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Juvenile Osteochondritis Dissecans in a 13-year-old male athlete: A case report

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Objective: *To present the clinical management of juvenile osteochondritis dissecans (OCD) of the knee and highlight the importance of a timely diagnosis to optimize the time needed for less invasive, non-operative therapy.*

Clinical Features: *A 13-year-old provincial level male soccer player presenting with recurrent anterior knee pain despite ongoing manual therapy.*

Intervention and Outcome: *A multidisciplinary, non-operative treatment approach was utilized to promote natural healing of the osteochondral lesion. The plan of management consisted of patient education, activity modification, manual therapy, passive modalities and rehabilitation, while being overseen by an orthopaedic surgeon.*

Conclusions: *Considering the serious consequences of misdiagnosing osteochondritis dissecans, such as*

Objectif : *Présenter le traitement clinique de l'ostéochondrite disséquante juvénile (OCD) du genou et souligner l'importance d'un diagnostic précoce en vue d'optimiser le temps nécessaire pour un traitement non chirurgical moins invasif.*

Caractéristiques cliniques : *Un joueur de soccer de 13 ans, au niveau provincial, présente des douleurs antérieures du genou (récurrentes) malgré un programme de thérapie manuelle en cours.*

Intervention et résultats : *Une approche de traitement multidisciplinaire non chirurgical a été utilisée pour favoriser la guérison naturelle de la lésion ostéochondrale. Le plan de traitement comportait la sensibilisation du patient, la modification des activités, la thérapie manuelle, les modalités passives et la réadaptation, sous la supervision d'un chirurgien orthopédiste.*

Conclusions : *Compte tenu des conséquences graves d'un mauvais diagnostic de l'ostéochondrite*

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the potential for future joint instability and accelerated joint degeneration, a high degree of suspicion should be considered with young individuals presenting with nonspecific, recurrent knee pain. A narrative review of the literature is provided to allow practitioners to apply current best practices to appropriately manage juvenile OCD and become more cognizant of the common knee differential diagnoses in the young athletic population.

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KEY WORDS: case report, osteochondritis dissecans, knee injuries, non-specific knee pain, osteochondral lesions, medial femoral condyle, ROCK

disséquante, telles que la possibilité d'une instabilité articulaire et d'une dégénérescence accélérée des articulations à l'avenir, il faut être extrêmement suspicieux avec les jeunes qui présentent des douleurs récurrentes non spécifiques du genou. Un examen narratif des revues scientifiques est offert pour permettre aux professionnels d'avoir recours aux pratiques exemplaires actuelles pour traiter adéquatement l'OCD juvénile et de se sensibiliser davantage aux diagnostics différentiels communs du genou chez les jeunes sportifs.

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MOTS CLÉS : observation, ostéochondrite disséquante, blessures du genou, douleurs non spécifiques du genou, lésions ostéochondrales, condyle fémoral médial, ROCK, chiropratique

Introduction

The knee is complex and is often affected by pathologies and/or traumatic events, resulting in a visit to primary health care practitioners, including chiropractors. It has been reported that a chiropractor's practice can consist up to 20% of extremity conditions, with roughly equal distributions between the upper and the lower extremities.[1] Therefore, it is important that a chiropractor have a thorough understanding of the common extremity conditions, particularly those that may have potentially significant sequalae. The anatomical structures that present in the knee region can make the assessment challenging. A thorough history and physical examination, is essential in determining the differential diagnosis for knee pain.[2,3] The necessity for a quick and accurate diagnosis becomes even more significant when these injuries are present in children and adolescents, given their skeletal immaturity and growth potential. Any inappropriate management or delay in diagnosis may result in significant consequences such as future chronic pain, limitations of daily activities or sport participation, joint instability, and accelerated joint degeneration.[4-10] A brief list of some of the more common injuries associated with the knee in the adolescent age group is outlined in Table 1. It would be appropriate for a chiropractor to be aware of these diagnoses, which include age-specific differentials such as epiphyseal and/or apophyseal injuries.

