Current Concepts Review

JOURNAL OF CHILDREN'S ORTHOPAEDICS

Journal of Children's Orthopaedics
2023, Vol. 17(1) 54–62

DOI: 10.1177/18632521231152269
journals.sagepub.com/home/cho

Osteochondritis dissecans of the knee in adolescents: How to treat them?

Joao Cabral[1]*, and Julio Duart[2]*

Abstract

Background: Osteochondritis dissecans is an acquired condition of the joint that affects the articular surface and the subchondral bone. The juvenile form of osteochondritis dissecans presents in those aged 5–16 years with open growth plates. The causes of osteochondritis dissecans are unknown.

Methods: The goals of treatment are to promote healing of the subchondral bone and prevent chondral collapse, subsequent fracture, osteochondral defect formation, and early joint degeneration. Treatment modality is influenced on clinical symptoms, skeletal maturity, as well as the size, stability, and location of the lesion. This article will review the treatment strategies of juvenile form of osteochondritis dissecans of medial femoral condyle and of atypical regions, such as lateral femoral condyle, patellofemoral joint, and tibial plateau.

Level of evidence: level III.

Keywords: Juvenile osteochondritis dissecans, knee, pediatric

OCD of medial femoral condyle: surgical strategies

Osteochondritis dissecans (OCD) is an acquired condition of the joint that affects the articular surface and the subchondral bone. The term OCD was first described by Konig in the late 1880s, as an inflammation of the bone cartilage interface.[1] The most commonly affected joint is the knee, followed by the ankle, elbow, shoulder, and hip. The juvenile form of the disease (JOCD) presents in those aged 5–16 years with open growth plates. The causes of OCD are unknown; however, repetitive trauma, inflammation, accessory centers of ossification, ischemia, and genetic factors have been proposed.

The goals of treatment

The goals of treatment are to promote healing of the subchondral bone and prevent chondral collapse, subsequent fracture, osteochondral defect formation, and early joint degeneration.

Treatment modality is influenced on clinical symptoms, skeletal maturity, as well as the size, stability, and location of the lesion.[2,3]

The authors' preferred treatment algorithm for OCD, base don this goals (Figure 1).

Treatment decisions

Conservative treatment should be the primary approach for stable JOCD of the knee.

Most authors recommend at least 3–6 months before the decision for surgical treatment.[2,3]

Non-operative treatment options include: immobilization (casting, bracing, splinting, and unloader brace); limited weight-bearing; and activity restriction.

There is controversy regarding the duration and timing of these interventions.

[1]Serviço de Ortopedia Pediátrica, Hospital Pediátrico—Centro Hospitalar e Universitário de Coimbra, EPE, Coimbra, Portugal
[2]Complejo Hospitalario de Navarra, Pamplona, Spain

*Both authors contributed equally.

Date received: 16 Dcember 2022; accepted: 18 December 2022

Corresponding Author:
Joao Cabral, Serviço de Ortopedia Pediátrica, Hospital Pediátrico—Centro Hospitalar e Universitário de Coimbra, EPE, Avenida Afonso Romão, 3000-602 Coimbra, Portugal.
Email: cabral.joao@gmail.com

