

Osteochondritis Dissecans of the Tibial Plateau in Children and Adolescents

A Case Series

Millicent Croman,* MBBCh, Dennis E. Kramer,[†] MD, Benton E. Heyworth,[†] MD, Mininder S. Kocher,[†] MD, MPH, Lyle J. Micheli,[†] MD, and Yi-Meng Yen,^{†‡} MD, PhD

Investigation performed at Boston Children's Hospital, Boston, Massachusetts, USA

Background: Osteochondritis dissecans (OCD) of the knee is a relatively well-known condition, most commonly arising in the femoral condyle. Lesions arising in the tibial plateau are rarely described.

Purpose: To present a case series of OCD lesions of the tibial plateau.

Study Design: Case series; Level of evidence, 4.

Methods: Medical records and diagnostic imaging of patients <20 years of age with confirmed diagnosis of OCD of the tibial plateau from a single institution were retrospectively reviewed. Characteristic and radiographic features as well as details of both nonoperative and surgical management were investigated. Lesion characteristics and treatment outcomes were also analyzed.

Results: A total of 9 lesions were identified in 9 patients (5 females, 4 males) who fit the inclusion criteria. The mean age at diagnosis was 14.2 years (range, 9-17 years). Knee pain (8/9) of longer than 1 year in duration was the most common presenting symptom. All 9 lesions were located on the lateral tibial plateau, and concomitant lateral compartment pathology was present in 5 of 9 patients (4 lateral femoral condyle OCDs, 3 lateral meniscal tears [1 discoid], and 1 discoid meniscus). Only 2 lesions were visible on initial radiographs; all 9 were visible on magnetic resonance imaging. All patients underwent initial nonoperative treatment; 2 patients demonstrated resolution of symptoms. Two patients underwent surgery for concomitant pathology, and the OCD was not addressed surgically. A total of 5 patients continued to be symptomatic after nonoperative treatment, prompting surgical intervention, which consisted of microfracture and chondroplasty in all 5 cases. A total of 2 of the 5 microfracture patients had resolution of symptoms, while another 2 patients had continued symptoms ultimately responsive to steroid injection treatment. One patient had revision microfracture, followed by autologous chondrocyte implantation and an arthroscopic lysis of adhesions. At final follow-up, ranging from 7 months to 10 years, 8 patients were asymptomatic, while 1 patient had developed early osteoarthritis.

Conclusion: OCD of the tibial plateau in young patients is rare, usually involves the lateral side, and may have significant long-term implications for knee function. Presenting symptoms are often vague, and lesions may not always be visible on initial radiographs, which may lead to delayed treatment and adversely affect outcomes.

Keywords: bone lesion; cartilage; knee

Osteochondritis dissecans (OCD) is a condition characterized by an idiopathic, acquired, localized lesion of subchondral bone, which may subsequently involve the overlying articular cartilage. The definitive cause of OCD is still unclear, although several theories regarding the cause have been put forth, including repetitive microtrauma, genetic predisposition, or localized ischemia.^{6,7,10,12,25} While OCD has been historically classified based on somewhat archaic terms such as “juvenile” and “adult” OCD,^{3,13,16,21,24} 1 OCD study group has emphasized the

distinction based on physeal status, with evidence demonstrating that patients with OCD and open physes have better healing rates than those with closed physes.^{3,10,18,28,30}

OCD in skeletally immature patients represents the more common presentation of overall OCD cases, having been reported in 50% to 60% of cases (or higher) within reported series of OCD.^{7,10,12,16,29} Within the knee, 75% of cases are reported on the medial femoral condyle, usually the lateral aspect that represents a watershed area for vascularity. Lateral femoral condylar lesions are approximately half as common as that of the medial femoral condyle, with patellar and trochlear being far less common.^{10,12,13,16,17,21} Despite being an articulating surface within the knee, there have been exceedingly rare case reports of OCD lesions within the

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tibial plateau.^{1,2,9,11,19,23,27,33} Little is known about how tibial plateau lesions may differ from lesions in the femoral condyle.

