An Evidence-based Approach to the Evaluation and Management of Hip Pain In Children

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This case discussion reviews the various conditions that cause hip pain and suggests an efficient approach. This article addresses an ongoing problem of how to integrate new technology into the evaluation of clinical problems. Some of the tests that were standard in medical training in the past still have merit, whereas others need to be replaced with newer chemical or imaging technology. What do we learn from a plain radiograph? Should we order the more expensive MRI or focus on more cost-effective procedures? What should you do if you do not have an MRI available? Once again, challenging common practice with evidence from good clinical studies keeps the standard of care at a high and practical level.

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EDUCATIONAL OBJECTIVES

- To present the differential diagnosis of hip pain.
- To demonstrate a work-up guided by evidence-based principles of a child with hip pain.
- To understand the initial management steps for various causes of pediatric hip pain.

Key Questions

1. **How is hip pain evaluated in the acute setting?**
2. **What is the role of the primary care physician, the emergency department physician, and the orthopedist?**
3. **What is the appropriate, cost-effective work-up?**
4. **What are the initial steps in management?**

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Case Presentation

An 8-year-old girl has a 2-day history of worsening hip and thigh pain. She never had pain in this hip before. There is no antecedent history of trauma. Her mother first heard the complaints a few days ago and noticed that her daughter stopped playing with her friends. Over the last 2 days she will only walk a few feet before sitting down. Although she has not had any fevers that coincide with this onset of hip pain, she did have fevers approximately 10 days before during a bout of streptococcal pharyngitis. She denies having rashes or any notable insect bites. She denies having any other swollen or painful joints. She is otherwise healthy, has reached all of her developmental milestones appropriately, and her immunizations are up to date.

Scope of the Problem

A hip problem in a child may require urgent treatment to obtain the best possible result. Several conditions affecting the hip can damage the articular cartilage or alter the shape of the femoral head. Such damage and distortion can lead to an incongruent hip joint with an early onset of degenerative arthritis. Therefore, rapid diagnosis and management of hip pain is essential. In a prospective evaluation of 1,000 clinic visits,[1] 61 visits were directly related to musculoskeletal pain and 6% of this pain was localized to the hip. Boys were more often afflicted with hip pain than girls.

Some conditions affecting the hip in a child are readily apparent by history and physical examination, others can be diagnosed with simple imaging, whereas other conditions are subtle and require a comprehensive imaging approach to obtain an accurate diagnosis. Although the pediatrician should focus on efficient and cost-effective diagnosis and management, the "cost" of delayed treatment of a condition such as septic arthritis of the hip is far greater than any group of diagnostic tests.

DIFFERENTIAL DIAGNOSIS

One hundred years ago, a child with hip pain and a limp would probably be suspected to have tuberculosis. Since the advent of radiographs and an increasing

TABLE 1 ■ **Differential Diagnosis of Hip Pain**

Mechanical	*Vascular*	*Infectious*	*Autoimmune*	*Oncologic*
Fracture	Perthes	Septic arthritis	Transient synovitis	Benign tumors
Dislocation	AVN	Osteomyelitis	JRA	Fibrous dysplasia
SCFE	Sickle Cell disease	Pyomyositis	Reiter syndrome	Aneurysmal bone cyst
Foreign body		Diskitis		Simple bone cyst
Meyer's dysplasia		Lyme disease		Malignant tumors
		Tuberculosis		Osteosarcoma
				Ewing tumor

AVN, avascular necrosis; SCFE, slipped capital femoral epiphysis.

understanding of the hip joint and its pathology, the differential diagnosis has extended far beyond tuberculosis, to include other types of infection, as well as problems that are mechanical, vascular, autoimmune, and oncological (Table 1)

The differential diagnosis for this 8-year-old patient should also include several noninfectious conditions.

- Slipped capital femoral epiphysis (SCFE) may be considered, although she is quite young for this condition. SCFE is more typical in obese adolescents. If SCFE occurred in our pateint, endocrine dysfunction should be considered.
- Legg-Calve-Perthes is also a possibility. This condition is an idiopathic avascular necrosis of the proximal femoral epiphysis that is most common in children between the ages of 4 and 8 years. Boys are affected more often than girls. Prognosis is best when the condition begins in children younger than age 6.
- Transient synovitis is the most common cause of hip pain in young children. It occurs in children between the ages of 3 and 8 years and is characterized by an acute onset of hip pain, often associated with a limp; fevers are rare. The children usually appear healthy and have a resolution of their symptoms within a few days after onset. These children do not have the relentless worsening of their symptoms that is seen in septic arthritis.
- Pyomyositis is another consideration in a child who looks ill and has symptoms that refer to the groin and leg. Muscle infections, especially in the psoas muscle or adductor muscle, can mimic septic arthritis. Often, advanced multiplanar imaging is needed to make a rapid diagnosis.