An important differential diagnosis that should be considered in both children and adolescents with vague, recurrent knee pain is juvenile osteochondritis dissecans (JOCD). Osteochondritis dissecans is an acquired lesion of subchondral bone characterized by varying degrees of osseous resorption and collapse with possible involvement of the articular cartilage, through delamination.[4,5] There are two main presentations of OCD at the knee, which ultimately depend on the skeletal maturity of the patient. As a point of clarification, JOCD of the knee is reserved for youth and adolescents who have open growth plates on radiographs, while the diagnosis of adult OCD is reserved for skeletally mature patients with closed physes.[4-7]

This case focuses on JOCD of the knee and highlights the importance of a timely diagnosis in preserving joint function and optimizing the time needed for less invasive, non-operative therapy for an adolescent. Through appreciation of the epidemiology, etiology, clinical presentation and management of JOCD of the knee, this case will not only help the practitioners to appropriately manage JOCD, but become more cognizant of the common knee conditions in the young athletic population.

Table 1:
Important differential diagnoses to consider in youth presenting with knee pain.

Differential Diagnosis of Knee Pain in the Adolescent	
Synovial Impingement Syndromes	Pathologic plica Hoffa syndrome
Osteochondroses/Tendonitis	Osgood-Schlatter Sinding-Laresen-Johannsen Patellar tendonitis
Patellar Instability	
Patellofemoral Pain Syndrome (PFPS)	
Osteochondritis Dissecans	
Hip Pathology*	Slipped capital femoral epiphysis (SCFE) Legg-Calve-Perthes (LCP) Stress (fatigue) fracture
Tumours	Osteosarcoma Osteoid osteoma
Infection	Brodie's abscess
Idiopathic Anterior Knee Pain	
Meniscal Tears	Discoid meniscus
Fracture	
Ligamentous Injury	
Iliotibial Band Syndrome	

**Likely associated with accompanying hip pain and/or dysfunction.*

Case presentation

A 13-year-old provincial level male soccer player presented to a chiropractic office complaining of right knee pain, one day after an on-field injury. The injury occurred while the right foot, which was planted, was abruptly slide-tackled on the lateral side while attempting to kick the ball with the left foot. The trauma created a valgus load in his right knee and the patient collapsed on field. He was helped off the field and was unable to return to play due to an inability to weight bear. The patient complained of significant generalized pain over his right knee and the only relieving factor for the first 24 hours was the application of ice to the right knee joint. He did not report any popping sensation or instability associated with the knee injury. He denied any prior history of right knee pain or injury. He reported that his training schedule consisted of four to five on-field practices along with one to two games per week.

Upon initial examination, there was mild swelling located over the right medial knee and pes anserine insertion. Digital palpation was associated with generalized pain over the right anterior knee, particularly over the medial joint line. Passively, right knee range of motion was limited to 60° in flexion with pain, while all other ranges were observed to be full. However, all passive movements were associated with end range discomfort. Resisted ranges of motion were not completed due to pain. Similarly, most of the orthopaedic testing was non-contributory with regard to the diagnosis, due to the degree of discomfort associated with the testing. However, tests for effusion, ligamentous laxity and meniscal involvement, such as the swipe test, Lachman's test, anterior and posterior drawer tests, valgus and varus stress tests, and McMurray's tests were deemed to be unremarkable. The valgus stress test to the right knee resulted in the most pain but no findings of laxity were elicited.

Based on these results, a working diagnosis of a grade I MCL sprain was made and the patient was placed on a three week course of conservative management, consisting of activity modification, cryotherapy, laser ther-

apy, soft tissue therapy, and knee mobilizations. The patient was also placed on a gradual isometric strengthening program that was initiated at the end of the second week. He made good recovery and returned to play in 4 weeks without pain.

Approximately two weeks later, he returned back to the office complaining of right-sided retropatellar pain. The patient stated that this episode started after a training session that included a bout of uphill sprinting and repetitive squatting exercises. Upon examination, there was a notable tenderness reported over the medial proximal and middle facet surfaces of the patella in addition to the right medial joint line. At this time, a working diagnosis of patellofemoral pain syndrome (PFPS) was made and the patient was given a conservative treatment plan that included activity modification, progressive rehabilitation for PFPS, laser therapy, and manual therapies that included soft tissue therapy and graded knee mobilizations. The patient was able to return to play within 2 weeks with the aid of a soft patella stabilizing knee brace.