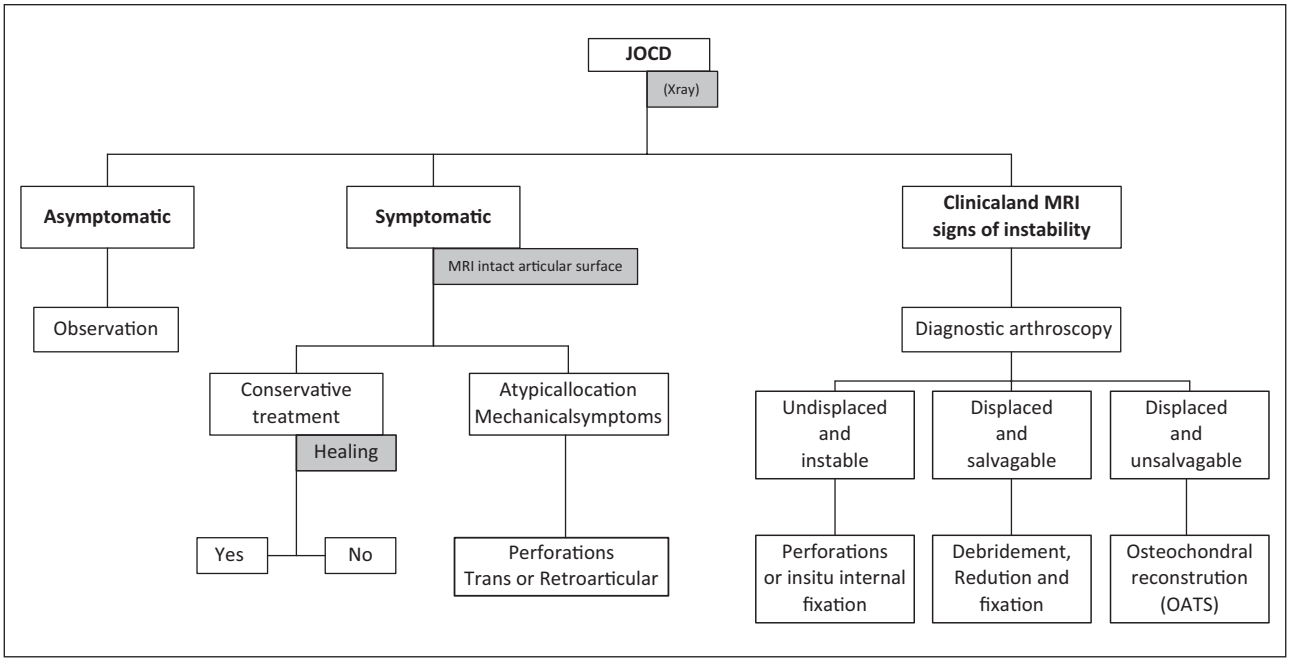

Figure 1. Authors' preferred treatment algorithm for JOCD of the knee.

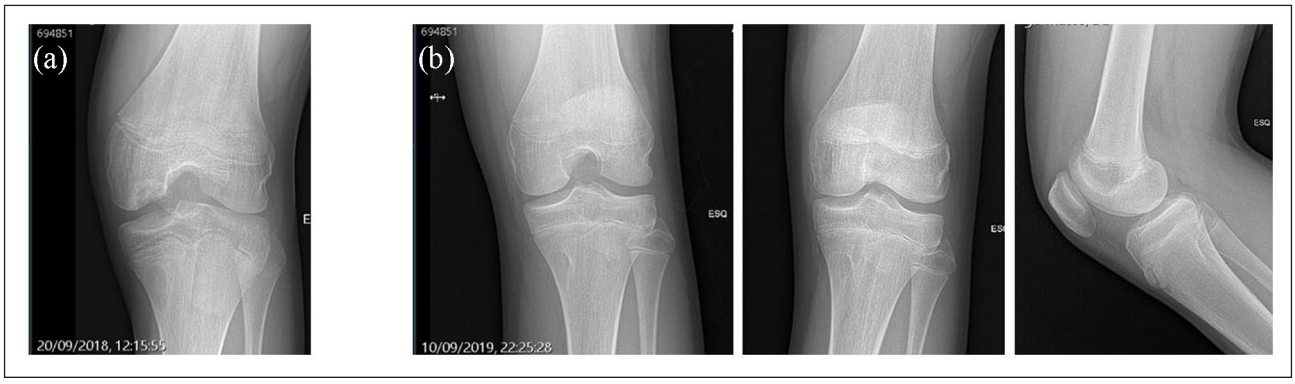

Figure 2. (a) Inicial OCD lesion of the medial femoral condyle and (b) 10 months after conservative treatment with complete healed X-ray lesion site.

We recommend the three-phase non-operative management protocol described by Kocher et al.[4]

The first phase involves knee immobilization for 4–6 weeks with crutch-protected, partial weight-bearing 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), weight-bearing as tolerated is permitted without immobilization. A rehabilitation program is initiated emphasizing knee ROM 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 3–4 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 (Figure 2). A magnetic resonance imaging (MRI) is repeated in phase 3 to assess healing.

Results

Approximately 50%–67% of JOCD lesions heal in 6–12 months with non-operative treatment and thus do not require surgery.[5–9]

Lesions in atypical locations, such as the non-weight-bearing portion of the lateral femoral condyle (LFC), are more likely to be unstable and associated with lower healing rates with non-operative treatment.[8]

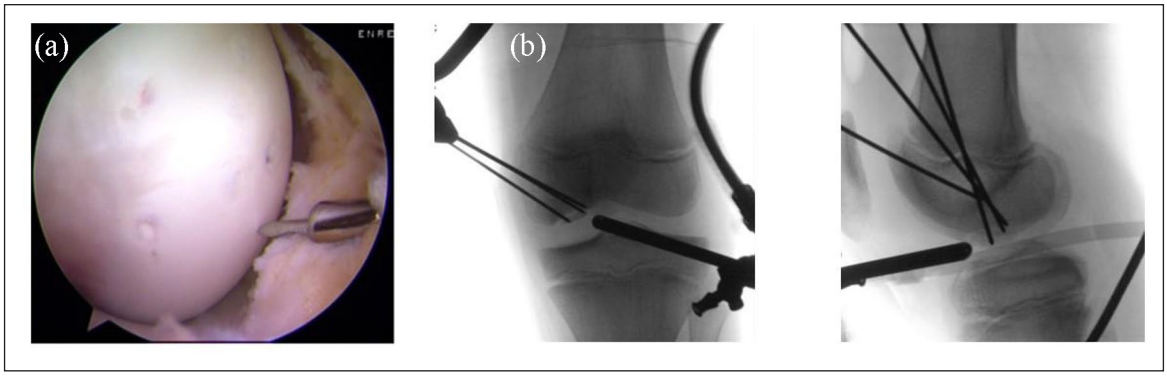

Figure 3. (a) Transarticular drilling with arthroscopic support and (b) retroarticular drilling with arthroscopic and fluoroscopic support.

