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A Surgeon's Case-Based Guide to the Management of Osteochondritis Dissecans of the Knee in the Pediatric Athlete

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Introduction

Given the lack of clinical studies investigating the comparative effectiveness of osteochondritis dissecans (OCD) treatments, orthopedic surgeons currently utilize different approaches for various types of lesions[1,2]. We present the standard-of-care treatment protocol used at the Children's Hospital of Philadelphia (CHOP), a high-volume center for juvenile OCD cases, as a comprehensive guide for treating common presentations of pediatric knee OCD.

Treatment Approach

Pre-Surgical Characterization of the Lesion

Characterizing the stability of an OCD lesion is critical for guiding non-operative or operative treatment recommendations. The stability of OCD lesions depends upon the mechanical integrity of the affected subchondral bone and the status of the adjacent articular cartilage. In general, a *stable* lesion will be immobile with healthy, intact articular cartilage whereas an *unstable* lesion may be mobile and demonstrate disrupted articular cartilage[3,4]. While arthroscopy is the gold standard for precisely characterizing a lesion, magnetic resonance imaging (MRI) provides useful diagnostic information to guide decision-making in potentially unstable lesions before making an incision[5]. Though multiple radiologic classification systems exist, evidence of distinct fragments, high T2 signal intensity between parent and progeny bone, disruption of the articular cartilage, and the presence of loose bodies on MRI are all accepted criteria for reliably determining stability[6]. Other strong predictors for failed non-operative healing include large lesion size on MRI[7,8] and mechanical symptoms at presentation[8].

Case 1. Stable, Intact Lesion

14 yo male with a 1-year history of diffuse medial-sided pain of the left knee who fell directly onto the anterior aspect of both knees during a basketball game 1 month ago. Since that fall he has experienced increased anteromedial knee pain. He was seen by his primary care physician who ordered radiographs and an MRI.

Stable lesions limited to the subchondral bone with intact articular cartilage are most common in pediatric patients[9]. Since stable lesions in patients with open physes tend to have a relatively high potential for healing[7], an initial trial of non-operative treatment is recommended. For an isolated intact lesion, the non-operative protocol includes a hinged knee brace locked in extension for 6 weeks followed by 6 weeks of no bracing but continued activity modification, including no high-impact running or jumping. After a 3-month trial of non-operative treatment, the patient receives a follow-up MRI to evaluate for signs of healing, which include re-ossification, disappearance of the radiolucent

Figure 1. A comparison of pre-operative and 2-year post-operative radiographs show healing of a stable OCD lesion with intact cartilage on the lateral aspect of the medial femoral condyle (MFC).

zone, resolution of the sclerotic rim, radiographic union of the lesion, resolution of the lesion, and resolution of radiolucent demarcation[10]. If radiographic signs of some but not complete healing are present, a second 3-month trial of non-operative treatment, including 6 weeks of bracing and 6 weeks of continued activity modification, is recommended. Indications for operative management at 3-months follow-up include no evidence of healing or a worsening lesion on radiographs in a patient with closed/closing epiphyseal plates.

The standard operative procedure for stable, intact lesions is knee arthroscopy with multiple drilling through the progeny bone and into the parent bone in an effort to recruit marrow elements and evoke a healing response[11]. Transarticular and retroarticular drilling with a Kirschner wire have demonstrated similar efficacy in the treatment of these lesions[12,13]. While transarticular drilling has historically been performed more frequently at CHOP, retroarticular drilling may be valuable, especially for posterior lesions. Key technical recommendations for transarticular drilling include the use of a variety of knee flexion angles or accessory portals to maintain a perpendicular angle between the portals and articular cartilage. For retroarticular drilling, the use of a C-arm and a small parallel guide to ensure accurate pin placement is recommended. The surgeon should place a single pin at the center of the lesion and use the parallel guide to place adjacent pins.

Case 2. Unstable, Salvageable Lesion

12-year-old female presents with right knee pain that began 1-2 months ago. She has tenderness over the medial femoral condyle and decreased range of motion with no locking or giving way. Symptoms are made worse by activity.