The purpose of this study was to retrospectively review a series of patients with OCD lesions of the tibial plateau at a single pediatric institution over a 13-year period. The primary goal was to elucidate the clinical outcomes and diagnosis of these rare lesions and to determine complication and reoperation rates, presence of residual symptoms, and ability to return to prior activity levels after operative and nonoperative treatment.

METHODS

After obtaining institutional review board approval, a medical record search was conducted to identify patients with OCD lesions of the tibial plateau who had been seen and treated by providers at a single pediatric tertiary care referral center between January 2003 and July 2016. Inclusion criteria were patients aged 0 to 19 years with diagnosis of OCD lesions of the tibial plateau verified by radiography or magnetic resonance imaging (MRI). The search identified 9 children with a mean age at diagnosis of 14.2 years (range, 9-17 years) and a mean follow-up of 2.5 years (range, 7 months-10 years).

Electronic medical records, including clinic notes, radiographic images, and operative notes, were reviewed for study analysis. Patient characteristics such as age, sex, ethnicity, and body mass index were recorded. Sports participation, presenting symptoms, duration of symptoms, treatment received, healing time after surgery, and time to return to sport or activity were obtained. MRI, computed tomography, and plain radiographs were reviewed for coexisting pathology.

A total of 5 patients underwent operative treatment exclusively for their OCD. These patients underwent standard knee arthroscopy under tourniquet. During arthroscopy, the lesion was assessed and treated on the basis of its arthroscopic appearance, which in each case involved chondroplasty, debridement of the calcified cartilage layer, and microfracture of the lesion. Postoperatively, patients were placed in a hinged knee brace and made partial weightbearing for 6 weeks. A continuous passive motion machine was used. A physical therapy program was instituted at 2 weeks after surgery, which focused on quadriceps, hamstring, and hip abductor strengthening utilizing resistance bands and eventually weights. Return to activity was contingent on lesion

TABLE 1
Patient Demographics

Total patients (total affected knees)	9 (9)
Females, n (% of 9 patients)	5 (55)
Males, n (% of 9 patients)	4 (45)
Affected knee, n (% of 9 patients)	
Right	3 (33)
Left	6 (67)
Body mass index, kg/m ² , mean ± SD (range)	22.9 ± 6.1 (14.4-36.2)
Age, y, mean ± SD (range)	14.2 ± 2.8 (9-17)
Symptom duration, n (% of 9 patients)	
0-6 months	3 (34)
7-12 months	1 (11)
13+ months	5 (55)
Symptom, n (% of 9 patients)	
Knee pain with or without joint line tenderness	8 (88)
Swelling	4 (45)
Clicking/locking	2 (22)
Tibial plateau physis, n (% of 9 knees)	
Open	4 (45)
Closed	5 (55)

healing on follow-up radiographs or MRI and symmetric range of motion and strength and functional testing, which were performed by the physiotherapist.

RESULTS

A total of 9 OCD lesions on the tibial plateau in 9 patients were identified from a review of 443 medical records for patients with OCD of the knee (2% overall). Characteristics of the study cohort (4 males, 5 females) are summarized in Table 1. A total of 6 of 9 patients participated in organized sports (3 played basketball, 1 played ice hockey, 1 played football, and 1 swam competitively). A total of 2 lesions were evident on radiographs, while all lesions were seen on MRI. All 9 lesions were located on the lateral tibial plateau. A high percentage of concomitant knee pathology in the lateral knee was identified, including 4 cases of OCD of the lateral femoral condyle and 5 cases of abnormalities of the lateral meniscus (Table 2). Table 3 shows a breakdown of the specific location within the tibial plateau and sizes of the lesions. A total of 6 OCD lesions were on the left while 3 lesions were on the right. Lesion size ranged from 8 × 15 mm to 25 × 25 mm. The largest lesions tended to be found on the central portion of the lateral tibial plateau.

†Address correspondence to Yi-Meng Yen, MD, PhD, Department of Orthopaedic Surgery, Boston Children's Hospital, 300 Longwood Avenue, Boston, MA 02115, USA (email: yi-meng.yen@childrens.harvard.edu).

*Department of General Surgery, Case Western Reserve, Cleveland, Ohio, USA.