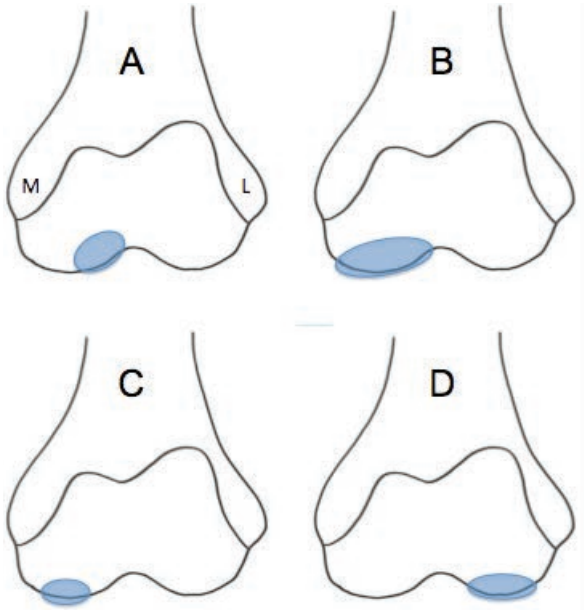
A few weeks later during training, he fell on his right knee after tripping over another player. Despite icing for a few days, the pain persisted. Examination findings demonstrated a mild knee effusion as well as focal bony tenderness over the medial joint line and condylar surfaces of the distal femur. Due to the reoccurring issues with his right knee and the suspicion of a possible osseous injury, a series of conventional radiographs of the right knee were requested (Figure 2). The findings were consistent with JOCD and the patient was referred to an orthopaedic surgeon for further consultation and advanced imaging (Figure 3). Since imaging revealed a stable osteochondral lesion with open distal femoral growth plates, a trial of conservative care was initiated that limited rigorous activity for 6 months and permitted light activities such as swimming and cycling under orthopaedic supervision. At 6 months, MRI revealed successful healing of the stable osteochondral fragment of the right knee.

Discussion

Epidemiology

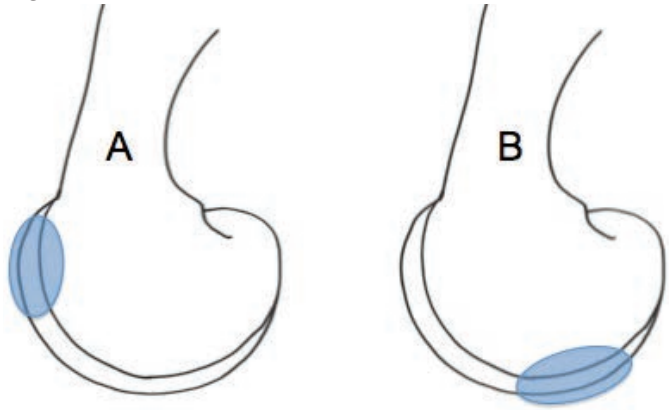
JOCD of the knee occurs in skeletally immature patients with open distal femoral physes visible on radiographs. Although the exact prevalence is unknown, reported ranges within the literature are 15-29 cases per 100,000

Figure 1A



This image illustrates anterior-posterior presentations of OCD on the articular surface of distal femur. The medial (M) and lateral (L) condyles are labeled in image A for reference. OCD lesions may appear on the medial condyle in the classic (A), extended classic (B) and inferocentral locations (C). Image D shows the inferocentral location on the lateral femoral condyle.

Figure 1B



Osteochondral lesions at the knee may present on the anterior portion of the articular surface (A) or most commonly, at the weight-bearing posterior portion of the articular surface (B).

Figure 2

Conventional AP and lateral radiograph views of the right knee. The osteochondral defect (white arrows) is observed in the posterolateral aspect of the right medial femoral condyle.

with an average onset ranging from 11-13 years.[7-9,11-13] Many authors agree that the true prevalence and incidence may be under reported due to asymptomatic cases and clinical misdiagnosis.[4,12]

