Stable Slipped Capital Femoral Epiphysis: Evaluation and Management

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Abstract

Slipped capital femoral epiphysis (SCFE) has been classified traditionally on the basis of the duration of symptoms, but it has recently been recognized that this classification system may be misleading. It has instead been recommended that slips be classified on the basis of the presence or absence of gross instability between the epiphysis and the metaphysis. An adolescent with chronic SCFE has had symptoms for more than 3 weeks and does not have physeal instability. The first priority of treatment of stable chronic SCFE is to avoid the complications of avascular necrosis and chondrolysis while securing the epiphysis from further slippage. The treatment of choice for stable chronic SCFE is stabilization in situ, which can be most easily achieved with single-screw fixation. Primary realignment procedures, such as osteotomies, are not recommended.

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Slipped capital femoral epiphysis (SCFE) is the most common hip disorder in the adolescent age group. The incidence is approximately 2 cases per 100,000 persons.[1] Boys are affected more often than girls.[1] The average age at which SCFE develops in girls is 12.1 years ± 1.0; in boys it is 14.4 years ± 1.3. When skeletal age rather than chronologic age is considered, the average pelvic bone age at onset is 13.2 years ± 0.6 for girls and 15.1 years ± 0.6 for boys. There appears to be uniformity in the skeletal age at onset of SCFE; that is, there is a narrow window of time during which SCFE occurs.[2]

Epidemiology

The adolescent who is at greatest risk for the development of SCFE is overweight and skeletally immature. In one study,[3] the weights of 60% of the patients were more than two standard deviations above the mean for their chronologic age.[3] The left hip is more commonly involved than the right. The incidence of bilateral involvement is 20% to 40%. Black persons have a higher incidence than whites.

Etiology

In individual cases, the etiology of SCFE is usually unknown. If SCFE occurs outside the usual age range, it is often associated with a condition that decreases the strength of the physis, such as an endocrine disorder or the changes that follow radiation treatment in the hip area.[4] Mechanical shear forces on the physis associated with obesity may be the cause of SCFE, or there may be a predisposing factor that weakens the physis.

Retroversion of the femoral neck has been associated with SCFE, possibly due to shear forces that occur during walking. Endocrine disorders associated with SCFE include hypothyroidism, growth hormone deficiency, and hypogonadism.[5] Animal studies have demonstrated that the ability of the physis to resist shear forces decreases at the time of puberty. Growth hormone stimulates physeal cell division, further decreasing the strength of the growth plate as the zone of hypertrophy widens. However, several studies evaluating possible hormonal disorders in patients with SCFE have failed to detect any abnormalities, suggesting that mechanical factors, such as obesity, are usually the most important cause of SCFE.

The association of SCFE with synovitis in the hip has led some to pos-

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tulate that the etiology of SCFE may be related to a localized abnormality in the immune system. Increased levels of immunoglobulin (Ig) A, IgM, and IgG have been reported in patients with SCFE, but it is unclear whether these changes are primary or secondary to the slip.

Pathogenesis

It was originally thought that the femoral head slipped downward on the femoral neck, creating an epiphyseal coxa vara. Recent studies have demonstrated that this is not the case; the name SCFE is therefore actually a misnomer. The femoral head remains in the acetabulum, while the femoral neck displaces anteriorly, creating a retroversion deformity of the proximal femur.

Slipped capital femoral epiphysis is associated with synovitis with hypervascularity, round cell infiltration, edema, and hyperplasia of the synovial membrane. There is widening of the physis, and the cells in the physeal zone of proliferation are disorganized and grouped into clusters. The slip occurs through the physeal zone of hypertrophy, with occasional extension into the zone of primary calcification.

Natural History

Stable SCFE occurs slowly, with concomitant remodeling of the femoral neck. As the femoral neck displaces anteriorly with respect to the femoral head, there is simultaneous anterior and posterior resorption of the femoral neck and subperiosteal new-bone formation posteriorly, creating a retroversion deformity of the proximal end of the femur. The slipped epiphysis will eventually fuse with the femoral neck at the end of growth. Although some patients with SCFE never experience symptoms and healing subsequently occurs with minimal deformity, gradual progression of the slip is the rule, until physeal closure occurs.