▶ How do you approach the evaluation of this patient?

Developing a diagnosis for a child with hip and thigh pain requires a detailed history and physical examination. The clinician's focus should be on the localization of the pain, the length of time it has been present, antecedent trauma, and signs of systemic illness. The history should include any recent infections or antibiotics used, any past medical problems that may be related, any history of pain in the opposite hip or any other joints, and recent history of trauma. The term trauma encompasses a wide range of conditions including, but not limited to, falls, motor vehicle collisions, contact sports, gymnastics, and iatrogenic events (for example, recent hip aspiration).

Physical examination is best considered in three parts: (1) the gait examination, (2) standing/floor examination, and (3) the tabletop examination. The gait examination is a critical part of an evaluation for hip problems. Assuming the child can walk despite the pain, the examiner should focus on the presence or absence of a Trendelenburg sign—a lurching gait characterized by drop of the pelvis to the opposite side of the affected leg. Children protect a painful limb by shortening the stance phase of gait on the affected side. Children with a SCFE will tend to walk with the leg externally rotated, as will those with a large hip effusion that causes discomfort with internal rotation.

On the standing/floor examination, the examiner should test for a Trendelenburg sign. This is performed by asking the child to stand alternately on each leg for a period of 5 to 10 seconds. The examiner looks for a dropping of the pelvis on the side opposite the affected side, indicating weak abductor muscles. While the child is standing, the examiner should also check for a pelvic obliquity with both feet flat on the floor and legs straight. The pelvic obliquity would be a sign of a leg length inequality. The spine should also be examined, including a forward bend test for scoliosis.

The tabletop examination begins with a visual inspection for rashes, joint swelling, and leg length equality. Inspect the child's limb at rest. Children with a hip joint effusion will rest the leg flexed and externally rotated to maximize the size of the hip's intracapsular volume. A child with SCFE will hold the leg externally rotated. Before performing an aggressive manipulation of the hip, the examiner should check for short-arc tenderness by gently rolling the limb through internal and external rotation. Then the limits of flexion, extension, abduction, and internal and external rotation are documented (Table 2).

The opposite hip and both knees and ankles

TABLE 2 ■ Physical Examination

Phase	Test	Comment
Gait	Trendelenberg sign	Lurching gait and dropping of the pelvis to the opposite side of the affected limb
	Walking with extremity externally rotated	Common in SCFE and hip effusions
Standing floor	Pelvic obliquity	Leg-length discrepancy
	Forward bend test	Scoliosis
	Trendelenberg sign	Dropping of pelvis while standing on one extremity to the opposite side of the affected limb (sign of weak adductor muscles)
Tabletop	Inspection	Rashes Joint swelling Leg-length inequality
	Extremity flexed and externally rotated	Hip effusion
	Extremity externally rotated	SCFE

SCFE, slipped capital femoral epiphysis.

should be ranged as well, looking for limitations of motion or other signs of contractures. With the child in the prone position, internal and external hip rotation can be most accurately checked. Quadriceps tightness also can be checked in the prone position.

▶ How do you organize the approach to the differential diagnosis?

The pediatrician should consider three factors in developing a differential diagnosis for hip pain: (1) the location of the pain, (2) whether the child appears systemically ill, and (3) whether there has been any history of trauma. The first consideration is the location of the pain. Pain emanating from the hip joint will be localized to the groin area. If the child localizes the pain to the lateral aspect of the thigh, diagnoses such as trochanteric bursitis or iliotibial band syndrome should be considered.[2]

The second consideration is the child's overall health. A child who is ill and has groin pain should be carefully and quickly evaluated for the possibility of septic arthritis or osteomyelitis. Septic arthritis, in particular, requires rapid treatment to avoid long-term sequelae. Osteomyelitis also must be rapidly diagnosed and treated. A child who is not ill and has groin pain could have several less urgent conditions. Table 3 lists several hip conditions and typical findings at presentation.

The third consideration is whether there is an antecedent history of trauma. If the child sustained a fall and has sudden hip pain, conditions such as acute slipped capital femoral epiphysis, muscle contusion, fracture, or dislocation must be considered.

▶ How do you organize the approach to the differential diagnosis?