Similar findings have been found in the patellofemoral location.[8]

Other authors have reported that presenting symptoms of effusion or mechanical features, larger lesion size, and the presence and extent of sublesional sclerosis on radiographs are predictive of nonhealing at 6 months.[10,11]

Return to full activity is allowed after complete re-ossification is demonstrated on X-ray.

The goals of surgical treatment

Surgical treatment is suggested in stable (immobile) lesions not responding to an initial course of non-operative therapy and in unstable (mobile) lesions.

Symptomatic and stable OCD that fails to heal with non-operative treatment may require perforations.

Unstable OCD may require fixation of the fragment.

Detached fragment may require microfractures (MFs)/AMIC/mosaicplasty.

Treatment decisions

Arthroscopy is now the main method used for the surgical treatment of OCD. The initial exploration will guide the therapeutic decisions—assessing instability.

However, the use of MRI is mandatory, given its greater sensitivity. It allows the treating surgeon to evaluate location, surface area, and depth of the lesion.

Instability criterias that we must take into account include high signal-intensity line, fluid extending to the articular surface, cyst beneath the lesion and focal articular defect.

Perforations

Drilling is thought to disrupt the sclerotic margin of the lesion and consequently promote healing via growth factors released from healthy underlying cancellous bone.

Arthroscopically confirmed stable JOCD lesions can be drilled either transarticular or retroarticular[12] (Figure 3).

Transarticular drilling is performed during arthroscopy. The lesion is usually identified based on its grayish or yellowish color, demarcation, and/or softer consistency upon probing, compared to the adjacent white cartilage. A Kirschner wire 1.2–1.5 mm in diameter is used, with a low-speed power drill. A cannula is useful for directing the pin, protecting the soft tissues, and pre-determining the depth of the drill hole (usually 20 mm). A total of 5 to 10 drill holes are created by switching between the antero-medial and antero-lateral portals.

Postoperatively, patients are maintained without weight-bearing by the use of crutches for 4 to 6 weeks.

Sports activities can be resumed after 3 to 6 months depending on the postoperative course.

The drawbacks of this technique include violation of the normal surface cartilage, we do not actually see the K-wires passing through the entire lesion, uncertain long-term implications for joint surface damage created by articular cartilage drill sites, and far posterior condylar lesions may be difficult to access.

Retroarticular drilling

Retroarticular drilling involves inserting a pin into the epiphysis under fluoroscopy guidance, from the outside to the inside of the knee, without entering the joint cavity. A parallel wire guide is then inserted to guide the other drillings.

This technique spares the articular surface and physes by drilling through the affected condyle.

Risks include soft-tissue injury, fragment mobilization, and incomplete perforation of the lesion. Retroarticular drilling is technically more challenging, surgical time is prolonged, and fluoroscopic guidance is needed.

Postoperatively, patients are maintained without weight-bearing by the use of crutches for 4–6 weeks.

Sports activities can be resumed after 4–6 months depending on the postoperative course (Figure 4).

Results

High rates of healing with low complication rates have been reported in juvenile OCD using either transarticular or retroarticular drilling modalities.[13]

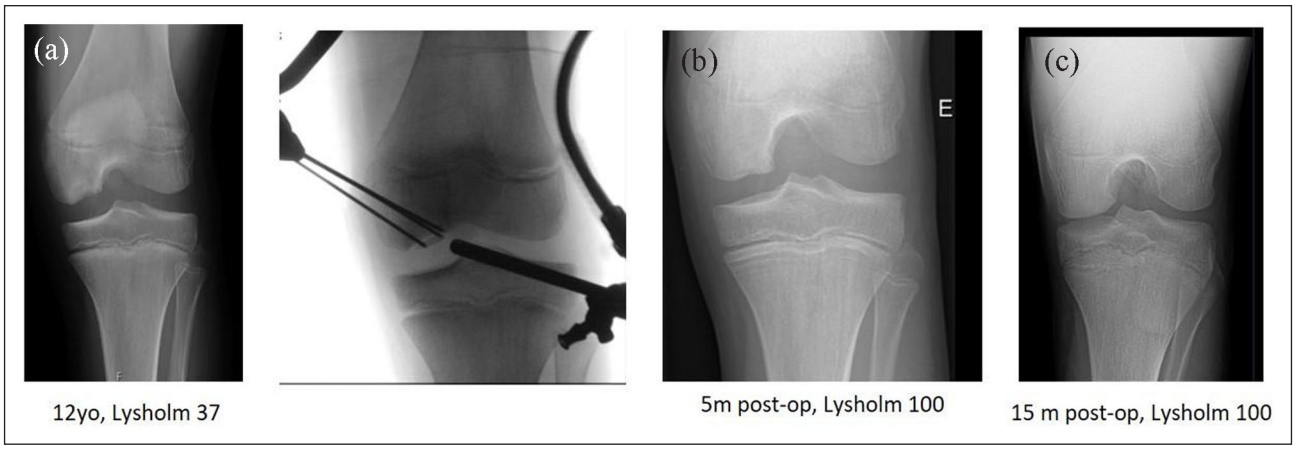

Figure 4. (a) Retroarticular drilling in a 12-year-old patient with medial femoral condyle OCD lesion and a Lysholm of 37, (b) 5 months post-operative already with no funcional impairment and Lysholm of 100, and (c) 15 months post-operative with a complete healed X-ray lesion mantaining a Lysholm of 100.

