilization, protected weightbearing, and unloader bracing has not been established. Skeletally immature patients with stable lesions that have not healed with nonoperative treatment should have consideration given to arthroscopic drilling to promote healing before the lesion progresses and requires more involved treatment with a less optimistic prognosis. Magnetic resonance imaging may allow early prediction of lesion healing potential. The majority of adult osteochondritis dissecans cases as well as those skeletally immature patients with unstable lesions and secondary loose bodies require fixation and possible bone grafting. Many unstable lesions will heal after stabilization, but long-term prognosis is not clear. Chronic loose fragments can be difficult to fix and have poor healing potential. Results of excision of large lesions from weight-bearing zones are poor. Chondral resurfacing techniques have limited long-term data for cases of osteochondritis dissecans in skeletally immature patients.

Keywords: osteochondritis dissecans (OCD); articular cartilage

Osteochondritis dissecans (OCD) is an increasingly common cause of knee pain and dysfunction among skeletally immature and young adult patients. Osteochondritis dissecans is an acquired, potentially reversible idiopathic lesion of subchondral bone resulting in delamination and sequestration with or without articular cartilage involvement and instability.10,14,24,29,35,51 The cause of OCD remains controversial.10,14,24,51 Knee OCD is classified according to anatomical location, surgical appearance, scintigraphic findings, and chronological age and can be further divided into juvenile and adult forms depending on distal femoral physeal maturity.10,14,24,27,51 The majority of cases of adult OCD are thought to be owing to persistence of an unresolved juvenile OCD lesion, although de novo adult OCD lesions have been described.10

Adult OCD lesions have a greater propensity for instability and typically follow a clinical course that is progressive and unremitting. In comparison, juvenile OCD lesions with an intact articular surface have a potential for healing through cessation of repetitive impact loading.12,25,37,56 Both adult and juvenile OCD lesions that do not heal have potential for later sequelae, including premature degenerative joint disease.40,61

Management of juvenile OCD is multifaceted. Nonoperative initial management is indicated for stable lesions in skeletally immature patients.10,12,13,24 Operative treatment is indicated for any detached or unstable lesions in which physeal closure is imminent or completed and nonoperative management has failed.10 The more progressive natural history associated with adult OCD necessitates surgical intervention in most cases.

This article reviews the origins, clinical presentation, diagnostic evaluation, nonoperative management, and operative management of OCD of the knee in both children and adults.

EPIDEMIOLOGY

Although the exact prevalence of OCD is unknown, reports of between 15 and 20 per 100,000 have been made.28,39
Gender differences have also been highlighted, with a preponderance among male patients in a ratio of 5:3. The incidence of this condition has been influenced in recent times by growing participation in competitive sports by children at younger ages across both genders. As a result, the mean age of OCD onset begins to be decreasing, along with an increased prevalence among girls. Moreover, increased acknowledgment of serious knee injuries in the pediatric population and widespread use of MRI and arthroscopy over the past decade have resulted in greater recognition of OCD lesions. Contemporaneous trends in youth sports such as loss of free play, early sport specialization, multiple leagues in a single sport, and intensive training may also be contributing factors.

More than 70% of OCD lesions are found in the “classic” area of the posterolateral aspect of the medial femoral condyle, with inferior-central lateral condylar lesions accounting for only 15% to 20% of cases and femoral trochlear lesions seen in less than 1%. Patellar involvement is uncommon (5%-10%) and is typically located in the inferior-medial area.

ETIOLOGIC CHARACTERISTICS

There has been controversy surrounding the origins of this enigmatic condition since the term osteochondritis dissecans was coined by König in 1887. Although several causes have been postulated, including inflammation, genetics, ischemia, ossification, and repetitive trauma, there remains insufficient evidence to conclusively support any of these causes at present. Furthermore, the overlapping spectrum of osteochondral lesions, the lack of distinction in the literature between adult and juvenile forms of the disease, and the interchangeable and often inappropriate use of terminology contribute to the inconsistency regarding the diagnosis, management, and prognosis of OCD. In addition, typical “idiopathic” OCD must be differentiated from similar-appearing osteochondral lesions resulting from avascular necrosis associated with chemotherapy, hemoglobinopathy, and steroid use.