†Department of Orthopaedic Surgery, Division of Sports Medicine, Boston Children's Hospital, Boston, Massachusetts, USA.

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Ethical approval for this study was obtained from Boston Children's Hospital Institutional Review Board (protocol No. IRB-P00029974).

Figures 1 and 2 show OCD lesions of the tibial plateau seen on radiographs and MRI, respectively.

A total of 2 patients underwent nonoperative treatment exclusively, 2 patients underwent surgical treatment for a concomitant knee issue (1 for patellar instability and 1 for a discoid meniscus) in which the OCD was not specifically addressed (both OCDs were <10 mm in size), and 5 patients underwent surgical treatment after failing nonoperative

TABLE 2
Knee Pathology^a

Concomitant Knee Pathology	Patients, n
OCD lesion—lateral femoral condyle	4
Lateral meniscal tear	3
Lateral discoid meniscus	2
Recurrent patellar instability	2
OCD lesion—lateral patellar facet	1

^aOCD, osteochondritis dissecans.

TABLE 3
OCD Linear Characteristics^a

Location of Lesion	Patients, n (Lesion Size)
Central portion of lateral tibial plateau	3 (25 × 25 mm, 14 × 15 mm, 12 × 6 mm)
Lateral portion of lateral tibial plateau	5 (510 × 12 mm, 10 × 6 mm, 16 × 16 mm, 10 × 13 mm, 11 × 17 mm)
Medial portion of lateral tibial plateau	1 (8 × 15 mm)

^aOCD, osteochondritis dissecans.

treatment consisting of rest, physical therapy, and lateral unloader bracing (ranging from 2 months to 2 years). In the 5 patients for whom surgery was performed primarily for the OCD, arthroscopic findings consisted of 3 patients with unstable osteochondral fragments not amenable to fixation and 2 patients with Hefti stage V lesions, also classified as “craters” or gross osteochondral defects. Arthroscopic microfracture and chondroplasty were therefore pursued in all 5 cases (Figure 3). Although all 9 patients were able to return to activity/sports, the length of time varied widely. Patients who underwent operative OCD treatment returned to activity between 3 and 12 months, while nonoperative patients ranged from 3 to 6 months. One patient treated nonoperatively had a follow-up MRI that showed resolution of the OCD 1 year later.

One of the 5 patients treated surgically for the OCD, a 16-year-old female with a lateral 11 × 7 mm lesion, returned to sports but had continued symptoms and radiographic lucency of the plateau, prompting revision microfracture 1 year postoperatively. Despite improvement for approximately 5 years, worsening symptoms prompted arthroscopic removal of loose bodies and cartilage biopsy approximately 6 years later, followed by autologous chondrocyte implantation surgery. The autologous chondrocyte implantation surgery was complicated by arthrofibrosis that was treated with an arthroscopic lysis of adhesions 6 months later. Three other patients underwent repeat knee arthroscopy for only concomitant knee pathology (meniscal retear or discoid meniscal revision). A total of 2 patients with continued knee pain after surgical treatment of their OCD underwent steroid injection treatment, which was associated with significant improvement and return to activity.

The mean length of follow-up for this group was 46 ± 34 months (range, 7-120 months). At the latest follow-up, 8 patients reported no symptoms and were able to return