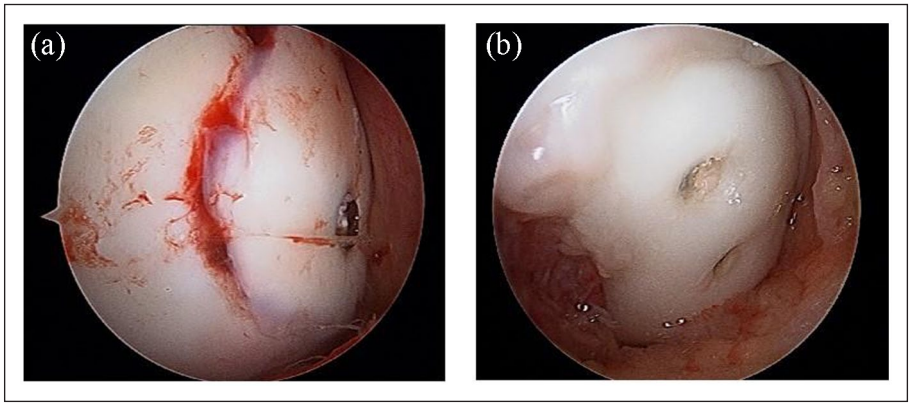

Figure 5. (a) Metalic implants and (b) absorbable implants.

Surgical treatment for stable lesions with intact articular cartilage involves drilling the subchondral bone aiming to stimulate vascular ingrowth and subchondral bone healing.

Fixation of the fragment

Unstable OCD or loose but intact fragments with macroscopically normal surface cartilage and a layer of subchondral bone will require fixation of the fragment.

This can be achieved with the use of metalic implants, absorbable implants, autologous osteochondral plugs or hybrid fixation combining metallic screws and osteochondral plugs (Figure 5).

Osteochondral reconstruction

When the fragment is too severely damaged to be repositioned and fixated or if the fragment is detached and cannot be visualized, osteochondral reconstruction is indicated. Before treatment it is imperative to evaluate the location, surface area, and depth of the lesion by MRI and arthroscopically.

The options may be as follow:

MFs—Serve to stimulate the generation of fibrocartilage, which can fill defects of up to 4 cm^2. The outcomes are satisfactory in the short term but may deteriorate over time.

Autologous matrix-induced chondrogenesis (AMIC)—A biological membrane can be placed over the site of MF and cancellous bone grafting to enhance chondrogenesis. The mesenchymatous stem cells released by the bone marrow through the MFs concentrate under the membrane, within the defect (Figure 6).

Mosaic osteochondral transplantation—Can be used for defects of up to 4 cm^2 but is ideally used for defects smaller than 2 cm^2. Osteochondral plugs are placed in a mosaic arrangement to fill the defect. The limitations include articular congruence of the plugs and donor site morbidity (Figure 7).

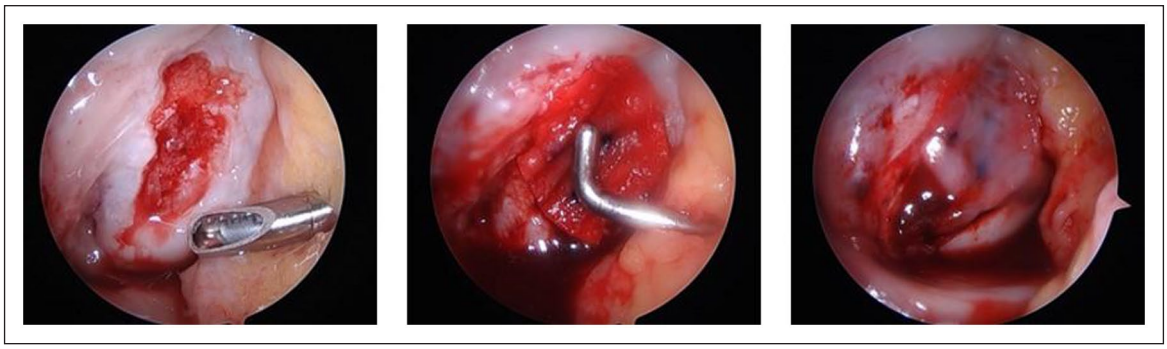

Figure 6. Autologous matrix-induced chondrogenesis (AMIC) on an internal femoral condyle.

Figure 7. Mosaic osteochondral transplantation on an internal femoral condyle.