Several conditions should be considered in our 8-year-old patient. With her history of a streptococcal pharyngitis recently and her acute worsening of her symptoms, osteomyelitis and septic arthritis must be considered. Lyme disease, gonococcus (GC), and tuberculosis also are rare infectious causes of hip problems. Lyme arthritis more commonly presents with a knee effusion, GC is generally in sexually active or possibly sexually abused children, and tuberculosis should be considered in those at risk.

Analysis of Case Presentation (Physical)

Our patient has a low-grade fever (99.8°F), but her other vital signs are normal. She does not appear ill. Notably, enlarged submandibular lymph nodes were noticed at physical examination. Further, she has an antalgic gait with a shortened stance phase on the left. The results of her Trendelenberg test were negative. She has pain when the hip is internally rotated. Left hip abduction is 35° compared with 50° on the right side. Examination of her other joints reveal no effusions and a full range of motion.

DIAGNOSTIC APPROACH

Although radiographs are inexpensive and easily obtainable, some authors have questioned their use in this setting.[3–6] However, radiographs can be initially useful to demonstrate fractures, bony lesions, and SCFE. The anteroposterior (AP) and frog lateral views of the hip and pelvis are an essential starting point for this case.

A bone scan is an excellent localizing test[3] that can quickly demonstrate multiple sites of involvement and can demonstrate the vascularity and bone turnover of a region (the "biology"). Bone scan has been shown to be highly sensitive, specific, efficient, and predictive in localizing lesions in occult limping children especially as compared with temperature, white blood cell (WBC) count, erythrocyte sedimentation rate (ESR),

TABLE 3 ■ Common Causes of Pediatric Hip Pain

Condition	Typical Age (years)	Common Presentation
Transient synovotis	2 to 10	Hip pain, muscle spasm, restriction of motion, refusal to walk Onset acute or insidious Usually appear healthy Diagnosis of exclusion
Septic arthritis	0 to 8	Refuse to bear weight Significant pain, even with short arc range of motion Appear uncomfortable or inconsolable Often arthritis of only one joint Fever, chills, systemic complaints Joint effusion seen on ultrasound WBC, ESR, and/or CRP are typically elevated
Osteomyelitis	0 to 10	Short arc motion should be unhindered (unless septic arthritis is present) May be reluctant to bear weight Extremity swelling or subtle loss of ROM High fever and elevated WBC may be seen Bone scan or MRI useful in diagnosis
Perthes	4 to 8	Usually affects boys First sign often a painless limp Early phase with limited abduction of hip, limited internal rotation, and antalgic gait Late phase exhibits Trendelenburg gait, improved motion MRI in early stages and x-ray in late stages confirms diagnosis
SCFE	10 to 17	Bilateral involvement in 1/3 of patients Acute slip Sudden onset of pain, severe enough to prevent weight bearing Normal WBC, CRP, and ESR Chronic slip Most common presentation Pain referred to hip, distal medial thigh, or knee Loss of internal rotation and abduction May have limped for months Radiographs show slippage and widened physis

WBC, white blood cell count; ESR, erythrocyte sedimentation rate; CRP, C-reactive protein; ROM, range of motion; MRI, magnetic resonance imaging; SCFE, slipped capital femoral epiphysis.

and plain radiography.[3] However, some authors argue that it has become outdated and cost ineffective with the availability of magnetic resonance imaging (MRI).[4]

There is significant debate in the literature as to the appropriate use of MRI for the pediatric patient with hip pain. Magnetic resonance imaging has the ability to demonstrate processes of both bone and soft tissue, and both structural and biologic pathology (for example, its use in diagnosing avascular necrosis [AVN]). Furthermore, MRI can detect joint effusions (qualitatively and quantitatively), as well as the presence of a soft tissue abscess. In addition, MRI has also become an essential part of the modern day work-up for malignancy. Some advocate that MRI should be performed when abnormalities are present at the clinical and sonographic examination and when radiographs do not allow a clear diagnosis.[4] Others believe MRI is the imaging modality of choice for the acute nontraumatic hip.[5] When compared with radiography, MRI is significantly more sensitive and specific for diagnosing the acute nontraumatic hip problem. In such cases, MRI was sensitive 79% of the time and specific 100% with an accuracy of 81%. In comparison, radiographs had a sensitivity of 70%, but a specificity of only 57% with an accuracy of 72%.[5] To further enhance the ability of MRI to detect lesions, intravenous contrast, such as gadolinium, can be used to further define or localize abscesses in the soft tissue and bone. Intravenous contrast can also assist in fracture detection. The hypointense signal of edema can mask a fracture line in the sacrum or acetabulum. For this reason, intravenous gadolinium can be used when a fracture is suspected.[7] However, MRI is not without its disadvantages. For best results, the MRI is performed on a patient who is completely still. As such, most children require sedation for an MRI. At some institutions, the cost and immediate availability may prohibit obtaining an MRI on every pediatric patient with hip pain. The average gross charge for an MRI (including the technical and professional fees) is approximately $1,700, whereas the cost for a radiograph is $250. The cost of a CT scan during the same conditions would be $1,200.

