Three Cases of Slipped Capital Femoral Epiphysis in One Family

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abstract

Slipped capital femoral epiphysis is a relatively common disorder of the hip that affects children in late childhood and early adolescence, with an incidence in the United States of approximately 10 per 100,000. Although the diagnosis and treatment of slipped capital femoral epiphysis have been well described, the search for its cause and a method of early identification continues. Recent publications have suggested that there is a familial association among individuals with slipped capital femoral epiphysis, but there is no current genetic marker established for the disorder. This article reports a series of 3 biologically related Caucasian sisters who were athletic; had body mass indices <25 kg/m²; had no record of any hormonal imbalances or endocrine abnormalities; had good nutrition; and presented with atypical characteristics of slipped capital femoral epiphysis. This is the first report of a series of 3 sisters with slipped capital femoral epiphysis in the United States. Our goals were to document our experience in the identification and treatment of these patients to highlight the complexities of slipped capital femoral epiphysis presentation patterning, to increase the awareness and reporting of familial cases of slipped capital femoral epiphysis by other physicians, and to encourage additional research in this area. As clinicians progress in the ability to diagnose and treat patients with slipped capital femoral epiphysis, they also must be mindful of the varying presentation characteristics.
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lipped capital femoral epiphysis is a relatively common disorder of the hip that affects children in late childhood and early adolescence; the incidence in the United States is approximately 10 per 100,000.1 Slipped capital femoral epiphysis most frequently occurs as a stable chronic (>3 weeks of symptoms) slip in obese boys of Polynesian and African descent.2,3 The term slipped capital femoral epiphysis is actually a misnomer because the femoral epiphysis is not moving in this condition: the epiphysis is stabilized in the acetabulum, and it is the femoral neck and shaft that displace, usually in an anterior direction with external rotation relative to the femoral epiphysis. The disorder is most common in peripubertal children and is thought to be the result of mechanical weakening along the femoral physis.1

There are several classification systems for slipped capital femoral epiphysis based on various aspects such as timing (acute versus chronic slips), percentage slip, angle slip, and stability. In 1993, Loder et al2 described a classification method based on stability: stable patients can bear weight on a hip with slipped capital femoral epiphysis whereas unstable patients cannot bear weight. This method has been used for its ability to detect high-risk complications, such as osteonecrosis and chondrolysis, that can develop from a delay in treatment.

On imaging, slipped capital femoral epiphysis is commonly classified based on Klein’s line and Southwick angles. Slipped capital femoral epiphysis is present when Klein’s line, a line drawn across the superior aspect of the proximal femur in anteroposterior or lateral radiographs, does not intersect part of the epiphysis. Southwick angles compare the angle between the anterior and posterior aspects of the physis with the femoral neck axis. A difference of <30° between hips is mild, 30° to 50° is moderate, and >50° is severe.4

The diagnosis and treatment of slipped capital femoral epiphysis have been well described,1,4 and single-screw percutaneous fixation is the preferred form of treatment. However, the search for the cause and early detection of this condition continues.1

This article reports 3 biologically related Caucasian sisters with slipped capital femoral epiphysis who presented with atypical characteristics of the disorder. This case series is the first analysis of 3 sisters with slipped capital femoral epiphysis in the United States. Our goals were to document our experience in the identification and treatment of these patients to highlight the complexities of slipped capital femoral epiphysis presentation pattern, to increase awareness and reporting of familial cases of slipped capital femoral epiphysis by other physicians, and to encourage additional research in this area.

**Case Reports**

Over a 7-year period, 3 sisters (the only children in their family) presented for evaluation of hip pain. There was no family history of slipped capital femoral epiphysis, endocrine problems, or obesity. The patients are described in the order of their presentation.