Each technique demonstrated a significant post-surgical improvement in clinical outcome scores. However, MF demonstrated poorer outcomes in larger lesions ($>3\,cm^2$) and shorter durability.[14]

OCD in atypical locations

The characteristics of the OCD in the knee are not uniform and that they vary according to the location, the patient's age, the activity level of the patient, and the duration of its presence. According to the latest research from the ROCK group, OCD affects the LFC in 18%, the trochlea in about 10%, the patella in 6%, and the tibial plateau in less than 1%.[15]

Treatment recommendations have already been discussed in this article, and some algorithms have been published.[16] It is important to remember that most of the available scientific evidence and treatment recommendations are established for injuries that affect the medial condyle.[17]

Several authors have attempted to describe clinical and radiographic predictors of successful non-operative treatment. Wall studied whether patient age, lesion size, lesion location, presenting knee symptoms, and sex predict the healing status after 6 months of a standard protocol of non-operative treatment for stable juvenile OCD of the knee. They observed that in two-thirds of immature patients, 6 months of non-operative treatment that includes activity modification and immobilization results in progressive healing of stable OCD lesions. Lesions with an increased size and associated swelling and/or mechanical symptoms at presentation are less likely to heal. Based on this study, they have designed a nomogram to predict the likelihood of OCD healing based on the quantitative size and qualitative symptoms of the lesions.[10]

Krause studied the healing preditors of stable juvenile OCD knee lesions after 6 and 12 months of non-operative treatment and found that the healing outcomes were related to lesion width, patient age, and the size of cyst-like lesions deep.[5]

Samora have reported that lesions in atypical locations are more likely to be unstable and associated with lower healing rates with non-operative treatment.[8]

LFC

OCD of the LFC may be related to axis abnormalities[18] and the presence of a discoid meniscus.[19] Therefore, it is convenient to assess these two entities in the context of a lesion in this location.

Takigami observed that concurrent OCD was found in 22 of 152 knees with discoid lateral meniscus. Male sex, young age, and having a type C meniscal shift of the discoid lateral meniscus as shown by MRI were found to be predictive factors for OCD of the LFC.[20]

A majority of patients with juvenile OCD in the LFC could be managed with conservative treatment. The presence of discoid meniscus and longer time period from onset to consultation were significantly related with poor prognosis.[21]

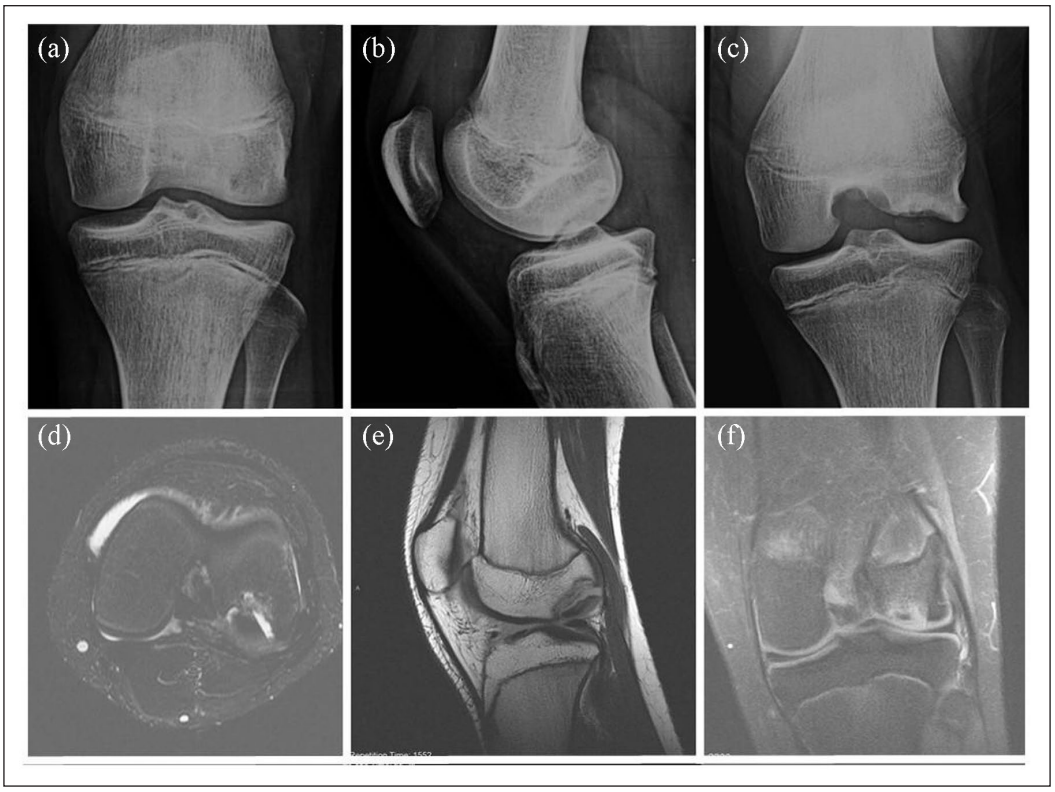

Figure 8. Thirteen-year-old female patient, an amateur handball player consulted knee pain in the lateral region for months. On examination, she had pain in the posterior region of the knee, multiple episodes of effusions. In the radiological study, we can observe a lesion in the lateral femoral condyle (a–c). The MRI of the knee showed signs of instability (d–f).

LFC OCD lesions of the knee in weight-bearing and non-weight-bearing zones presented similarly at initial evaluation. Non-weight-bearing lesions demonstrated higher rates of progeny bone formation and radiographic healing at mean 2-year follow-up.[22]

Instable lesions may need surgical treatment to address the lesion site, taking into account the lesion site, the fragment and the lesion stability (Figures 8 and 9).