The potential role of an inflammatory process in the origins of OCD was postulated by König. As with most of the hypotheses regarding the causes of OCD, it was soon disregarded because of the absence of corroborating evidence. Others hypothesized that OCD was owing to an ossification abnormality. Ischemia as a result of blood, fat, and even tuberculous emboli has been proposed as a potential cause of OCD by a number of authors. More recent histopathologic studies, however, have failed to identify either avascular necrosis of the OCD fragment or a relative ischemic watershed of the lateral aspect of the medial femoral condyle. A genetic predisposition to OCD was postulated in 1979 after a report by Mubarak and Carroll of OCD among 12 family members over 4 generations. A later study by Petrie contradicted these results by identifying OCD in only 1 of 86 first-degree relatives. At present, the common form of OCD is thought not to be familial.

There have been many reports in the literature regarding the potential role of trauma (either acute macrotrauma or repetitive microtrauma) in the origins of OCD, particularly because of the increasing prevalence among athletes. Fairbanks suggested in 1933 that OCD was the result of “violent rotation inwards of the tibia, driving the tibial spine against the inner condyle.” Although this theory cannot account for OCD lesions occurring at other sites, the role of repetitive trauma, especially among athletes with OCD, seems valid and has been subsequently supported by a number of experimental studies using animal models. It has been suggested that repetitive trauma may induce a stress reaction resulting in a stress fracture within the underlying subchondral bone. If repetitive loading persists and exceeds the ability of the subchondral bone to heal, necrosis of the fragment may occur and lead to fragment dissection, separation, and nonunion. Supporting the importance of altered mechanics in the origin of OCD, recent reports have described the development of lateral femoral condyle OCD after arthroscopic discectomy of a discolateral meniscus or with other meniscal injury in nondiscoid menisci.

The relationship between adult and juvenile forms of OCD also remains unclear. In some cases, the condition develops in childhood, and the lesion either fails to heal or only becomes clinically apparent after closure of the physes. However, de novo cases arising in adulthood have also been described.

CLINICAL PRESENTATION

The majority of juvenile OCD cases involve stable lesions that ultimately heal without long-term consequence. Presentation is generally non-specific and includes poorly localized knee pain that is exacerbated by exercise, particularly when climbing hills or stairs. In contrast, adults OCD lesions are typically unstable and follow an insidious and unremitting course. The presence of swelling and stiffness and mechanical symptoms such as locking or catching are common in adult OCD and indicate unstable, loose fragments. Incongruity of the joint surface, due to sloughing of loose bodies and subsequent poor healing, predisposes the patient to early-onset degenerative joint disease.

On physical examination, an antalgic gait may be observed with both stable and unstable lesions. On palpation, maximal tenderness can often be elicited over the anteromedial aspect of the knee with varying amounts of knee flexion. This corresponds to the most common site of OCD lesions on the lateral aspect of the distal medial femoral condyle. Pain may be elicited with internal rotation of the tibia (Wilson sign), or an external rotation gait may be observed. However, the Wilson sign was recently found to lack sensitivity in a series of 32 patients with medial femoral condyle OCD lesions, in which 75% had a negative test result. Unstable lesions are distinguishable by the presence of mechanical symptoms, knee effusion, and often crepitus and pain with motion. Atrophy of the quadiceps muscles provides a good indication of how long the lesion has been present. Bilateral involvement is reported in up
Figure 1. The AP (A) and notch (B) radiographs of a juvenile osteochondritis dissecans lesion of the medial femoral condyle. The lesion can be difficult to see on an AP radiograph and is often more apparent on the notch view, which images the posterior aspect of the femoral condyle with the knee flexed.

to 25% of cases; therefore, examination of both knees is important. However, if bilateral disease is present, the lesions are typically asymmetrical in terms of size and symptoms.

DIAGNOSTIC STUDIES

Radiologic imaging is essential in characterizing the OCD lesion, predicting prognosis after nonoperative management, and assessing the ultimate status of the lesion. Because success of nonoperative management can be unpredictable in juvenile OCD, many studies have investigated various OCD imaging protocols. An ideal imaging algorithm would assist the surgeon in distinguishing cases that would benefit from surgical intervention from those that have a high chance of healing with nonoperative management. The application of technetium bone scanning and, more recently, MRI and MR arthrography have been well documented in the literature. To date, however, no single imaging protocol reliably predicts success of nonoperative management.