Cooperman et al[6] found nine adult hip specimens with untreated SCFE at the Cleveland Museum of Natural History; osteoarthritis was detected in eight of the nine hips, with the most advanced degeneration seen in those with the most severe slips. The “pistol-grip deformity” noted on the radiographs of patients with early osteoarthritis is considered by some to be secondary to a prior asymptomatic SCFE during adolescence.

Clinical Examination

The patient usually complains of pain in the hip or groin, with worse pain on walking. The hip is innervated by three nerves: the obturator, the femoral, and the sciatic. Femoral nerve pain is referred to the anterior distal thigh; obturator nerve pain is usually referred to the medial thigh; and sciatic nerve pain is primarily referred to the buttock or posterior thigh region. As a result, the teenager may complain of pain in the area of the knee rather than the hip, and the diagnosis may be missed initially. If a child’s complaints of knee pain are not supported by the clinical findings, the hip must be examined carefully. In addition, both hips should be examined, as patients with bilateral SCFE may have pain on only one side.

On physical examination, the patient with a stable SCFE walks with an antalgic limp with the leg externally rotated. Examination of the hip classically demonstrates a loss of internal rotation, but a loss of flexion and abduction is also common. In contrast, the patient with an unstable SCFE is unable to walk or bear weight, even with crutches. The Salter-Harris type I fracture present in the unstable type of SCFE creates an effusion in the hip; there is also limitation of motion due to marked pain.

Classification

Traditionally, SCFE has been classified as acute, acute-on-chronic, or chronic, according to the duration of symptoms. With an acute slip, there is a sudden onset of pain that prevents walking.[7] With a chronic slip, there is a gradual onset of symptoms over a period of more than 3 weeks. An acute-on-chronic slip involves a history of pain for more than 3 weeks and a recent, sudden exacerbation of pain that precludes walking. Based primarily on the duration of symptoms, this classification may mislead physicians because it does not consider the stability of the slip.

Loder et al[8] recently revised the classification of SCFE by dividing slips into those that were “stable” and those that were “unstable.” They reported that patients with stable slips were able to walk, while those with unstable slips could not bear weight even with the use of crutches. This classification is useful in predicting the likelihood of avascular necrosis of the femoral head, which develops in about half of patients with unstable slips but in fewer than 10% of those with stable slips. This classification also correlates with the prognosis; Loder et al reported a satisfactory result in 96% of stable hips, but in only 47% of unstable hips.

Kallio et al[9] proposed a modification of the classification of SCFE based on sonographic visualization of the proximal femur. Unstable SCFE is associated with effusion within the hip, with or without the presence of bone remodeling (Table 1). Clearly, it is important to determine whether the slip is stable or un-