▶ What is the role of ultrasound?

Ultrasound provides both a diagnostic and therapeutic modality when it is used to guide aspiration in evaluation of pediatric hip pain. Ultrasound, together with radiographs and serologic testing, represent the first choices in the evaluation of a painful hip if infection is suspected.[4] If performed properly, ultrasound can aid the physician in visualizing and localizing an effusion of the hip. However, ultrasound alone cannot discern between sterile, purulent, or hemorrhagic effusion.[8] To discern between each of these different effusions, an aspiration would be necessary. Clinical evaluation, radiographs, and ultrasound findings together determine the need for ultrasound-guided aspiration.[9] The hip aspirate should be sent for gram stain, culture, and cell count. By localizing the effusion and noting the direction of the ultrasound probe and the plane in which the ultrasound is done, aspiration of the hip in the pediatric patient can be straightforward. Ultrasound is most effective in diagnosing a hip effusion when the hip is extended and abducted, because the distance between the capsule and the femoral neck is significantly larger than when the hip is resting in the neutral position.[10] When there is high suspicion of an effusion, the use of ultrasound as the recommended initial imaging study in children with acute hip pain would reduce the number of early radiographs by 75%.[6]

When an infectious process is in the differential diagnosis, standard blood tests should include a WBC count with a differential, ESR, and C-reactive protein (CRP). An elevated WBC count alone is not sensitive for osteomyelitis or septic arthritis; the differential is more valuable. ESR is acute phase reactant that becomes elevated in the first 24 to 48 hours after the start of the inflammatory process. It takes approximately 2 to 3 weeks to return to normal levels. However, ESR is nonspecific—it can be elevated after surgery, after a systemic infection, or with certain medications. C-reactive protein, an acute phase reactant produced in the liver, is elevated early in an inflammatory process. Often, CRP rises within the first 6 hours of onset and then returns to normal over a 6- to 10-day period. CRP can be used to monitor response to treatment, whether that is surgery or antibiotics. The C-reactive protein assay is the most sensitive early test for musculoskeletal infections.[11] ESR and WBC count are significantly greater in those with septic arthritis than toxic synovitis.[9] Further blood work that may be useful in patients with nontraumatic hip pain include a Lyme titer, antinuclear antibodies, or a rheumatoid factor titer.

In one study, all children with septic arthritis had a hip effusion on ultrasound and at least two of the following criteria: fever, elevated ESR, or elevated CRP.[12] A more recent, evidence-based approach for differentiating between septic arthritis and transient synovitis focused on four evaluative criteria[13]: history of fever, nonweight bearing, ESR $\geq$ 40 mm/h, and WBC $>$ 12,000. When 2 of the criteria are present, there is a 40% probability of septic arthritis, increasing to 93.1% with 3 and 99.6% with all 4.

The results of the preliminary blood work of our patient revealed a white count of 10.8 (normal [nl] 4-11), a sedimentation rate of 33 (nl <20), and a C-reactive protein of 0.7 (nl <1.0). Initial plain radiographs, an AP and Frog lateral of the pelvis, were normal. Given the age of the child, that there was no history of trauma, and that she did not appear ill, further diagnostic testing was debated. Her condition clearly localized to the hip so a bone scan did not seem necessary. If the differential were between septic arthritis and transient synovitis, the recommended test would be an ultrasound with possibly an ultrasound-guided aspiration. In this case, given the normal CRP and thus the low suspicion of infection, the differential was between Legg-Calve-Perthes and transient synovitis. In such a case, an MRI can be helpful in seeing early avascular necrosis not detectable on the plain radiographs. We chose an MRI. The MRI showed a small hip effusion, early avascular changes of the femoral head, with no other signs of infection, fracture, or other conditions. Thus, this 8-year-old's acute pain was caused by the subchondral fracture and synovitis seen in early Legg-Calve-Perthes.