**Patient 1**

The first sister (12 years old) presented in 2001 with a 1-month history of left leg and knee pain that radiated proximally on the left lateral aspect of the thigh from the left knee. The aching, and at times sharp, pain was primarily activity-related. At presentation, she was diagnosed with a stable, mild left hip slipped capital femoral epiphysis. She was at the 75th percentile for weight and less than the 3rd percentile for height; her body mass index was 25.7 kg/m². Her slipped capital femoral epiphysis was successfully treated with percutaneous screw fixation (Figures 1A and 1B). At her latest follow-up examination in 2009, she was being monitored for left hip pain and idiopathic scoliosis (Figure 1C).

**Patient 2**

The second sister (13 years old) presented in 2006 with a 6-month history of hip pain with weight bearing. Her medical history was remarkable for several episodes of chest tightness that occurred with exercise approximately 1 year before presentation. In addition, she was undergoing treatment for osteochondritis dissecans of the right ankle. Treatment for her osteochondritis dissecans included the use of a cane walker boot for several months. She thought that the changes in her gait and developing hip pain were related to the boot, and only after the hip pain markedly increased did she seek medical attention.

At presentation, she was diagnosed with a stable but severe right hip slipped capital femoral epiphysis. She underwent a cardiovascular evaluation and echocardiogram because of her history of chest tightness; both tests were normal. Endocrine tests also were normal. She was at the 90th percentile for weight and the 9th percentile for height, and her body mass index was 25.7 kg/m². Her slipped capital femoral epiphysis was successfully treated with percutaneous screw fixation (Figures 1A and 1B). At her latest follow-up examination in 2009, she was being monitored for left hip pain and idiopathic scoliosis (Figure 1C).

**Patient 3**

The third sister (10 years old) presented in 2007 with a 3- to 4-week history of insidious right hip pain attributed to physical activity. Her history was remarkable only for minor hearing problems for which she received myringotomy tubes when she was 6 years old, and she also underwent adenoidectomy and tonsillectomy when she was 8 years old. She was otherwise healthy, with no other medical problems.

Subsequent radiographic assessment showed a mild slipped capital femoral epiphysis in the right hip with early closure. It was determined that this stable slip did not require surgery, and she underwent nonoperative treatment with acetaminophen as needed and physical therapy. At her latest follow-up examination, the patient was doing well and had no pain or disability in either hip.
Case Report

At presentation, she was at the 90th percentile for weight and the 25th percentile for height, and her body mass index was 25.8 kg/m². Endocrine tests were normal. She was diagnosed with a stable, mild right slipped capital femoral epiphysis and was successfully treated with percutaneous screw fixation (Figures 2A and 2B).

Her postoperative course was unremarkable until 19 months later when she developed left hip pain and subsequently was diagnosed with a stable, mild left slipped capital femoral epiphysis. She underwent a second percutaneous screw fixation for this hip, and at her last follow-up examination, she had no pain or disability in either hip (Figures 2C and 2D).

DISCUSSION

Our case series is unique given the atypical presentation characteristics: the patients were Caucasian, nonobese, athletic sisters with bilateral involvement, and no history of endocrine problems. According to Kay, after a diagnosis of slipped capital femoral epiphysis has been made in a family member, a second family member has been reported to be affected in 3% to 7% of reported cases. There are few reports of slipped capital femoral epiphysis occurring in siblings, and our cases are the first description of 3 sisters in the United States.

Several studies have described the genetic characteristics of children presenting with slipped capital femoral epiphysis. In the past several decades, human leukocyte antigen testing has allowed for inferences about possible genetic causes of slipped capital femoral epiphysis, but such studies differ by region and do not identify a distinct genetic marker. The inheritance pattern seen in familial occurrences of slipped capital femoral epiphysis is thought to be autosomal dominant with variable penetrance. For example, Moreira et al of Portugal reported a case series showing that an African American father with minimal
slipped capital femoral epiphysis had 3 affected children from 2 unaffected wives. This familial clustering, as presented by Moreira et al\(^7\) and supported by our case series and other series,\(^2,4,8,9\) shows a predisposing hereditary factor. However, endocrine, geographic, and environmental factors have also been suggested as causative elements of slipped capital femoral epiphysis.\(^1,10\) Therefore, the familial clustering of slipped capital femoral epiphysis could be the result of a genetic marker, a common provocative environmental factor, or combined genetic and environmental predispositions.