Table 1
Classification of SCFE*

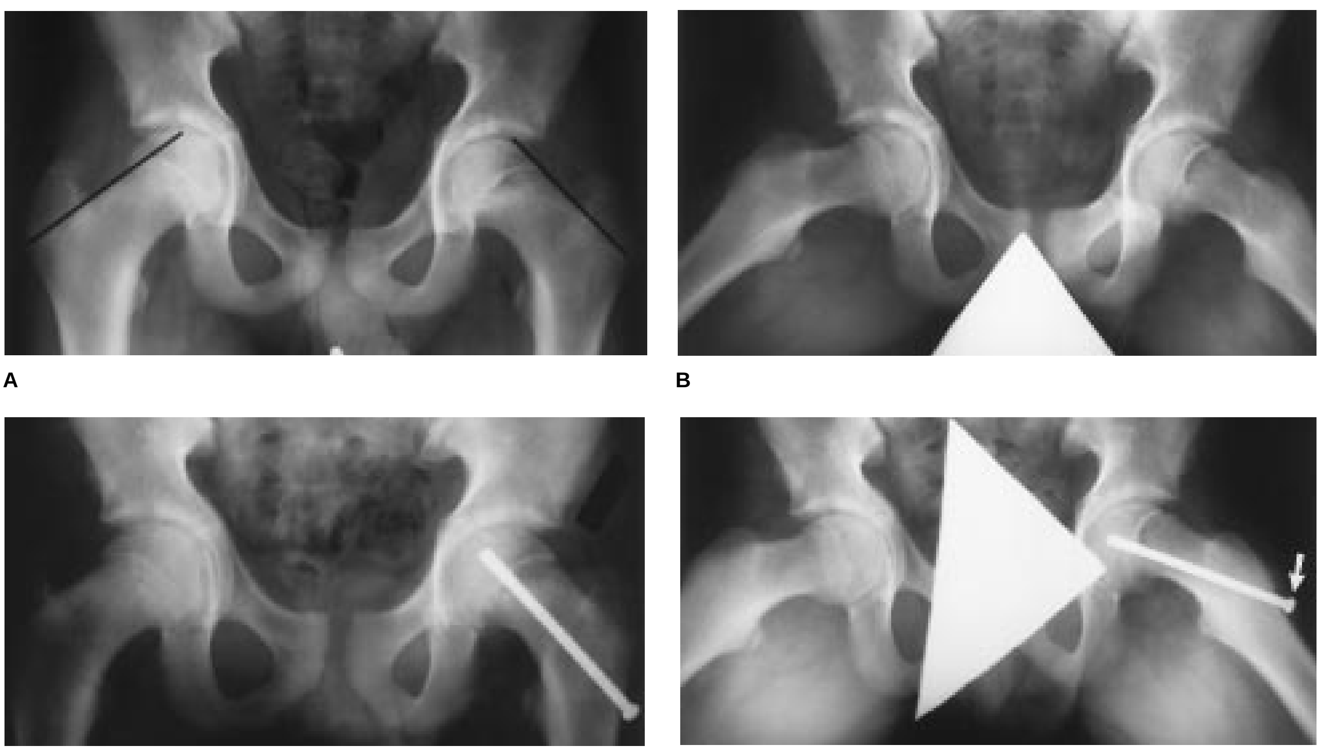
Type of SCFE	Able to Bear Weight?	Hip Joint Effusion?†	Closed Reduction Successful?	Metaphyseal Remodeling?‡
Stable	Yes	No	No	Yes
Unstable	No	Yes	Yes	No

* Adapted with permission from Kallio PE, Paterson DC, Foster BK, et al: Classification in slipped capital femoral epiphysis: Sonographic assessment of stability and remodeling. *Clin Orthop* 1993;294:196-203.
† As visualized on sonography.
‡ As visualized on sonography or radiography.

stable before treatment, both to determine the most appropriate treatment and to advise the parents of the potential development of later complications from the slip.

Diagnostic Imaging

Anteroposterior and frog-leg lateral pelvis radiographs are the traditional imaging studies obtained to evaluate for SCFE (Fig. 1). If the slip is unstable and the patient has too much pain to move the leg, true lateral radiographs of both hips are recommended because of the high frequency of bilateral SCFE. If the slip is minimal, specific regions should be evaluated, because the radiographic signs may be subtle. On the anteroposterior radiograph, the physis is irregular and wider than normal. Since the femoral neck displaces anteriorly, the femoral epiphysis falls posteriorly; as a result, the height of the epiphysis is usually decreased on the anteroposterior projection relative to the contralateral hip. A line drawn along the superior border of the femoral neck (Klein's line) normally intersects the lateral part of the epiphysis but usually fails to do so in the presence of SCFE.



A B C D

Fig. 1 **A,** Anteroposterior pelvis radiograph of a 12-year-old boy with a stable SCFE on the left. Note that Klein's line fails to intersect the epiphysis on the left. **B,** Improved visualization of the SCFE on a frog-leg lateral radiograph. **C,** Postoperative anteroposterior radiograph shows the screw in the center of the epiphysis, perpendicular to the physis. **D,** Postoperative frog-leg lateral radiograph shows the screw entering the bone anteriorly (arrow), traversing the neck to engage the center of the epiphysis perpendicular to the physis.

The radiologic classifications of SCFE are based on either displacement or tilt of the femoral head with respect to the femur. As the femoral neck moves anteriorly, the percentage of displacement of the femoral head on the neck can be measured and classified as follows: minimal, 0% to 33%; moderate, 34% to 66%; severe, 67% to 100%. Similarly, as the femoral head tilts posteriorly, the angle between the femoral head and the femoral shaft can be measured on the frog-leg lateral radiograph with use of the technique described by Southwick.[10] The value for the head-shaft angle of the normal hip is subtracted from that for the head-shaft angle on the affected side and classified as follows: mild, 0 to 29 degrees; moderate, 30 to 60 degrees; severe, greater than 60 degrees (Fig. 2). For bilateral slips, 12 degrees is subtracted from the head-shaft angle to calculate the degree of the slip. Twelve degrees was selected because it was the average head-shaft angle (range, 4 to 21 degrees) on the frog-leg lateral radiographs of 65 asymptomatic adolescents.[3] The head-shaft angle on the true lateral radiograph reflects the amount of retroversion of the proximal femur.

