

Keeping Slipped Capital Femoral Epiphysis in Mind

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A 13-year-old previously healthy male presents for evaluation of acute right knee pain that has been present for the past several weeks. The pain is described as cramping in nature, radiating proximally to the right thigh. Pain is intermittent. Knee pain was reported to have a sudden onset when the patient missed a step going down the stairs, hitting his knee in a flexed position on a hard floor when he fell. Patient reportedly felt a “pop” and immediate pain. Pain is provoked with ambulation. Patient denies any knee swelling, fever, chills, numbness, weakness, or difficulty bearing weight. The patient has not taken any pain-relieving medicine and denies any alleviating factors.

Upon physical examination, the patient is noted to have an antalgic gait. There was a noted 5 cm difference in leg length, with the right leg being shorter. There is limited right hip range of motion (ROM), particularly in internal and external rotation. McMurray’s test and Lachman’s test were negative. There was no crepitus upon right knee ROM testing. Body mass index (BMI) was 23.46 kg/m.² Radiographic images of the pelvis and right knee were obtained for further evaluation..

QUESTIONS:

What is the most likely diagnosis?

- A. Anterior hip dislocation
- B. Legg-Calvé-Perthes disease
- C. Metaphyseal-epiphyseal type III fracture
- D. Osteomyelitis
- E. Slipped capital femoral epiphysis

For a case presenting as above, what would be the best initial imaging exam?

- A. MRI right knee
- B. XR Bilateral hip
- C. XR right knee
- D. B & C
- E. All of the above

What is the single greatest risk factor for the likely diagnosis?

- A. Endocrinopathies
- B. History of previous radiation therapy to the affected region
- C. Male gender
- D. Mechanism of trauma
- E. Obesity

FIGURE 1:



FIGURE 2:



FIGURE 3:



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ANSWERS

What is the most likely diagnosis?

The correct answer is:

E) Slipped capital femoral epiphysis

Provided the history, physical examination, and radiographic images presented, it can be confidently stated that the patient has acquired right-sided slipped capital femoral epiphysis, likely secondary to trauma.¹ The patient is within the average age range (10 to 15-years-old) most likely to develop SCFE.² Children within this age range presenting with knee pain radiating to the hip, leg length discrepancy, and an antalgic gait should be considered to have SCFE until proven otherwise. The radiographs provided help to confirm our suspected diagnosis and show the metaphorical “ice cream slipping off the cone,” which represents the misalignment of the epiphyseal head with the metaphysis along the growth plate.¹ Pelvic hip radiograph represents the unilaterality of the disease. It is important to note that SCFE falls under the category of a Salter Harris type I fracture, which is a fracture along the physis, leaving the epiphysis and metaphysis directly unaffected. In comparison, Salter Harris type III fractures present with a fracture through the epiphysis and physis of the joint.³ SCFE does not satisfy the criteria to be labeled as a Salter Harris type II-V fracture. Legg-Calvé-Perthes disease is idiopathic avascular necrosis of the femoral head, which typically presents with widening of the joint space due to inflammation of the joint capsule and a crescent sign (subchondral epiphyseal lucency representing necrotic bone).⁴ Neither of these are clearly visible on the radiographs. Osteomyelitis presents with a more infectious clinical picture. The radiograph for osteomyelitis would show soft tissue effusions, blurring of soft tissue planes, and bone destruction in the form of cortical lucency and lytic lesions.⁵

Anterior hip dislocations tend to show up clearly on radiographic imaging, with the femoral head located in an inferior position in comparison to the acetabulum.⁶ The patient presenting with anterior hip dislocation would not be able to ambulate, and would most likely not be able to bear weight.

For a case presenting as above, what would be the best initial imaging exam?