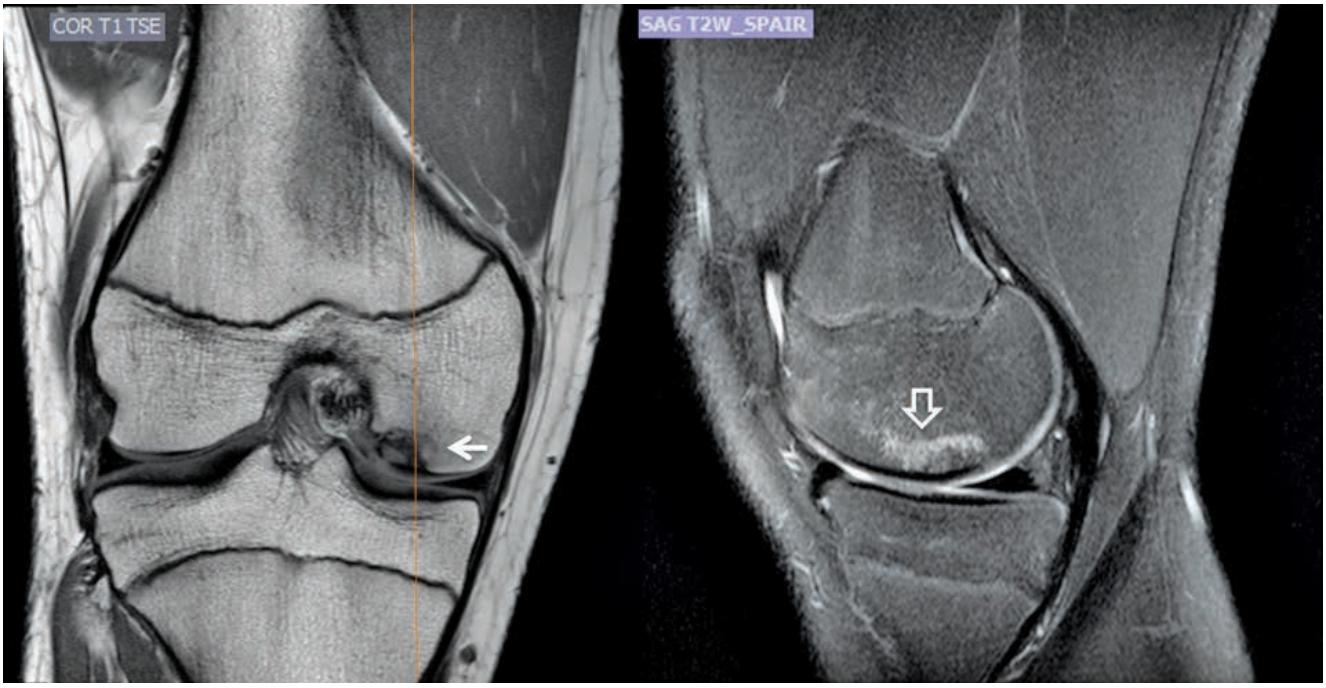
With regard to gender distribution, JOCD traditionally has a male predilection, with an approximate ratio of 5:3[4,5], although in recent years, an increasing prevalence in the female population, and a decreasing mean age of onset has been noted.[4-7] Several authors attribute the increase in the incidence of JOCD in recent years in part to the growing number of youth involved in year-round competitive sports, the widespread use of MRI and the increased awareness of the pathology among more health care providers.[4,5,10]

JOCD of the knee occurs most frequently in the classic location of the posterolateral aspect of the medial femoral condyle, as it is reported in more than 70% of cases.[4-10] Lesions may also present in the inferior-central lateral condyle that account for 10 to 20% of cases, while femoral trochlear lesions account for less than 1% of cases. Typical locations of OCD presenting on the distal femur are illustrated in Figures 1A and 1B. Although patellar involvement is uncommon (less than 5% of cases), when present, it is often located on the inferomedial surface of the patella. The pathology is most often monoarticluar, but bilateral involvement has been reported in 15-30% of cases.[4,5] When bilateral involvement is present, it is often asymmetrical in terms of lesion size and clinical symptoms.

Etiology

König originally coined the term osteochondritis dissecans in 1887 to hypothesize an inflammatory process resulting in dissection of articular cartilage and subsequent fragmentation of subchondral bone leading to loose body formation.[5] However, numerous histological studies have been unable to support a theory of inflammation.[4,5,7] Recent histological studies have also failed to provide evidence for osteonecrosis of the OCD fragment (progeny bone) or a relative ischemic watershed at the lateral aspect of the medial femoral condyle.[4] Instead, it seems the necrosis found in OCD may be secondary to the ac-

Figure 3



Coronal T1 TSE and sagittal T2 SPAIR MR images demonstrating a stable osteochondral lesion in the right knee (solid arrow). Marrow edema (open arrow) is observed with high signal intensity on the sagittal view.

tual detachment of the lesion rather than an underlying pathology.[4,5]

There have been numerous theories proposed to explain the cause of JOCD of the knee. However there is insufficient evidence to support a single etiology.[4-7] Currently, most authors believe the condition is multifaceted and composed of several theories including repetitive microtruama, abnormal ossification, aberrant joint mechanics and genetic predisposition.[4-8]

With regard to the theory of genetic predisposition for acquiring OCD, two studies have suggested an autosomal-dominant inheritance pattern.[4,5,7] Other studies have suggested that a genetic component to this pathology is likely due to bilateral presentation in up to 30% of cases along with the fact that many individuals experiencing JOCD may have osteochondral defects in multiple joints.[5] Despite these findings, Petrie[14] found only one relative with the disease in a radiographic examination of 86 first-degree relatives of 34 patients with confirmed JOCD. Although there is a potential genetic role as discussed in the literature, the role remains elusive and unclear at this time.