While an initial non-operative trial is indicated for a stable, intact knee OCD lesion, radiographic evidence of an unstable lesion implies low healing potential regardless of patient age and thus typically warrants operative management without a non-operative trial. Though the specific operative technique may vary depending on the state of the lesion, unstable but salvageable lesions typically undergo surgical arthroscopy with internal screw fixation of any hinged portion[4]. During arthroscopy, the surgeon can evaluate for the amount of subchondral bone. We typically opt for fixation with a headless metal reverse threaded compression screw if sufficient subchondral bone is visualized on imaging or flathead screws when there is trace subchondral bone present. Members of the Research in Osteochondritis Dissecans of the Knee (ROCK) multicenter study group have provided a detailed overview of each of the common surgical techniques for internal fixation of hinged lesions[4]. In the case that fibrous tissue is discovered at the base of the lesion, the tissue should be curetted and a stable rim should be prepared such that the void can be filled with a local bone graft from the proximal tibia[14].

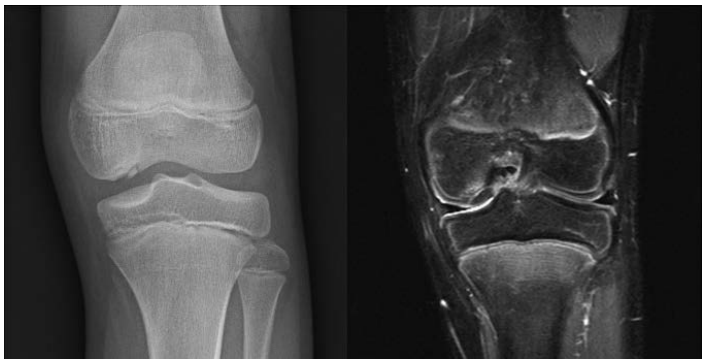

Figure 2. Pre-operative radiograph and MRI show unstable OCD lesion on the lateral aspect of the MFC requiring fixation.

Case 3. Unstable, Unsalvageable Lesion

16-year-old male basketball player who presents for follow-up for bilateral knee pain. He was last seen two years prior for left greater than right knee pain. His pain does not prevent him from participating in his activities, but he does have decreased ROM and intermittent buckling and swelling of the left knee when playing basketball.

While primary fixation is the most viable option for unstable, salvageable OCD lesions in the knee, other surgical options should be explored if the lesion has produced multiple fragments, the articular cartilage is excessively damaged, or there is a mismatch defect between the progeny and site of origin[15].

Surgical techniques often vary based on the size of the unsalvageable lesion. For small defects ($\sim$1cm^2), we typically opt for marrow stimulation via surgical arthroscopy to produce replacement fibrocartilage, including abrasion arthroplasty, drilling, or microfracture[15]. For intermediate defects ($\sim$1-2cm^2), we typically use osteochondral autograft. For larger unsalvageable defects ($>$2cm^2), we typically opt for either autologous chondrocyte implantation (ACI) or osteochondral allograft. To ensure the best possible outcome for osteochondral allograft, the surgeon should precisely log the size of the lesion and send advanced imaging studies to precisely match the graft to the patient's knee.

Conclusion

Although there is limited consensus in the literature for the optimal management of knee OCD, this multi-case report provides an overview of the current treatment practices at a high-volume center treating knee OCD for the various type of lesions both young and experienced surgeons may encounter in their practice.

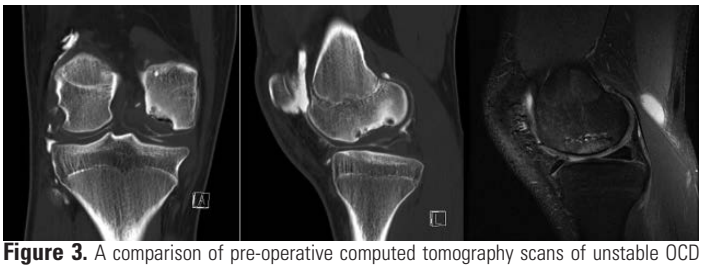

Figure 3. A comparison of pre-operative computed tomography scans of unstable OCD lesion showing a breach in the articular cartilage on the lateral aspect of the MFC and post-operative MRI after osteochondral allograft.

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