Sonography does not entail the projectional errors of conventional radiographs and can accurately show the amount of the slip, the presence of a hip effusion, and metaphyseal remodeling. Although not used as often as routine radiography, ultrasound evaluation may be more sensitive in detecting mild slips.[9]

The routine use of bone scintigraphy in the evaluation of SCFE is not recommended, although premature closure of the greater trochanteric apophysis has been reported to be a predictive sign of chondrolysis in hips with SCFE.[11] Bone scans have also been used in the preoperative assessment of patients with an unstable slip who are at high risk for avascular necrosis. Some caution in interpreting bone scans in this setting is recommended, as false-negative results have been reported.[12]

While computed tomography and magnetic resonance (MR) imaging can show the anatomic deformity of the proximal femur in SCFE, the true lateral radiograph visualizes the deformity almost as well and at a lower cost. In unstable slips, with a higher risk of avascular necrosis, MR imaging may be valuable because it depicts marrow changes associated with avascular necrosis earlier than does radiography.

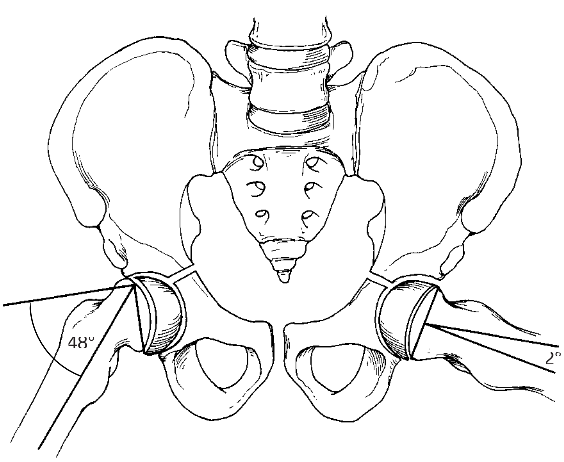


Fig. 2 The head-shaft angle, as described by Southwick,[10] is measured on the frog-leg lateral radiograph to determine the degree of the slip, which is calculated by subtraction of the angle on the normal side from the angle of the affected hip. In the example shown, the head-shaft angle is 36 degrees (48 degrees minus 12 degrees).

Treatment

In treating a patient with a stable SCFE, the most important priority is "primum non nocere" (first, do no harm). The traditional management for a patient with SCFE has long been immediate admission to the hospital, so as to begin treatment without delay. This was recommended to prevent the possibility of adding an unstable slip to a previously stable one, which can occur if the patient slips and falls. As timely stabilization of the slip is still recommended, hospital admission at the time of diagnosis is preferred when possible. Some medical centers currently advocate scheduling the operative procedure on an outpatient basis, thus avoiding hospitalization altogether. In such circumstances, proper patient and parent education on activity restriction before surgery and expedient scheduling are mandatory.

Treatment is designed to stabilize the slip and avoid the complications of avascular necrosis and chondrolysis. Previous investigators have reported that black patients have a higher incidence of chondrolysis, but recent studies report similar incidences for all races. As noted by Howorth, avascular necrosis does not occur in untreated stable SCFE.[4]

Although some patients with a stable SCFE may heal spontaneously, progressive gradual slipping is the rule if the physis remains open, and treatment is necessary to prevent continued slippage. The treatment of SCFE currently includes several accepted, yet very different, methods, with each approach having its advantages, disadvantages, and risks of causing chondrolysis or avascular necrosis. The three primary treatment approaches are

(1) stabilization of the slip in situ, (2) correction of the deformity at the physeal level with stabilization, and (3) stabilization of the slip in situ with corrective osteotomy distal to the physis. The safest treatment for a chronic or stable SCFE is in situ stabilization.