Although the cause of slipped capital femoral epiphysis is still debated, most sources agree with regard to its epidemiology and demographics.\(^1,4\) The mean age at diagnosis is 13.5±1.7 years in men and 12.0±1.5 years in women, with a predominance in men (60% of cases).\(^3\) Most patients with slipped capital femoral epiphysis are obese, with weights above the 95th percentile according to age at the time of diagnosis.\(^3\) The racial predilection of slipped capital femoral epiphysis is 1.0 for Caucasians, 4.5 for Pacific Islanders, 3.9 for African Americans, and 2.5 for Hispanics.\(^1,8\) Several case series support these demographic representations in their descriptions of the occurrence of more than one case of slipped capital femoral epiphysis in the same family.\(^7,8,11\)

Our series, however, is unique in the consistent atypical presentation of baseline characteristics. The patients were siblings, female, Caucasian, and slightly overweight, although not obese. These atypical characteristics are important indicators that if there is a hereditary or genetic link with slipped capital femoral epiphysis, the mechanism may transcend the physical characteristics of patients. The patients in our series did not want to pursue genetic testing.

Loder et al\(^12\) found that slipped capital femoral epiphysis occurs at a higher incidence in children with endocrine disorders, specifically hypothyroidism. Thyroid dysfunction was present in another familial case series of slipped capital femoral epiphysis in Australia.\(^11\) After we noticed the familial trend in our patients, endocrine studies, including thyroid tests, were performed on the second and third patients. Their thyroglobulin, thyroid-stimulating hormone, and T3 levels were normal; the only notable deviation was a decreased serum creatinine level in both patients.

Loder et al\(^12\) also noted that previous use of growth hormone supplementation was an associated factor with slipped capital femoral epiphysis.\(^1\) None of our patients were on gonadotropin-releasing hormone supplements or had previously taken these substances. Similarly, their testosterone and estrogen levels were normal. Systemic diseases, such as renal osteodystrophy, have commonly been associated with patients with slipped capital femoral epiphysis who have heights less than the 10th percentile for age; however, none of our patients had any signs of systemic diseases or chondrodysplasias.\(^4\) Finally, none of our patients had undergone previous radiation therapy, which also has been implicated in slipped capital femoral epiphysis.\(^4\)

The cause of slipped capital femoral epiphysis most likely involves biochemical and biomechanical factors that combine to weaken the physis.\(^1\) All 3 of our patients participated in similar athletic endeavors such as field hockey, volleyball, softball, soccer, and skiing, and all described themselves as being “very active” in these sports. The sisters also reported consuming well-balanced diets. They ate many of the same foods and took multivitamins most days of each week. We have previously reported on an association between slipped capital femoral epiphysis and vitamin D deficiency,\(^13\) but in this case series, the patients’ nutritional states and activity levels were appropriate for their gender and age. It was interesting to note, however, that 2 of the sisters had medical histories requiring cardiac evaluation; there is no previous research reporting the combination of cardiac abnormalities and slipped capital femoral epiphysis.

It is also important to note that 2 and possibly all 3 of our patients could have benefited from prophylactic pinning of the uninvolved hip during their initial operation. The use of prophylactic pinning in slipped capital femoral epiphysis is a controversial area of research. It likely would have prevented follow-up visits for pain and reoperation in our case series.\(^14,16\)

As clinicians progress in the ability to diagnose and treat slipped capital femoral epiphysis, they must also be mindful of the varying presentation characteristics. Our series is clinically relevant because of its sibling hereditary connection and the atypical demographic presentation. Patients with a past positive familial history of slipped capital femoral epiphysis should be closely monitored for early detection. With an earlier diagnosis, these patients can be successfully treated, possibly avoiding subsequent major complications such as osteoarthritis, corrective osteotomy, and hip replacement.

**REFERENCES**