The correct answer is:

D) B & C - XR Bilateral hip and XR right knee

Unilateral Late Initial imaging for a pediatric patient with a limp must begin with X-ray evaluation of the affected knee and bilateral hips. In cases of hip pathology such as Slipped Capital Femoral Epiphysis, knee pain may signify referred pain from true hip pathology. This makes it very important to evaluate both the knee and hip joints in patients with similar presentations. X-ray imaging is the best initial imaging exam, as it is readily available and inexpensive in comparison to MRI and CT scanning.⁷ Identification of SCFE on X-ray is diagnostic, and emergent action must take place without delay upon diagnosis. Both anteroposterior and lateral views of the hips obtained via frog-leg or cross-table views should be used for adequate evaluation of joint spaces and bony features.⁷ Bilateral hip X-ray should be obtained to allow direct comparison and to help identify modest discrepancies in anatomy. Additionally,

MRI can provide extra diagnostic information as it is able to detect pathology earlier and can demonstrate early marrow edema.^{8,9} Despite its usefulness, MRI is not the best initial test for examination.

What is the single greatest risk factor for the likely diagnosis?

The correct answer is:

E) Obesity

All of the multiple choice answer options are known risk factors for developing SCFE.^{2,10-14} Of all known risk factors, obesity is the single greatest risk factor for developing SCFE.¹⁰⁻¹² In the pediatric population, there is a significant positive correlation between BMI above the 95th percentile for age and a diagnosis of SCFE.¹⁰ Part of the reason may be that children have developing growth plates that have yet to fuse. Additionally, the hip is an important weight-bearing joint that can be compromised by excess weight or force during a child’s skeletal developmental period. Another risk factor for developing SCFE is the presence of an endocrinopathy, such as hypothyroidism. This complication has been reported in cases of young adults as well.^{14,15}

As observed, total body radiation exposure among patients with pediatric cancer may also contribute to an increased incidence of SCFE, most likely due to a decreased growth hormone production.¹³ Male gender and trauma are also established risk factors in the development of SCFE.^{2,11} It is important to note that physical activity is not a risk factor for developing SCFE.¹¹

DISCUSSION

Introduction/Epidemiology/Risk factors

Slipped capital femoral epiphysis is a unique disorder in adolescent patients that is not uncommon and has long-term effects on those afflicted despite surgical intervention, requiring the attention of primary care physicians who are the in the frontlines of evaluation and treatment.¹⁶ The overall international incidence ranges from 0.33/100,000 to 24.8/100,000 children between the ages of 8-15 years. In the United States alone, the overall incidence is 10.8/100,000, although incidence varies by region.² An updated report on SCFE epidemiology has even suggested that climate variations may play a role in occurrence, noting that northern cities have positive correlations of SCFE during autumn seasons.^{2,17} It has been established that male gender has a higher incidence in comparison to females, with an incidence of 13.35 out of 100,000 among males, compared to 8.07 out of 100,000 among females.¹⁷ For boys, the average age of occurrence is 12 years, versus 11.2 years for girls.² It is important to note that the average age of occurrence has been decreasing, thus SCFE has been diagnosed in younger and younger patients over the years.² Despite this trend in decreasing age at diagnosis, there have been cases of older patients who have developed SCFE, usually associated with an endocrinopathy such as hypothyroidism.^{14,15} Another important epidemiological factor to consider is racial differences in occurrence. Recent studies in the U.S. have noted that African-American patients have a higher incidence of SCFE in comparison to Hispanic, Asian/Pacific Islander, and Caucasian patients. Obesity has been proven to have a strong correlation with SCFE.^{2,10,12,17} A retrospective study on SCFE patients and associated BMIs showed that 81.1% of the

patients had a BMI above the 95th percentile.¹⁰ A correlation has been observed stating that the higher the BMI, the higher the incidence of bilateral SCFE.^{10,12} All of the above are important factors to consider when evaluating pediatric patients with suspicions of slipped capital femoral epiphysis.

Pathophysiology

It is not completely understood why SCFE occurs.¹ There have been considerations to its etiology but has generally been deemed idiopathic in nature. The pathology in SCFE is essentially a Salter Harris Type I fracture involving the misalignment of the femoral epiphyseal head along the physis in comparison to the metaphysis or femoral body. It is probable that dysfunction occurs due to the weakness of growth plates during developmental stages of adolescence, particularly during accelerated growth phases. Provided the strong association of SCFE with obesity and the possibility of traumatic causes, there is a possibility that mechanical forces are to blame for epiphyseal slipping off the femoral neck. In 2015, a computational model was developed to help ascertain the mechanical forces that lead to SCFE. The study concluded that body mass, type of physical activity, and the presence of a perichondrial ring were the most important factors to developing epiphyseal slippage, whereas physeal-diaphysis angle and the physeal thickness did not play as heavily as a role in pathology.¹⁸ In addition to mechanical forces, metabolic factors have been suggested to play a significant role in the development of SCFE. Endocrinological conditions such as hypothyroidism, hypogonadism, and growth hormone deficiencies have been associated with SCFE.¹⁹ A recent study has suggested that effects on the growth hormone-insulin-like growth factor 1 axis by these various metabolic conditions may be responsible as the hormone is important for growth plate composition and eventual closure.²⁰