Single-Screw Fixation In Situ

There are several advantages of single-screw fixation for SCFE: high success rate, low incidence of further slippage, and minimal complications if the screw is properly placed. Brodetti[13] studied the vascular supply to the femoral head with an injection of a barium–Berlin blue suspension and reported that the main blood supply to the femoral head comes from the lateral epiphyseal vessels, which enter posterosuperiorly and anastomose with the vessels from the ligamentum teres near the junction of the medial and central thirds of the femoral head (Fig. 3). The inferior metaphyseal vessels enter anteroinferiorly and anastomose with the vessels of the ligamentum teres and the lateral epiphyseal vessels, but the physis acts as a barrier, limiting the contribution of the inferior metaphyseal vessels in the adolescent.

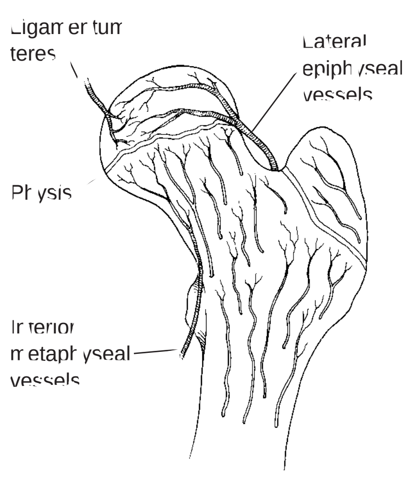


Fig. 3 Blood supply of the femoral head before physeal cartilage closure. The lateral two thirds of the femoral head is supplied by the lateral epiphyseal vessels.

Brodetti[13] appropriately warned against placing a screw or nail in the posterosuperior quadrant of the femoral head because of the high possibility of causing avascular necrosis by injuring the lateral epiphyseal vessels. The ideal position for a screw or pin is in the central area, or "neutral zone," of the femoral head.

In positioning the patient with a stable SCFE, either a fracture table or a fluoroscopic operating table may be used. If a fracture table is used, the patient is placed supine to allow simultaneous anteroposterior and lateral imaging. Because the operative procedure is highly dependent on adequate fluoroscopic imaging, it is crucial that the femoral head and neck be well visualized on both projections before starting the procedure.

Since most stabilization or pinning of SCFE is done with small skin incisions, the proper starting position for the pin or screw is important. To determine this starting point, place a guide pin on the skin overlying the proximal femur and, under anteroposterior fluoroscopic guidance, position this pin so that it projects up the femoral neck and over the center of the femoral head, crossing the physis in a perpendicular manner. Once this pin position has been obtained, a pen line is drawn on the skin along the length of the pin. The same procedure is then used with the lateral image, and a 1-cm incision is made at the intersection of the two lines (Fig. 4). Since the epiphysis is displaced posteriorly in SCFE, the skin incision becomes increasingly more anterior as the severity of the slip increases.

The guide pin is advanced freehand through the soft tissues to engage the anterolateral femoral cortex, usually on the distal aspect of the femoral neck. The position and angulation of the guide pin are adjusted simultaneously in both planes with the use of fluoroscopic guidance to obtain the proper position before the pin is drilled into the bone. It is ideal to position the guide pin in the center of the femoral head, perpendicular to the physis, on both fluoroscopic views on the first try, since multiple unused drill holes can weaken the bone and predispose to fracture at this site (Fig. 5).

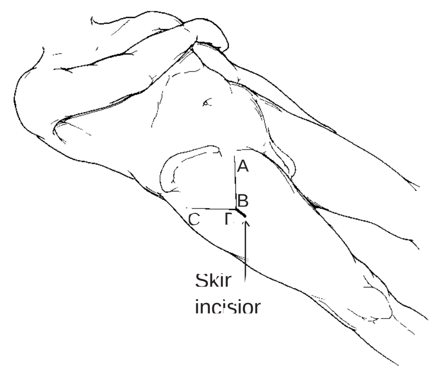


Fig. 4 Technique and landmarks used to mark the position of the skin incision for pin placement. A–B represents line overlying femoral head and neck (bisecting femoral head and lying perpendicular to physis) as visualized on anteroposterior fluoroscopic image. C–D represents line overlying femoral head and neck (also bisecting femoral head and lying perpendicular to physis) as visualized on lateral image.