In 1933, Fairbanks[15] proposed a traumatic mechanism where impaction of the tibial spine on the lateral aspect of the medial femoral condyle leads to the common presentation of JOCD. However, this mechanism can only explain the development of lesions in the classic site of the medial femoral condyle, and does not support those occurring in other areas, such as the lateral femoral condyle and patella.[4] The most current accepted theory on the etiology of OCD at the present is repetitive microtruama, predominantly due to the increasing prevalence of this condition in young athletes. Although there is general acceptance, the exact nature of the mechanism is still unknown.

In 1999, the European Pediatric Orthopedic Society published a multicenter study that examined a total of 509 OCD lesions in a total of 452 knees. They found that approximately 55% of the young patients with confirmed JOCD were regularly active in sports and performed strenuous athletic activity.[16] It has been well recognized that children and adolescents are more prone to sport-related injuries, in part due to the lack of fully developed motor skills, temporary declines in coordination and bal-

ance at puberty, as well as changes in limb length versus limb mass.[7] These factors ultimately result in increased strain on the musculoskeletal system, including the more vulnerable areas such as the epiphyseal plates and apophyses. With the growing number of youth athletes involved in early, year-round sport specialization, it is thought that repetitive loading can lead to stress reactions that can progress to fracture of the underlying subchondral bone.[5-7] Persistent loading, particularly at high axial loads to the knee joint, may exceed the healing capacity of the progeny segment and lead to nonunion.[5] However, this mechanism does not explain asymptomatic lesions or those developing in sedentary individuals.

Theories such as aberrant joint loading and issues with epiphyseal endochondral ossification have also been suggested to contribute to the proposed multifaceted etiology of JOCD of the knee. Associations have been found between discoid meniscus and lateral femoral condyle lesions, and with the development of lesions in cases of mechanical axis malalignment.[4,5,7] Knees with medial femoral condylar lesions have been positively associated with varus malalignment, while those with lateral condylar lesions are associated with valgus mechanical malalignment.[5,7] Recent research has provided new MRI findings to support previous theories regarding JOCD formation through aberrant development of only a portion of the epiphyseal growth plate. Abnormal epiphyseal endochondral ossification may occur after a particular acute or repetitive insult, leading to a slowly evolving lesion as the patient ages. Evidence from T2 fat saturation sequences has helped describe two potential scenarios. The first is a permanent cessation of ossification after insult that leads to a completely cartilaginous OCD lesion without endochondral ossification. The second scenario involves temporary cessation of ossification that allows for future partial or complete normal ossification with time.[4]

Although there has been more than a century from the first discovery of this pathology, the relationship between the juvenile and the adult forms of OCD remains uncertain. Despite cases that have supported a de novo mechanism in the adult form, many experts believe that the adult lesions represent acute injury or are a persistent form of JOCD.[4-10] Further confounding this debate is the potential overlap of both presentations during mid or late-adolescence to adulthood.

Clinical Presentation

Since early recognition of JOCD is critical in the management, and ultimately the prognosis of the pathology, awareness of the subtle clinical symptoms and a high degree of suspicion in young individuals with non-specific knee pain are important.

The clinical presentation of JOCD of the knee is heavily dependent on the stage of pathology, including the size and stability of the lesion. Typically, in the early stages of this condition, a young patient may present with non-specific knee pain with or without a history of trauma.[5] In active youth with a symptomatic presentation, pain is exacerbated by periods of rigorous exercise or activities such as climbing hills or stairs.[4,5,8,9] These patients may have an observable limp after these periods of high activity and in less than 20% of cases, present with local knee effusion and swelling.[4] More advanced stages of the condition may present in a similar fashion to adult OCD of the knee, with symptoms of catching, locking, instability (giving way), and more obvious signs of atrophy and joint effusion. These signs are characteristic of unstable lesions or loose intraarticular chondral or osteochondral bodies.[6,10]