If MRI is not available, serial radiographs can be taken. However, as in this case, radiographs may not show any changes if the disease is early in its course. As such, if a diagnosis of Perthes is highly likely, then a period of nonweight bearing or limited weight bearing should be undertaken until confirmation can be attained with either an MRI or radiographic changes that would appear in a few weeks.

TREATMENT OPTIONS

Perthes is generally treated without surgery. The principles of nonoperative treatment are maintenance of range of motion and containment of the femoral head through the evolution of healing of the epiphysis. Nonoperative treatment includes activity modification and protected weight bearing.[14] Containment of the femoral head in the normal acetabulum during the repair process may lead to a more spherical head and a congruous joint. When significant loss of motion occurs, casting in abduction, sometimes with adductor tenotomy, will regain motion and containment.[15]

Legg-Calve-Perthes disease was first published in February 1910 by Legg in the United States, by Calve in July in France, and by Perthes in October in Germany. The aim of treatment for this disease is to prevent deformity of the femoral head, thereby preventing degenerative joint disease of the hip in adult life. The principle of treatment is prevention of excessive forces on the hip during healing and revascularization. The methods of treatment in the past, all based on the principle of limited weight bearing, have included continuous confinement to bed in an institution for several years, to various weight-relieving braces, to a sling and crutches. The underlying principle in treatment (to prevent excessive forces on the

hip) is containment of the femoral head. Even with treatment, prognosis is variable. Age of onset plays a significant role, with those younger than 6 years having a good prognosis, fair if half the femoral head is involved in those between 6 and 9 years, and poor if onset is after age 9.

REVIEW OF TREATMENT OF OTHER CONDITIONS

The management of transient synovitis includes aspiration of the hip joint if septic arthritis is a concern. Once the diagnosis has been made, antiinflammatory agents, rest, and time (usually a few days) will allow symptoms to resolve.[16]

Septic hips are a surgical emergency; as soon as the diagnosis is made, they should be drained through an anterior approach. Intraoperative cultures of the joint fluid and surrounding tissue are obtained. The joint is thoroughly lavaged with saline and the skin is closed over a drain. Intravenous antibiotics are begun after cultures are obtained. In one study, a community-acquired, acute gram-positive septic arthritis of the hip was managed safely with surgical drainage, a shortened course of parenteral antibiotics, and then oral therapy.[17] Two weeks of intravenous antibiotics followed by up to 4 weeks of oral therapy[18] led to no known treatment failures in 116 cases. Antibiotic coverage is based on antimicrobial susceptibilities. If left untreated, a septic hip can lead to destruction of the joint or the femoral head, leg length discrepancy, and/or hip dislocations.

Osteomyelitis, when diagnosed early, is usually treated medically. In acute cases, empirical treatment may be used initially. Surgery is indicated if there is radiographic evidence of bone destruction, or if there is no response to medical treatment. The length of treatment with intravenous antibiotics remains controversial. The 6-week benchmark was determined largely with childhood hematogenous osteomyelitis.[19] Six weeks of oral antibiotics are to follow 6 weeks of parenteral therapy in those with a history of chronic osteomyelitis.[20] In practice, CRP is monitored closely, and the course of antibiotics is shortened if the CRP returns to normal rapidly.

Patients with Lyme arthritis of the hip are treated with oral antibiotics (usually amoxicillin for 4 weeks). If the child has neurologic symptoms, carditis, or resistant arthritis, then intravenous antibiotics are required (ceftriaxone).[21]

CASE REVIEW

The management of the 8-year-old girl with Legg-Calve-Perthes was guided by a thorough history and physical examination that immediately limited the long differential diagnosis. In this case, some basic laboratory work, a radiograph, and an MRI confirmed diagnosis. Magnetic resonance imaging was essential in diagnosing early Perthes disease in our patient by detecting changes that were not yet visible on plain radiographs.

Summary of Key Points

- Pediatric hip pain is a common problem seen by pediatricians, emergency room physicians, and orthopaedic surgeons.
- Several conditions in the differential diagnosis of pediatric hip pain require urgent attention to avoid significant long-term sequelae.
- A careful history and physical examination are essential.
- Each form of radiologic testing has a sensitivity for diagnosis (see Table 3) of pediatric hip pain.
- Recent research on the efficacy of several laboratory and imaging tests now allows an evidence-based approach to the efficient and cost-effective evaluation of a child with a potential hip problem.
- Magnetic resonance imaging allows for early diagnosis of Perthe disease with minimalization of sequelae, especially in the older child.

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