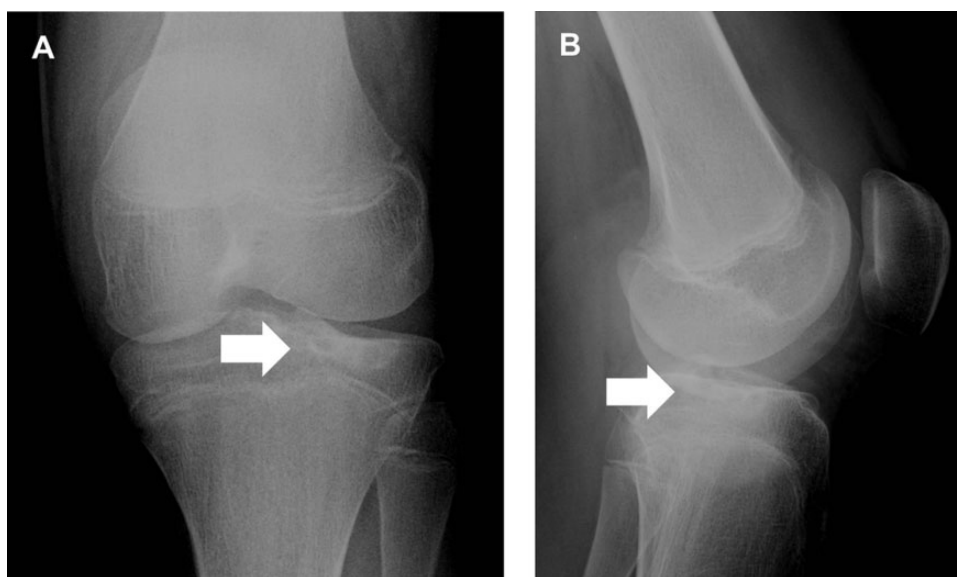


Figure 1. (A) Anteroposterior and (B) lateral radiograph of a patient with lateral tibial plateau OCD; arrows indicate the osteochondritis dissecans.



Figure 2. (A) Coronal T1 magnetic resonance imaging of the same patient presented in Figure 1. (B) Sagittal T2 image, Hefti stage III lesion.

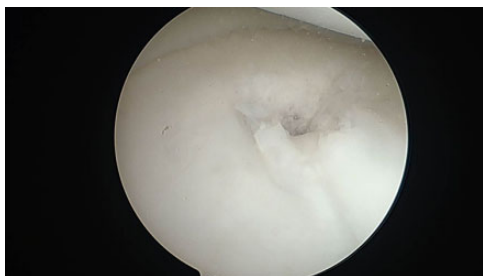


Figure 3. Intraoperative image of chondral injury of a tibial plateau osteochondritis dissecans lesion. The lesion was subject to microfracture.

completely to activity. One patient developed osteoarthritis of the knee but reported improved knee pain. This patient likely had an underlying undiagnosed genetic disorder as the patient developed osteoarthritis of the contralateral knee.

DISCUSSION

Most of the literature investigating OCD of the knee has focused on OCD lesions of the femoral condyles. These

studies^{4,12,13,15,16,32} have provided the characteristic data demonstrating that OCD lesions are more common in male patients and occur bilaterally in up to approximately 40% of patients. The current retrospective case series of 9 patients with tibial plateau OCD elucidated several features that are distinctive from condylar lesions, in that plateau lesions demonstrated a nearly equal distribution in sex, required diagnosis largely through MRI rather than radiographs, and necessitated chondral resurfacing techniques or salvage operations at the time of surgery rather than the drilling or fixation techniques more common to condylar OCD.

All 9 lesions in our series were found on the lateral tibial plateau. This is consistent with prior case reports^{1,2,9,11,19,27} of tibial plateau OCD, which has been reported almost exclusively on the lateral side, with only 1 known case report on the medial tibial plateau in an adult patient.³³ Of the 9 patients included in the current series, 8 patients had concomitant knee pathology. The most common concomitant lesion was an OCD of the lateral femoral condyle, followed by a lateral meniscal tear or discoid lateral meniscus. It is unknown whether these concomitant pathologies contributed to the development of the tibial plateau OCD, or perhaps whether the OCD had a causative role in the concomitant pathology. Several studies^{8,20,26} have described an association between a discoid lateral meniscus and OCD lesions of the lateral femoral condyle. A discoid meniscus or meniscal tear may alter the distribution of forces on the tibial plateau, which could be a contributory factor in the genesis of the plateau OCD.