As stressed above, it is imperative for JOCD to be detected in an early stage so that adequate time is reserved for growth plate fusion, to increase the likelihood of more complete healing and a better prognosis. The issue for the clinician is that many of the earlier signs and symptoms are similar to other typical causes of knee pain in the adolescent. In order to increase clinical suspicion for osteochondral lesions, the patient history, particularly the ongoing temporal pattern of the condition, must be recognized. Furthermore, in the athletic population, the type of sport and specific movements that exacerbate the condition should be noted.[2,5] Although these injuries are most common in sports involving high axial loading and jumping, participation in other activities that do not encounter as much axial loading should not be dismissed as a possible provocative factor.[5,7]

Cahill and Ahten[6] reported characteristic trends observed in patients diagnosed with JOCD. Their findings may help clinicians identify historical findings to increase awareness for JOCD. Several trends support a theory of repetitive overuse or fatigue phenomenon as only 10% of patients have a history of acute trauma. Many of the individuals in their study were involved in more than 3

sports, and participated in year-round vigorous training programs. They also noted that 80% of these patients had symptoms for an average of 14 months before detection.[6] As noted above, the challenge with a vague and poorly localized knee pain in young patients is often difficult and must include other systemic and musculoskeletal diagnoses, as highlighted in Table 1.

Physical examination can also be vague, although tenderness is most often elicited over the anteromedial aspect of the femoral condyle with varying degrees of knee flexion.[9] Knee range of motion is often unremarkable in early stages of the pathology, but may have limitations in passive extension due to pain or mechanical obstruction in progressive stages with loose body formation. Knee effusion has been reported in less than 20% of cases on initial examination and atrophy of the quadriceps muscles in the effected limb may be noted only in advanced or long-standing lesions.[4] Orthopedic testing for ligament stability and meniscal involvement should be completed to rule out competing differential diagnoses.[5] In the case noted, examination of the knee failed to demonstrate any obvious signs of meniscal involvement or laxity for both cruciate and collateral ligaments. Wilson's sign has been a traditional orthopedic test designed to aid in the diagnosis of JOCD, as the test attempts to impinge the tibial spine into the lesions at the classic location of the posterolateral aspect of the medial femoral condyle. A positive test is thought to produce a painful reproduction of symptoms at the anteromedial joint line while the knee is flexed to 30º with maximal internal rotation of the tibia. A positive finding is confirmed if symptoms dissipate once the knee is placed into external rotation at the same range of motion. Several authors have questioned its usefulness for clinical diagnosis as recent findings suggest poor sensitivity and specificity of this test.[4,5,7-9] Despite these recent results, the test may have an application as an outcome measure in patients that have positive findings on initial examination.[17] In the case presented, Wilson's test was deemed negative on physical examination even with the presence of OCD at the posteriolateral aspect of the medial femoral condyle.

Imaging

Due to the nonspecific nature of the clinical signs and symptoms of this pathology, diagnosis and characterization of JOCD is dependent on imaging. Among its use in diagnosis, imaging is significant for management as it is used to monitor progress and overall prognosis.[17] In the initial stages of assessment, conventional radiography, bone scans, computed tomography (CT), CT arthrography, magnetic resonance imaging (MRI), and magnetic resonance arthrography have been utilized.[17,18,19] Despite the use of several imaging techniques and diagnostic criteria, there is no single modality that reliably predicts nonsurgical healing capacity.[5,7,11] Furthermore, there is no single system that has gained wide acceptance since determining the stability of JOCD lesion is difficult to ascertain. The most accepted predictive factors for instability are skeletal maturity, the size of the lesion, and articular continuity.[4-7,17-20]

Most authors agree that conventional radiography should be the initial step for the diagnosis of JOCD and other osseous differentials in the knee as it allows determination of the location and size of the lesion as well as the skeletal maturity of the patient.[4-10,17-21] Most lesions can be identified through radiographs, which typically consist of four views, including anteroposterior (AP), lateral, tunnel, and merchant or sunrise views (see Figure 1).[5,17] Since JOCD can present asymptomatically and bilaterally in up to 30% of patients, several authors' believe it is clinically relevant and acceptable to obtain a contralateral knee series, especially if symptoms are present.[17,19] JOCD lesions typically present as a well-circumscribed area of subchondral bone separated by a crescent-shaped radiolucent outline of the fragment as demonstrated in Figure 2. Although this modality aids in initial assessment, the inability of radiographs to accurately describe size, stability, as well as the overlying articular cartilage of JOCD lesions, limits their ability in determining prognosis or making therapeutic decisions.[17]