Presentation/Classification/Severity

As discussed above, patients with SCFE can present with knee pain that sometimes radiates towards the ipsilateral hip, leg length discrepancy on exam, an antalgic gait, and difficulty bearing weight or ambulation.¹ Patients may also have diminished hip ROM, particularly in internal and external rotation.¹ Current classifications of SCFE are based on stability and severity of slippage. Stability of the hip in SCFE is determined by whether or not the patient can bear weight or not.²¹ If a patient is able to bear weight, with or without crutches, then it is considered a stable SCFE. Inability to bear weight is considered unstable.²¹ Severity of SCFE is determined by the angle the femoral body with the femoral head. An angle of <30 is considered mild, 30-50 is moderate, and >50 severe.²²

Diagnosis

SCFE is primarily diagnosed through the use of radiographs.⁷ For patients presenting with knee pain, and within the demographics discussed above, the provider should obtain X-ray imaging of the knee in AP and frog-leg view, along with bilateral hip X-rays for comparison and to rule out bilateral SCFE. CT and MRI imaging is not routinely used for diagnosis, but may be added to further evaluate severity of disease and in assessing the prognosis. Additionally, in questionable cases, CT scanning or MRI may detect small slippages. In postoperative management, CT and MRI have been used by surgeons to help further assess and identify the degree of pathology preoperatively and complications postoperatively, such as hardware failure, ischemic necrosis, and morphology predispos-

ing to femoroacetabular impingement.²³ Furthermore, physicians should consider screening for endocrinopathies in patients in atypical presentation such as patients outside of the typical age range.

Treatment/Management

Untreated SCFE leads to conditions such as avascular necrosis, which may be unseen on imaging until 6-24 months after occurrence, and severe degenerative arthritis in the affected hip.^{1,24} Long term outcomes are favorable when the degree of slippage is minimal.¹⁶ As prognosis depends on severity, the goal of treatment is to prevent further slippage of the femoral head until the growth plate has closed.¹ Despite a growing change in surgical management and practice among orthopedic surgeons, the general treatment of SCFE still remains in the form of immediate surgery as conservative therapies tried in the past did not only show significant benefit.²⁵ To reiterate, once a diagnosis is made, treatment should not be delayed and the patient should be referred to orthopedic surgery immediately. Follow-up after surgical treatment requires re-evaluation every 3-4 months for up to 2 years. During this time, the patient will likely be restricted in physical activity to prevent complications from occurring and to allow healing. Afterwards, these patients may return to normal physical activity, including exercise, pending the surgeon's recommendations.¹ Though the definitive management has been established with surgical intervention, there have not been formal studies or investigations to whether or not osteopathic manipulative therapy/OMT can improve outcomes in the post-operative period. Moving forward, I believe OMT has the potential in improving long term outcomes, functional recovery, shorter times for return to physical activity, and decrease in long term complications.

Conclusion/Importance of discussion

As primary care physicians, we are to keep our differential diagnosis broad when brainstorming on probable causes to dysfunction. As unusual of a condition slipped capital femoral epiphysis is, it is relatively common in the U.S. and should be kept in the back of our minds when assessing lower extremity dysfunction and pathology in the pediatric population. Without diagnostic imaging, presentation of symptoms in SCFE can be vague, thus carrying the risk of a missed diagnosis for physicians in a condition with long-lasting effects on a typically young patient.²⁶ Awareness is important as primary care physicians and holding low threshold to evaluate and rule-out pathology is essential. In addition, provided the musculoskeletal nature of the disease and its treatment, there is great opportunity and potential for research to define the role of osteopathic manipulative therapy in its possible inclusion of SCFE post-operative management.

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