Patellofemoral joint

Regarding patella lesions, several classic series were described in the last decades of the last century[23]—as well as techniques to stabilize these lesions, some case reports and technical contributions have been published.[24,25]

The femoral trochlea has also been studied, first with several cases reports.[26–29] Wall et al.[9] evaluated trochlear groove OCD lesions in 24 knees in 21 adolescents Half of the knees treated non-operatively and two treated operatively showed radiographic signs of healing with patients returning to full activity without pain. Various surgical approaches have been described (drilling, fixation, MF, drilling with subsequent delayed MF, and drilling with fixation) with approximately 67% success. Interestingly, the patients treated by drilling with fixation did not show signs of healing, a delay in diagnosis has been observed, which could explain the high rates of instability.

Price et al.[30] found a significant association between pediatric athletes who play basketball and soccer and the development of trochlear JOCD, suggesting that repetitive loading of the patellofemoral joint may play a role in the development of JOCD lesions. Patients with trochlear JOCD lesions were likely to undergo surgery, and repair and fixation of the lesions produced good outcomes at short-term follow-up.

Internal fixation of lateral trochlear groove OCD with simultaneous lateral retinacular lengthening in adolescent athletes achieved satisfactory clinical and radiological outcomes. Therefore, this combined surgical technique could be considered an effective treatment for lateral trochlear groove OCD, with a high rate of return to sport[31,32] (Figures 10 and 11).

Kramer suggested that OCD of the patellofemoral joint is a rare entity. Diagnosis is often delayed and prolonged duration of symptoms is common. These lesions commonly occur on the trochlea and are seen mostly in skeletally immature patients. A high rate of intraoperative lesion instability was noted. Surgical treatment produces a high rate of satisfaction and ability to return to sports. Female

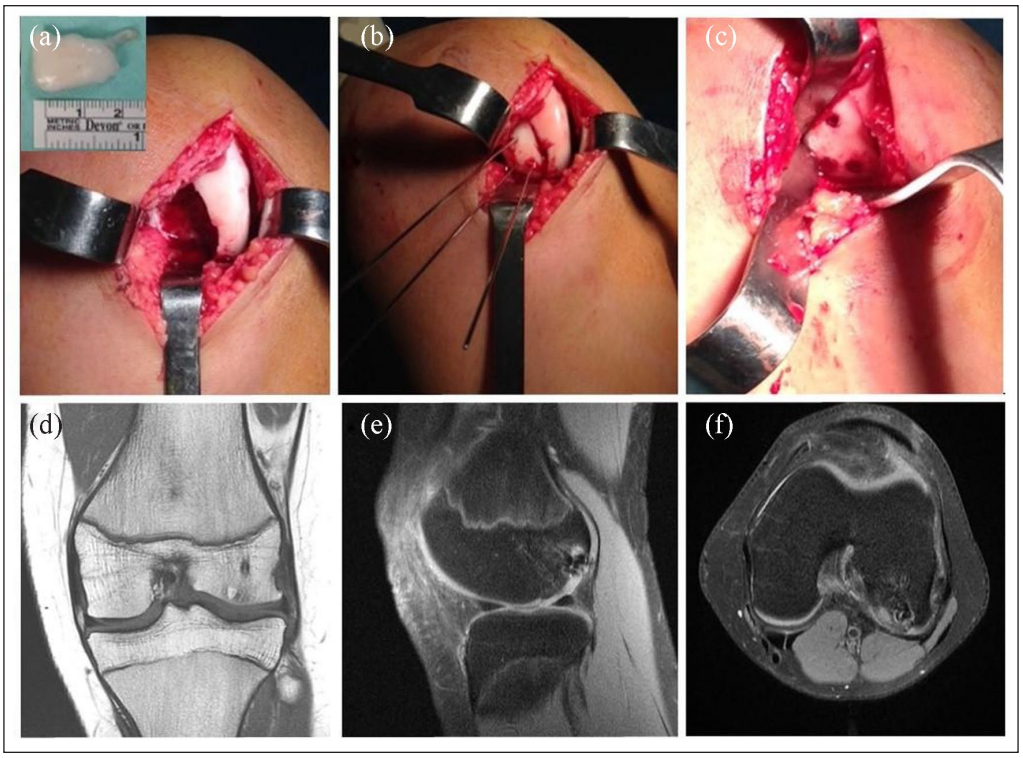

Figure 9. During the surgery, a crater-type lesion was observed with the detached fragment, a loose body was found (a), after preparing the surface, the fragment was fixed with poly L-lactic acid (PLLA) headless screws (b, c). Six months after the intervention, the patient presented clinical and radiological signs of healing (d–f).

Figure 10. Thirteen-year-old female patient, an amateur basketball player consulted anterior knee pain for months. On examination, she had pain in the patellofemoral joint and block episodes. In the radiological study, we can observe a lesion in the medial facet of the patella (a–c). The MRI of the knee showed signs of instability (d–e).