Nuclear medicine, specifically technetium-99m methylene disphosphonate bone scans, has been used for assessment of JOCD lesions. This modality was initially thought to be useful for determining cases of operative management due to its superior sensitivity over conventional radiography in detecting increased activity in the bone and predicting stability of the lesion.[5] However, due to its poor specificity to distinguish JOCD lesions from other joint abnormalities and the lack of quality evidence for reliably determining the stability of the lesion, this imaging modality has not been used extensively in determining management.[17]

Another commonly employed imaging study is computed tomography (CT). However, this modality has also been of limited use in providing information on JOCD lesion's stability or healing potential as its ability to assess the non-calcified aspect of the joint, which is necessary to determine prognosis, is poorly visualized.[17] Although CT arthrography is more useful as it can assess the cartilaginous aspect of the joint as compared to the conventional CT, its increased exposure to ionizing radiation, especially in young patients has made it less favourable.[5,20]

Currently, magnetic resonance imaging (MRI) is the preferred imaging modality for both diagnosis and the assessment of healing potential of JOCD of the knee due to its ability to provide excellent anatomical detail of both the bone and soft tissues structures with the absence of harmful ionizing radiation.[5,7,17,18,20,21] MRI has been reliable in differentiating abnormal ossification from true OCD lesions, and more importantly, assess stability of a lesion. Determining lesion stability is the greatest prognostic factor to assess the likelihood of a lesion healing with non-operative management.[17,18,21] True JOCD lesions on MRI are viewed as defects in the posterior femoral condyles with intercondylar extension and significant edema (Figure 3).[17] The most common MRI criteria for determining instability of JOCD lesions were originally described by De Smet et al [21] and include:

(1) A rim of high signal intensity surrounding an OCD lesion on T2-weighted images
(2) Cysts surrounding an OCD lesion
(3) A fracture line of high T2 signal intensity extending through the articular cartilage overlying an OCD lesion
(4) A fluid-filled osteochondral defect.

However, studies have found that in immature patients there might be different criteria for determining stability as compared to the adult presentation. It has been noted the presence of a T2 signal intensity surrounding the JOCD lesion only indicates instability if it has the same signal intensity as the adjacent joint fluid, is surrounded by a second rim of low T2 signal intensity, or has multiple breaks in the subchondral bone plate.[17] Cysts surrounding JOCD lesions were only indicative of instability when the lesion size was greater than 5 mm or multiple lesions were present.[17] Despite these findings, to date, there are no current consensus on the MRI criteria, which support the definition of JOCD instability.[11,17,18] Incidentally, MRI is commonly used to assess healing. Typically, signal intensity and subchondral bone marrow edema will return to normal after a period of 12 months.[17]

Management

Management of JOCD still remains a controversial topic and has been traditionally divided into non-operative and/or operative care. The American Academy of Orthopaedic Surgeons (AAOS) [22] published a recent guideline with respect to the diagnosis and treatment of OCD of the knee. Although there were 16 recommendations, 10 were inconclusive, 4 were consensus statements, and 2 were supported with low quality evidence. Furthermore, the body of literature surrounding the diagnosis and management of JOCD of the knee is limited to retrospective case series, reports, and expert opinions, which inherently have poor internal validity and biases, which limits firm conclusions to be drawn from the current literature. However, the guidelines from the AAOS and recent literature being published from organizations such as the Research in Osteochondritis of the Knee (ROCK) have made it possible for both manual practitioners and surgeons to select the most appropriate courses of management for patients based on the current state of the literature.[5] These principles were deemed to be the best available evidence and guided management of the current case.