Plain radiographs are necessary to characterize and localize the OCD lesion in both children and adults, to rule out other bony injury, to evaluate skeletal maturity, and to indicate the age of the lesion. Initial imaging must include AP and lateral views of the knee. As described by Cahill and Berg, lesion location and size can be obtained from the radiograph. Cahill and Berg also noted that in many cases of juvenile OCD, abnormalities on radiographs may be present only on the lateral views. Notch views are also extremely valuable, as they provide visualization of the posterior femoral condyles, which is not possible on the AP view (Figure 1). A skyline view should be added when patellar involvement is suspected. Caution must be taken in children younger than 7 years, as irregularities of the distal femoral epiphyseal ossification center may simulate OCD on plain radiograph. These asymptomatic sites are anatomical variants of normal ossification.

Magnetic resonance imaging is now a routine part of the diagnostic evaluation of OCD. It can accurately estimate the lesion size as well as the status of cartilage and subchondral bone (Figures 2 and 3). Furthermore, it can identify the extent of bony edema, appearance of high signal zone beneath the fragment, and the presence of loose bodies, which are characteristic of OCD lesions (Table 1).

Research to identify specific MRI findings that correlate with the ability of OCD lesions to heal after nonoperative treatment has been the focus of study. De Smet et al described 4 MRI criteria on T2-weighted images: (1) a line of high signal intensity at least 5 mm in length between
the OCD lesion and underlying bone, (2) an area of increased homogeneous signal at least 5 mm in diameter beneath the lesion, (3) a focal defect of 5 mm or more in the articular surface, and (4) a high signal line traversing the subchondral plate into the lesion. Of these signs, De Smet et al.\(^\text{18}\) found that a high signal line behind the fragment was most predictive and was found in 72% of unstable lesions. Pill et al.\(^\text{84}\) attempted to predict success of nonoperative treatment using MRI and clinical criteria. They applied the 4 signs of De Smet et al.\(^\text{18}\) and found the high signal line was the most common sign in patients who failed nonoperative treatment. Lesion size and patient maturity were also important predictors of failure of nonoperative treatment. O'Connor et al.\(^\text{85}\) compared MRI and arthroscopic findings, focusing specifically on prognostic value of the high signal line behind the fragment of De Smet et al.\(^\text{18}\) These authors and others believe this high signal line represents either healing vascular granulation tissue or synovial fluid collected beneath the subchondral bone, implying a break in the articular surface. In this study, investigators improved staging accuracy from 46% to 85% when they interpreted high signal line on T2-weighted images as a predictor of instability only when accompanied by a breach in articular cartilage seen on T1-weighted images.

As a number of studies have demonstrated the limited prognostic value of unenhanced MRI in juvenile OCD, research has been undertaken to assess the value of gadolinium MRI enhancement. Bohndorf\(^\text{86}\) demonstrated that after intravenous gadolinium administration, enhancement of high signal line behind the fragment indicated healing granulation tissue, not synovial fluid. In contrast, Vosstein et al.\(^\text{83}\) showed no correlation between gadolinium enhancement and healing in juvenile OCD cases. Despite these conflicting results, they did agree that lesion size was the main determinant of healing. Although Kramer et al.\(^\text{87}\) did not look at prognostic value in terms of healing, they determined that MR arthrography with gadolinium could reliably show loss of continuity of articular cartilage mantle.

The use of technetium bone scans to assess the healing potential of OCD lesions is well documented in the literature. In 1983, Cahill and Berg\(^\text{13}\) devised a classification system for juvenile OCD based on the appearance of technetium scintigraphy due to the correlation of scintigraphic activity to blood flow and osteoblastic activity (Table 2). They advocated the use of static serial qualitative technetium bone scans every 6 weeks, until evidence of healing occurred.\(^\text{15}\) Unfortunately, the isotopic tracer remains in the affected area for a significant time, even after healing, making interpretation difficult. Nevertheless, Litchman et al.\(^\text{81}\) found that lesions healed spontaneously in a small number of mature patients with OCD who had symptoms
Figure 3. Lateral radiograph (A) and sagittal MRI (B) of a stage 3 juvenile osteochondritis dissecans lesion of the medial femoral condyle. The lesion is clearly demarcated from underlying subchondral bone with apparent anterior separation of the articular surface.

for 2 or more months and had increased blood flow on quantitative technetium scans. Moreover, Paletta et al. reviewed quantitative bone scans in a small series (12 patients) and found that increased activity predicted healing in 100% of patients with open femoral physis but not in adolescents with closing physes. Unfortunately, it is this latter group in whom healing is most difficult to predict. Serial bone scanning has not been widely adopted in the management of OCD lesions, largely because of the time required for the study, need for intravenous access, and perceived risk of the isotope, as well as the emergence of MRI.