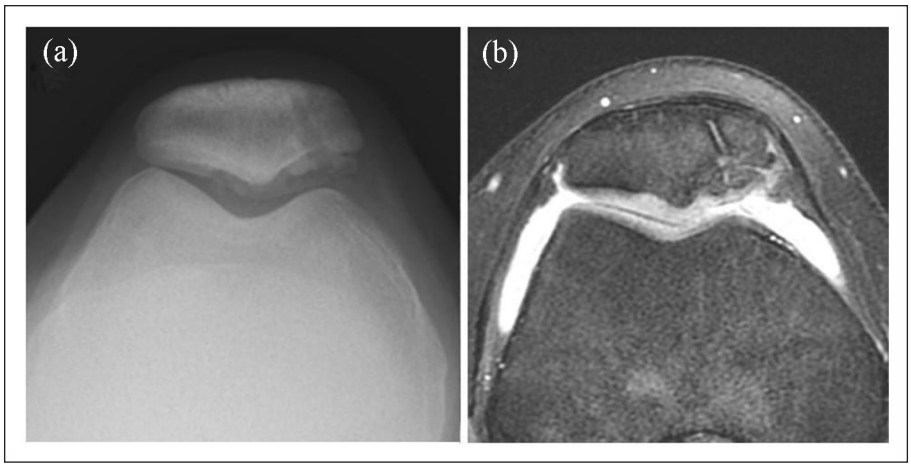

Figure 11. During surgery, a "trap door" lesion was observed. The lesion was fixed with poly L-lactic acid (PLLA) headless screws. Six months after the intervention, the patient presented clinical and radiological signs of healing (a, b).

sex, prolonged duration of symptoms, and treatment with internal fixation may be associated with a poorer outcome.[33]

OCD tibial plateau

Croman et al.[34] presented nine cases with different therapeutic options OCD of the tibial plateau. Knee pain of longer than 1 year in duration was the most common presenting symptom. All lesions were located on the lateral tibial plateau, and concomitant lateral compartment pathology (OCD of femoral condyle, meniscal tears and discoid meniscus). Two lesions healed with conservative treatment and five continued to be symptomatic after non-operative treatment, prompting surgical intervention (MF and chondroplasty), only two of then demonstrated healing of the lesion, two responded to steroid injection treatment and one patient had revision MF, followed by autologous chondrocyte implantation and an arthroscopic lysis of adhesions. They conclude that OCD of 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.

Conclusion

The treatment should be determined based on the stage of the lesion. Restricting sports activities is often sufficient to ensure healing in patients with open physes. Fixation is required if the lesion is unstable by MRI or arthroscopy. Mosaic osteochondral transplantation is a technique of choice. Follow-up must be provided until complete radiographic healing of the lesion.

Data availability

Data availability is not an applicable issue in this systematic review without any patient series.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical statement

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. According to official instructions by the local ethical boards of the study institution, this study was not evaluated by a review board, due to study design (current concepts review), while no patients were contacted for the study purpose.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iDs

Joao Cabral https://orcid.org/0000-0002-9484-1497

Julio Duart https://orcid.org/0000-0003-3121-3669

References

1. König F. Uber freie korper in den gelenken [in German]. *Deutsch Z Chir* 1888; 27(1–2): 90–109.
2. American Academy of Orthopedic Surgeons. *Clinical practice guideline on the diagnosis and treatment of osteochondritis dissecans*. Rosemont, IL: American Academy of Orthopedic Surgeons, 2010.
3. Masquijo J and Kothari A. Juvenile osteochondritis dissecans (JOCD) of the knee: current concepts review. *EFORT Open Rev* 2019; 4: 201–212.