The main presenting symptoms of OCD lesions in the pediatric or adolescent knee are typically nonspecific activity-related knee pain, with or without mechanical symptoms such as locking or catching.^{5,10,12,15,25,31} The current case series reported similar findings, with 8 of 9 patients reporting nonspecific knee pain and 2 patients reporting mechanical symptoms. The mechanical symptoms, however, may be attributed to the concomitant meniscal pathology. Among the study patients, the OCD of only 2 patients, who had the largest OCD lesions, was visible on radiographs. However, all 9 had OCD lesions detectable on MRI. This presentation is somewhat similar to OCD lesions of the trochlea and patella, in which they are frequently missed on plain radiographs.^{17,22} This may contribute to the delay in the diagnosis of these lesions. MRI clearly appears to be the most useful modality to characterize tibial plateau defects.

While nonoperative treatment was attempted for all of the lesions initially, only 2 patients were ultimately successfully treated in this manner. One patient with meniscal pathology and 1 patient with patellar instability were taken to surgery for their meniscus and patella, respectively, and the OCD was not addressed surgically because of an intact chondral surface and the small size and location of the lesion. These 2 patients went on to heal the OCD “nonoperatively,” although healing may have been related to postoperative restrictions. In addition, repeat MRI was only obtained in 1 case, so while the lesions remained asymptomatic, we cannot confirm that both completely resolved. In the 5 lesions that were treated operatively, all

TABLE 4
Tibial Plateau OCD Case Reports^a

Case Report	Treatment Described
Gothman and Nordstrom ¹¹ (1954)	Arthrotomy and excision of OCD lesion
Michiels ¹⁹ (1989)	Arthrotomy and removal of loose body (without drilling of lesion)
Deroussen et al ⁹ (2014)	Nonoperative: activity modification, abstinence from sports for 1 year
Abrams et al ¹ (2013)	Diagnostic arthroscopy, calcium phosphate injection into lesion
Towbin et al ²⁷ (1982)	Arthrotomy with excision of the lesion
An et al ² (2017)	Arthroscopy with combination retrograde osteochondral autograft procedure

^aOCD, osteochondritis dissecans.

were unstable on arthroscopic assessment, with chondral damage or loss, which differs from most studies^{14,28} on OCD of the femoral condyles but is similar to the trochlear and patellar lesions, which are more likely to be associated with instability and more advanced chondrosis.¹⁷ This may be related to the relative delay in diagnosis seen with these lesions, as well as the unique anatomy or subchondral vasculature of the tibial plateau. Tibial plateau lesions tend to be shallower in the subchondral bone than the classic condylar lesion and unstable on MRI. All of these lesions were treated with some combination of removal of loose bodies, curettage of the lesion, chondroplasty, and, in all cases, microfracture of the area. One patient required multiple operations after the index procedure, including autologous chondrocyte implantation, and another patient developed significant osteoarthritis (which may be because of an underlying genetic disorder), but was relatively pain-free. Previously reported treatments^{1,2,9,11,19,27} for lesions of the tibial plateau found in case reports in the literature are summarized in Table 4. Of the 5 case reports that reported outcomes, all patients eventually reported being asymptomatic and were able to return to activity between 2 months and 1 year postsurgically.

The limitations of the current study include its retrospective design, variable use of follow-up imaging, and limited follow-up in a subset of the cohort. As this was a retrospective review, some tibial plateau OCD lesions may have been missed or asymptomatic. While variable treatment protocols by different surgeons were undertaken, this is likely reflective of the larger noninstitutional population of surgeons who may encounter this rare entity and therefore may make the findings more generalizable than if a single technique had been investigated for different presentations of tibial plateau OCD. Finally, there were no postoperative patient-reported functional outcome measures, which would have provided a more consistent picture of long-term natural history after treatment of the condition. However, the current study represents the only case series of this rare form of OCD that may exist. Because these lesions are often missed on plain radiographs and may have serious implications, enhancing awareness of the condition and its unique features is critical to our comprehensive

understanding of OCD overall and the general health of adolescents. In this series, lesions exclusively occurred on the lateral tibial plateau and were highly associated with concomitant lateral joint pathology. Many of the patients had a delay in diagnosis, resulting in a high rate of intraoperative instability requiring more advanced techniques than is typical of OCD in children and adolescents. Arthroscopic intervention, when necessary, may alleviate symptoms, although larger lesions may eventually require cartilage resurfacing techniques. A high degree of suspicion and perhaps earlier advanced imaging may be warranted.

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