On the basis of the literature available to date, the current diagnostic imaging recommendations for OCD include AP, lateral, notch, and skyline radiographs followed by MRI. Although expensive, MRI provides vital information regarding lesion size, status of cartilage and subchondral bone, presence of high signal zone beneath the lesion, extent of bony edema, as well as possible loose bodies or other knee injuries. This information provides a rough guide to prognosis, as smaller lesions with intact cartilage are much more likely to respond to nonoperative treatment, especially in skeletally immature patients. Patients with unstable lesions, loose bodies, torn menisci, or other intra-articular injuries warrant initial arthroscopic evaluation and treatment.

### Table 1

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Small change of signal without clear margins of fragment.</td>
</tr>
<tr>
<td>2</td>
<td>Osteochondral fragment with clear margins but without fluid between fragment and underlying bone.</td>
</tr>
<tr>
<td>3</td>
<td>Fluid is visible partially between fragment and underlying bone.</td>
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<tr>
<td>4</td>
<td>Fluid is completely surrounding the fragment, but the fragment is still in situ.</td>
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<tr>
<td>5</td>
<td>Fragment is completely detached and displaced (loose body).</td>
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### Table 2

<table>
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<tr>
<th>Stage</th>
<th>Description</th>
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<tr>
<td>0</td>
<td>Normal radiographic and scintigraphic appearance.</td>
</tr>
<tr>
<td>1</td>
<td>The lesion is visible on plain radiographs, but bone scans reveal normal findings.</td>
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<tr>
<td>2</td>
<td>The scan reveals increased uptake in the area of the lesion.</td>
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<tr>
<td>3</td>
<td>In addition, there is increased isotopic uptake in the entire femoral condyle.</td>
</tr>
<tr>
<td>4</td>
<td>In addition, there is uptake in the tibial plateau opposite the lesion.</td>
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NONOPERATIVE MANAGEMENT

Because the natural history of stable OCD lesions is generally favorable in a child with open physes, there is widespread agreement that initial nonoperative management is indicated. Cahill reported that 50% of juvenile OCD lesions will heal within a 10- to 18-month period provided the physis remains open and patient compliance is maintained. Although it is now generally accepted that nonoperative management of juvenile OCD is best achieved with a period of altered activity/immobilization, controversy surrounding the therapeutic effects and, more importantly, the duration of immobilization still exists. Authors who focus on subchondral bone argue that the knee should be protected in a cast or knee immobilizer and treated as a fracture. Conversely, authors focused on articular cartilage cite the value of continuous motion for cartilage health. Smillie was the first to suggest that immobilization in patients younger than 15 years should not exceed 16 weeks. Hughston et al later supported this suggestion by demonstrating the detrimental effects of prolonged immobilization, including stiffness, atrophy of the quadriceps, and, potentially, cartilage degeneration.

Immobilization can be successfully achieved in a cast, brace, or standard knee immobilizer. Some authors prefer partial weightbearing in a cylinder cast in slight flexion, as it is thought to allow some compressive forces across the lesion while minimizing shear. A standard knee immobilizer can achieve the same effect but, by allowing bathing and other activities, may enhance compliance among children. Some authors recommend a hinged, unloader-type brace that allows motion. This treatment's efficacy has not been proven, and problems with compliance and expense exist. Further data are needed to determine optimal immobilization protocol.

We advocate a 3-phase nonoperative management protocol. The first phase involves knee immobilization for 4 to 6 weeks with crutch-protected, partial weightbearing gait. At the end of this period, the child should be pain free, and repeat radiographs should be obtained. In phase 2 (weeks 6-12), weightbearing as tolerated is permitted without immobilization. A rehabilitation program is initiated emphasizing knee range of motion and low-impact quadriceps and hamstring strengthening exercises. Sports and repetitive-impact activities are restricted. If there are radiographic and clinical signs of healing at 3 to 4 months after the initial diagnosis, phase 3 can begin. This phase includes supervised initiation of running, jumping, and cutting sports readiness activities. A gradual return to sports with increasing intensity is allowed in the absence of knee symptoms. An MRI may be repeated in phase 3 to assess healing. If symptoms return or follow-up radiographs show lesion recurrence, repeated nonoperative treatment can be considered. Complete resolution of symptoms takes time and patience. Patients may often be noncompliant with avoidance of sports and impact activities. Managing these impatient and frustrated young athletes includes counseling on the risks and benefits of continued nonoperative treatment versus moving on to surgical management, with an emphasis placed on the long-term outcome of the knee.