4. Kocher MS, Tucker R, Ganley TJ, et al. Management of osteochondritis dissecans of the knee: current concepts review. *Am J Sports Med* 2006; 34(7): 1181–1191.
5. Krause M, Hapfelmeier A, Möller M, et al. Healing predictors of stable juvenile osteochondritis dissecans knee lesions after 6 and 12 months of nonoperative treatment. *Am J Sports Med* 2013; 41(10): 2384–2391.
6. Pill SG, Ganley TJ, Milam RA, et al. Role of magnetic resonance imaging and clinical criteria in predicting successful nonoperative treatment of osteochondritis dissecans in children. *J Pediatr Orthop* 2003; 23(1): 102–108.
7. Cahill BR, Phillips MR and Navarro R. The results of conservative management of juvenile osteochondritis dissecans using joint scintigraphy. A prospective study. *Am J Sports Med* 1989; 17(5): 601–605. Discussion 605–606.
8. Samora WP, Chevillet J, Adler B, et al. Juvenile osteochondritis dissecans of the knee: predictors of lesion stability. *J Pediatr Orthop* 2012; 32(1): 1–4.
9. Wall EJ, Heyworth BE, Shea KG, et al. Trochlear groove osteochondritis dissecans of the knee patellofemoral joint. *J Pediatr Orthop* 2014; 34(6): 625–630.
10. Wall EJ, Vourazeris J, Myer GD, et al. The healing potential of stable juvenile osteochondritis dissecans knee lesions. *J Bone Joint Surg* 2008; 90(12): 2655–2664.
11. Ramirez A, Abril JC and Chaparro M. Juvenile osteochondritis dissecans of the knee: perifocal sclerotic rim as a prognostic factor of healing. *J Pediatr Orthop* 2010; 30(2): 180–185.
12. Accadbled F, Vial J and Sales de Gauzy J. Osteochondritis dissecans of the knee. *Orthop Traumatol Surg Res* 2018; 104: S97–S105.
13. Gunton MJ, Carey JL, Shaw CR, et al. Drilling juvenile osteochondritis dissecans: retro- or transarticular? *Clin Orthop Relat Res* 2013; 471(4): 1144–1151.
14. Chawla A, Twycross-Lewis R and Maffulli N. Microfracture produces inferior outcomes to other cartilage repair techniques in chondral injuries in the paediatric knee. *Br Med Bull* 2015; 116: 93–103.
15. Nissen CW, Albright JC, Anderson CN, et al. Descriptive epidemiology from the research in osteochondritis dissecans of the knee (ROCK) prospective cohort. *Am J Sports Med* 2022; 50: 118–127.
16. Cruz AI Jr, Shea KG and Ganley TJ. Pediatric knee osteochondritis dissecans lesions. *Orthop Clin N Am* 2016; 47: 763–775.
17. Carey JL and Shea KG. Carey AAOS appropriate use criteria: management of osteochondritis dissecans of the femoral condyle. *J Am Acad Orthop Surg* 2016; 24: e105–e111.
18. Gonzalez-Herranz P, Rodriguez ML and de la Fuente C. Femoral osteochondritis of the knee: prognostic value of the mechanical axis. *J Child Orthop* 2017; 11: 1–5.
19. Deie M, Ochi M, Sumen Y, et al. Relationship between osteochondritis dissecans of the lateral femoral condyle and lateral menisci types. *J Pediatr Orthop* 2006; 26: 79–82.
20. Takigami J, Hashimoto Y, Tomihara T, et al. Predictive factors for osteochondritis dissecans of the lateral femoral condyle concurrent with a discoid lateral meniscus. *Knee Surg Sports Traumatol Arthrosc* 2016; 26: 799–805.
21. Nakayama H, Iseki T, Kambara S, et al. Analysis of risk factors for poor prognosis in conservatively managed juvenile osteochondritis dissecans of the lateral femoral condyle. *Knee* 2016; 23: 950–954.
22. Zhou L, Gee SM, Wilson PL, et al. Comparison of weightbearing and nonweightbearing juvenile osteochondritis dissecans lesions of the lateral femoral condyle. *Orthop J Sports Med*. Epub ahead of print 11 August 2021. DOI: 10.1177/23259671211026901.
23. Schwarz C, Blazina ME, Sisto DJ, et al. The results of operative treatment of osteochondritis dissecans of the patella. *Am J Sports Med* 1988; 16: 522–529.
24. Matava MJ and Brown CD. Osteochondritis dissecans of the patella: arthroscopic fixation with bioabsorbable pins. *Arthroscopy* 1997; 13: 124–128.
25. Barth J, Brossard P, Boutsiadis A, et al. All-arthroscopic suture fixation of patellar osteochondritis dissecans. *Arthrosc Tech* 2017; 6: e1021–e1027.
26. Kurzweil PR, Zambetti GJ Jr and Hamilton WG. Osteochondritis dissecans in the lateral patellofemoral groove. *Am J Sports Med* 1988; 16: 308–310.
27. Luessenhop S, Behrens P, Bruns J, et al. Bilateral osteochondritis dissecans of the medial trochlea femoris: an unusual case of patellofemoral pain. *Knee Surg Sports Traumatol Arthrosc* 1993; 1: 187–188.
28. Mori Y, Kubo M, Shimokoube J, et al. Osteochondritis dissecans of the patellofemoral groove in athletes: unusual cases of patellofemoral pain. *Knee Surg Sports Traumatol Arthrosc* 1994; 2: 242–244.
29. Takahashi Y, Nawata K, Hashiguchi H, et al. Bilateral osteochondritis dissecans of the lateral trochlea of the femur: a case report. *Arch Orthop Trauma Surg* 2008; 128: 469–472.
30. Price MJ, Tuca M, Nguyen J, et al. Juvenile osteochondritis dissecans of the trochlea: a cohort study of 34 trochlear lesions associated with sporting activities that load the patellofemoral joint. *J Pediatr Orthop* 2020; 40: 103–109.
31. Lee DW, Lee JK, Cho YC, et al. Internal fixation of lateral trochlear groove osteochondritis dissecans with simultaneous lateral retinacular lengthening in adolescent athletes. *Am J Sports Med* 2021; 49: 3867–3875.
32. Kramer DE, Yen YM, Simoni MK, et al. Surgical management of osteochondritis dissecans lesions of the patella and trochlea in the pediatric adolescent population. *Am J Sports Med* 2015; 43: 654–662.
33. Deroussen F, Hustin C, Moukoko D, et al. Osteochondritis dissecans of the lateral tibial condyle associated with agenesis of both cruciate ligaments. *Orthopedics* 2014; 37: e218–e220.
34. Croman M, Kramer DE, Heyworth BE, et al. Osteochondritis dissecans of the tibial plateau in children and adolescents. *Orthop J Sports Med*. Epub ahead of print 26 August 2020. DOI: 10.1177/2325967120941380.