Treatment of JOCD of the knee is dependent on multiple factors. Two critical components that play a large role in initial management strategies are the skeletal maturity of the patient (time until growth plate closure) and the characteristics of the lesion (size and stability).[2-10,23] Non-surgical management is often the first line of treatment for stable lesions in patients with an open physis, which has at least 6 – 8 months of growth, prior to plate closure.[4-6,17,22] Immobilization and activity modification are the mainstays of conservative treatment. However there is controversy regarding the duration and timing of these interventions. Traditionally, immobilization via casting, bracing, or the use of a knee immobilizer was implemented before partial weight bearing with crutches for patients undergoing conservative care.[2-5,23] These methods have had less attention in recent years due to potential detrimental effects to the joint and muscles, such as quadriceps atrophy.[9,10] Several authors agree that the current non-surgical management should focus on restricting sport and high-impact activities for a course of 6-8 weeks,

but allow for normal weight bearing activities in a compliant patient.[4,5,10] Light activities such as walking, cycling, and swimming have been suggested during the first 3-4 months with return to normal activities and sport activities in about 4-6 months.[2-5,10] Recent findings regarding the success of non-operative healing rates of JOCD lesions in patients with an open physis are approximately 65% within a 6-month period.[24] Failed conservative therapy and poor compliance are cited as predominant factors for poor healing success.[6,22] Several authors[5,6,17] stress the critical role of the practitioner to educate both the patient and parents involved so that compliance is maintained for optimal success with conservative management.

Surgical management is reserved for patients after 6-9 months of failed conservative care, those with detached or unstable lesions, those approaching physeal closures within 6 months, or when there is evidence of full-thickness loss of overlying articular cartilage as identified on MRI.[8-10,17] The goal of surgical intervention is to preserve the congruity and integrity of native articular cartilage. There are several surgical interventions that may be considered based on the characteristic of the lesion and stage of the disease. In stable lesions that have failed nonoperative care, surgical approaches such as arthroscopic drilling (transarticular or retroarticular) are used to stimulate revascularization and encourage healing.[5,10] In unstable lesions, approaches involving internal fixation with or without debridement are necessary to stabilize the lesion. When the lesion has progressed and is not repairable, restorative techniques such as microfracture and osteoarticular transfer systems (autologous chondrocyte implantation or osteohondral allograft) may be initiated.[5,10,17,25] A recent systematic review by Aboussaly et al [11] stated that there are numerous surgical techniques for stable and unstable lesions. However, regardless of the surgical intervention, the vast majority of lesions (94%) were judged to have healed post-operatively. These authors also highlight the paucity in this body of literature and cautioned the interpretation of their data since all studies lacked control groups, had variable sample sizes, and had a high heterogeneity in study methodology and baseline characteristics.[11]

On reviewing the case presented, there were several clinical challenges that had to be addressed. Although the lesion was stable, the greatest issue was the time until growth plate closure. The patient was approximately 10 months to growth plate closure making the decision for conservative management more uncertain. To undergo such management, compliance was critical to ensuring optimal physiology for healing. An initial restriction from rigorous activity and soccer participation was prescribed for the first 6 months. This included no running or jumping, with the patient being permitted to do light activities such as walking, cycling, and swimming. Upon demonstration of healing of the lesion with imaging at 6 months, a progressive lower limb rehabilitation program incorporating multiplanar and axial loading was initiated.

Although there is limited high quality literature surrounding the management of juvenile OCD of the knee, the current case demonstrated how utilization of the current guidelines and cooperation from the patient and his parents with regard to activity restriction, resulted in a favourable outcome. However, future research involving more rigorous prospective methodology to address the lack of current consensus in imaging and treatment options will be required. As experts in musculoskeletal health, chiropractors can provide patient education to ensure compliance to activity modification and apply rehabilitation principles to optimize joint function in addressing juvenile OCD.

Conclusion

Juvenile osteochondritis dissecans of the knee is the most common cause of loose intraarticular bodies in adolescence and the prevalence of these lesions seem to be increasing in active populations. Considering the serious consequences of misdiagnosing osteochondritis dissecans, such as non-union, mobility of the fragment, and accelerated joint degeneration, a high degree of suspicion for OCD should be considered with young individuals presenting with non-specific, recurrent knee pain. Through understanding the epidemiological and etiological factors that are suggested to play a role in this condition, primary clinicians should have a high level of suspicion in cases of non-specific knee pain in adolescents. As always, a thorough history and physical examination would be required to help in diagnosing this condition. Imaging studies have a pivotal role in the diagnosis of these lesions and a rapid referral to an orthopedic surgeon is required to determine the stability of the condition and the need for either conservative or surgical management. Although the literature surrounding optimal management and consequent

prognosis of such injuries is lacking, practitioners can draw upon current best practices outlined by the AAOS and ROCK organizations. Furthermore, chiropractors can play a critical role in the multidisciplinary approach to such cases through potential clinical detection and nonoperative management of these patients.

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