Figure 4. Arthroscopic image of retrograde transarticular drilling of a stable osteochondritis dissecans lesion of the medial femoral condyle with an intact articular surface.

Compared with juvenile OCD, the adult form typically follows a more unremitting course, and as a result, nonoperative management is rarely indicated. After physeal closure, the capacity for healing reduces dramatically, and the potential for instability and subsequent loosening and detachment of loose bodies is high. In addition, adolescent patients nearing skeletal maturity with closing physes and limited growth remaining have decreased healing ability. Early, aggressive operative management is generally indicated to maintain the articular congruency and integrity of the joint.

OPERATIVE MANAGEMENT

Although patients with juvenile OCD have a capacity for healing, Cahill reported a success rate of only 50% after nonoperative management. Operative treatment should be considered in skeletally immature patients with detached or unstable lesions and in those patients approaching physeal closure whose lesions have been unresponsive to nonoperative management. In contrast, the majority of adult OCD lesions are unstable and the clinical course more deleterious, necessitating early, aggressive surgical intervention.

Both juvenile and adult forms of OCD affect subchondral bone and can secondarily compromise articular cartilage, making healing the subchondral bone sequestrum the aim of treatment. Goals of operative treatment also include maintenance of joint congruity, rigid fixation of unstable fragments, and repair of osteochondral defects. To achieve the latter, an ample supply of surrounding stable articular cartilage and a stable construct of subchondral bone, calcified tidemark, and repair cartilage with viability and biomechanical properties closely resembling those of native hyaline cartilage are needed.

Arthroscopic drilling of juvenile OCD lesions that have failed nonoperative management but remain stable, with intact articular surfaces, has been well documented in the
Figure 5. Lesions of the lateral femoral condyle (A) and trochlea (B) are less likely to heal with nonoperative treatment or arthroscopic drilling than are medial femoral condyle lesions.

literature. The application in adult OCD, however, is less well recognized. The 2 most common techniques used in juvenile OCD, transepiphyseal drilling without articular penetration and transarticular drilling, both aim to create

Figure 6. Unstable osteochondritis dissecans lesion in a patient approaching skeletal maturity treated with (A) arthroscopy, (B) bone grafting, and (C) K-wire fixation (3-month postoperative radiograph).
and all patients were asymptomatic at a mean follow-up of 4 years. Bradley and Dandy\(^6\) performed this technique in patients with OCD lesions in the classic site and noted healing on radiographs and pain relief in 9 of 11 knees within a 1-year period. One knee healed within 2 years, and a nonunion with loose body formation developed in 1 knee.\(^6\) Anderson et al\(^3\) performed transarticular drilling in 17 patients (20 knees) with open physes and in 4 patients with closed physes. In the skeletally immature group, 18 of 20 lesions healed. In the small skeletally mature group, 2 of 4 lesions healed at a mean follow-up of 5 years.\(^3\) Transarticular drilling was performed on 51 knees in 49 patients up to 18 years of age at the Children's Hospital of Philadelphia. Drilling was effective in skeletally immature patients and was curative in 83% of adolescents with open physes, in contrast to 75% of adolescents with closed physes. Factors associated with inadequate healing despite drilling included lesions in nonclassic locations (Figure 5), multiple lesions, and patients with underlying medical conditions. Lesion size was not associated with healing rate.\(^22\) Kocher et al\(^36\) reviewed functional and radiographic outcomes using this technique in 23 skeletally immature patients (30 knees) with lesions at the classic location at a mean follow-up of 3.9 years. There was significant improvement in the mean Lysholm score, and healing on radiographs was achieved in all patients at a mean of 4.4 months after drilling. Younger age was noted to be an independent multivariate predictor of Lysholm score using linear regression analysis.

In cases with unstable lesions, fibrous tissue found between the fragments should be removed. Debridement of significant portions of bone from the fragment and subchondral base of
the lesion should be avoided. If partially unstable lesions have subchondral bone loss, autogenous bone graft is packed into the crater before fragment reduction and fixation (Figure 6). In patients with unstable lesions with subchondral bone attached with an anatomical match between defect and fragment, fixation can be performed by a variety of arthroscopic or open methods. Navarro et al recently reported use of tibial metaphyseal bone strips to treat partially displaced OCD lesions. All 11 patients in their series returned to strenuous activities. Herbert screws and cannulated screws have been used successfully (Figures 7 and 8), with secondary surgeries required for removal.

The presence of loose or unstable fragments in both juvenile and adult forms of OCD necessitates surgical intervention. For intact and congruous loose fragments, this technique typically involves curettage of the femoral defect, drilling, and internal fixation. The use of bioabsorbable screws, pins (Figure 9), and bone and osteochondral plugs is widely reported in the literature. Although positive results have been reported by several authors, this type of surgical intervention is not devoid of complications, which typically relate to biodegradation of the synthetic polymers and host response. Friederichs et al and Sciscia et al in separate reports, noted loosening and failure of bioabsorbable screws that had backed out, causing damage to adjacent articular surfaces, and unabsorbed screw heads found as intra-articular loose bodies. In cases in which the OCD lesion is fragmented or has inadequate bony backing (<2 mm bone), extraction is often the only option. When the lesion has been unstable for a prolonged period and involves a weightbearing area of the knee, prognosis is poor. A variety of techniques have been developed for treatment of large, unsalvageable fragments (Figure 10) in an attempt to replace the defect. Drilling, abrasion arthroplasty, and microfracture methods attempt to recruit pluripotent cells from marrow elements. The recruited cells differentiate primarily into fibrocartilage. Results using these techniques for large lesions may show deterioration with time because of decreased fibrocartilage resilience and stiffness. Aglietti et al believed that fragment removal and crater debridement alone were a viable option, but in adults, a worsening of 1 grade of Fairbanks radiographic changes was found in 45% of patients.
at a mean follow-up of 9 years. Results of this technique were better in lesions less than 2 cm.2,4

Transplanted peristeum with the cambium layer facing the defect has been used to produce a cartilaginous extra-
cellular matrix. Madsen et al.12 studied long-term results of
periosteal transplantation without chondrocyte grafting in
knee OCD. Median patient age was 19 years among the 18
patients studied. Eight patients required reoperation up to
8 years postoperatively.

Transplantation of autologous osteochondral plugs from
nonweightbearing regions of the knee has been used for
defect replacement in skeletally mature patients.6,7
Outerbridge et al.19 reported good short-term results using
osteochondral grafts harvested from the lateral facet of the
patella in 10 adult patients with large femoral OCD lesions;
however, donor site pain may be problematic. Yoshizumi
et al.38 reported successful osteochondral graft treatment of
OCD lesions in 3 skeletally mature patients 18 years of age
and younger, but they noted potential disadvantages of
donor site morbidity and incongruent articular fit.

Autologous chondrocyte implantation has been used
to treat large, isolated femoral defects in skeletally mature
patients without lower extremity malalignment. The lack of
subchondral bone in addition to articular cartilage poses a
technical challenge. Peterson et al.22 reported results of this
treatment of OCD at 2- to 10-year follow-up. Mean patient
age was 26.4 years in the 48 patients treated. Thirty-five
patients had onset of OCD as juveniles. These authors
found integrated nonarticular cartilage repair tissue had
been formed and noted successful clinical results in more
than 90% of patients. Bentley et al.7 performed a prospec-
tive randomized comparison trial and found autologous
chondrocyte implantation had significantly superior out-
comes over autologous plugs for osteochondral defects in
adult knees; however, small numbers of patients with mul-
tiple associated factors may affect interpretation of these
results. Autologous chondrocyte implantation results were
comparable with those in other studies. Mosaicplasty plug
results deteriorated with time. King et al.23 evaluated autol-
gous chondrocyte transplantation for treatment of large
defects in articular cartilage of the distal femur in mature
adolescents and noted short-term outcomes slightly better
than previously reported results in adult patients; however,
longer term results are unknown.

Secondary reconstruction with bone–articular surface
allografts has been successful in patients with major surface
OCD defects. Technical challenges include the logistics of
graft storage, sizing, preparation, and access, often limiting
the technique to specialized centers with expertise. No long-
term results in skeletally immature patients are available,
and further investigation is required.31

SUMMARY

Osteochondritis dissecans of the knee is being seen with
increased frequency in pediatric, adolescent, and young
adult athletes. Early diagnosis and treatment are essential
to optimize outcomes. Stable lesions in skeletally immu-
ner patients should be initially managed nonoperatively,
with an emphasis on activity restriction. Unstable juvenile
lesions and stable juvenile lesions that do not heal with
nonoperative treatment require operative treatment. Most
adult OCD lesions require operative treatment initially
because of limited healing potential with nonoperative
 treatment. Operative treatment depends on the lesion
stage, with options including drilling, fixation, bone
grafting, fragment removal, and chondral resurfacing.

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