After the appropriate screw length to be used has been determined with a depth gauge, a large cannulated screw is placed over the guide pin and advanced until five threads engage the epiphysis. It is important that the screw not be left protruding too far beyond the anterolateral cortex, as it may be toggled by the anterolateral soft tissues with hip movement, leading to screw loosening.

Postoperatively, the patient is allowed to begin partial weight-bearing as tolerated. Most patients can

Fig. 5 Radiograph of a 13-year-old boy who underwent multiple-pin fixation of a stable SCFE. Three weeks postoperatively, he slipped and fell, sustaining an intertrochanteric fracture through an unused drill hole.

ambulate without crutches within 3 to 5 days.

Some surgeons prefer to use the fluoroscopic operating table, instead of the fracture table, to stabilize a chronic SCFE with a single screw. Since the chronic SCFE is by definition stable, the hip can be moved to obtain anteroposterior and frog-leg lateral views. There is less setup time prior to the start of the procedure. The exact starting point for the skin incision is somewhat harder to locate, because it is determined primarily from the anteroposterior image; however, this is not a major problem. Pinning of bilateral SCFE is quicker and easier for some. The screw placement over a guide pin into a central position in the femoral head, perpendicular to the physis, is the same as when a fracture table is used.

The results of single-screw fixation for SCFE have been gratifying. Aronson and Carlson[14] reported excellent or good results in 36 of 38 hips with mild slips, 10 of 11 with moderate slips, and 8 of 9 with severe slips. Avascular necrosis developed in only 1 patient with an unstable slip, and chondrolysis developed in none. Ward et al[15] reported on 42 patients (53 hips) with SCFE treated with a single screw. After a mean follow-up period of 32 months, 92% demonstrated physeal fusion and participated in full activities. No cases of chondrolysis or avascular necrosis were reported.

Once the physis has fused, the screw can often be removed percutaneously by reinserting the guide pin, under fluoroscopic control, into the screw (Fig. 6). The screwdriver can then be inserted over the guide pin to remove the screw. It is important to note that not all surgeons advocate routine screw or pin removal after physeal closure.

Multiple-Pin/Screw Fixation In Situ

Internal fixation with multiple pins or screws has historically been the traditional treatment method for both stable and unstable SCFE. Several investigations have confirmed that multiple pins can provide adequate stability while promoting early physeal fusion. In 1980, Walters and Simon[16] reported an unacceptably high rate of pin penetration into the hip joint when multiple pins or screws were used. These authors correlated pin protrusion with the subsequent development of chondrolysis and subchondral bone changes and demonstrated that as the degree of slip increases, it becomes more difficult to place multiple pins in a SCFE without joint protrusion of at least one pin.

Clustering of multiple pins in the posterosuperior quadrant of the femoral head may jeopardize the blood supply and cause avascular necrosis.[15] Several investigators have reported a direct correlation between the number of pins used and the incidence of complications. The question is whether a single screw can adequately stabilize a SCFE. Karol et al compared single-screw and double-screw fixation in ten pairs of immature bovine femurs. A SCFE was created and then reduced and internally fixed with one of these two screw patterns. The authors reported a 30% increase in stiffness with double-screw fixation compared with single-screw fixation in this situation, which simulates an acute slip. Their recommendation is single-screw fixation for SCFE, as the small gain in stiffness with the second screw does not offset the higher risk of complications.

Bone-Graft Epiphysiodesis In Situ

Bone-graft epiphysiodesis to stabilize a SCFE was first reported by Ferguson and Howorth in 1931.[18] The surgical technique includes an iliofemoral exposure, after which a rectangular window of bone is removed from the anterior femoral neck. A hollow mill is used to create a tunnel across the physis, and a corticocancellous iliac-crest bone graft is driven into this tunnel as a bone peg across the proximal femoral physis. Weiner et al[19] reported on their 30-year experience with this technique in treating 185 slips (26 acute and 159 chronic) in 159 patients. Further slipping occurred in 4 of the 159 hips with chronic slips, avascular necrosis developed in 1, and chondrolysis developed in none.

There are several possible advantages to using bone-graft epiphysiodesis to treat SCFE. The graft is inserted at the correct angle and is positioned in the center of the femoral head, minimizing the risk of damaging the blood supply to the femoral head. The graft is not inserted as deep as has been recommended for internal fixation with multiple pins, reducing the risk of protrusion of the graft. Physeal closure may be quicker with

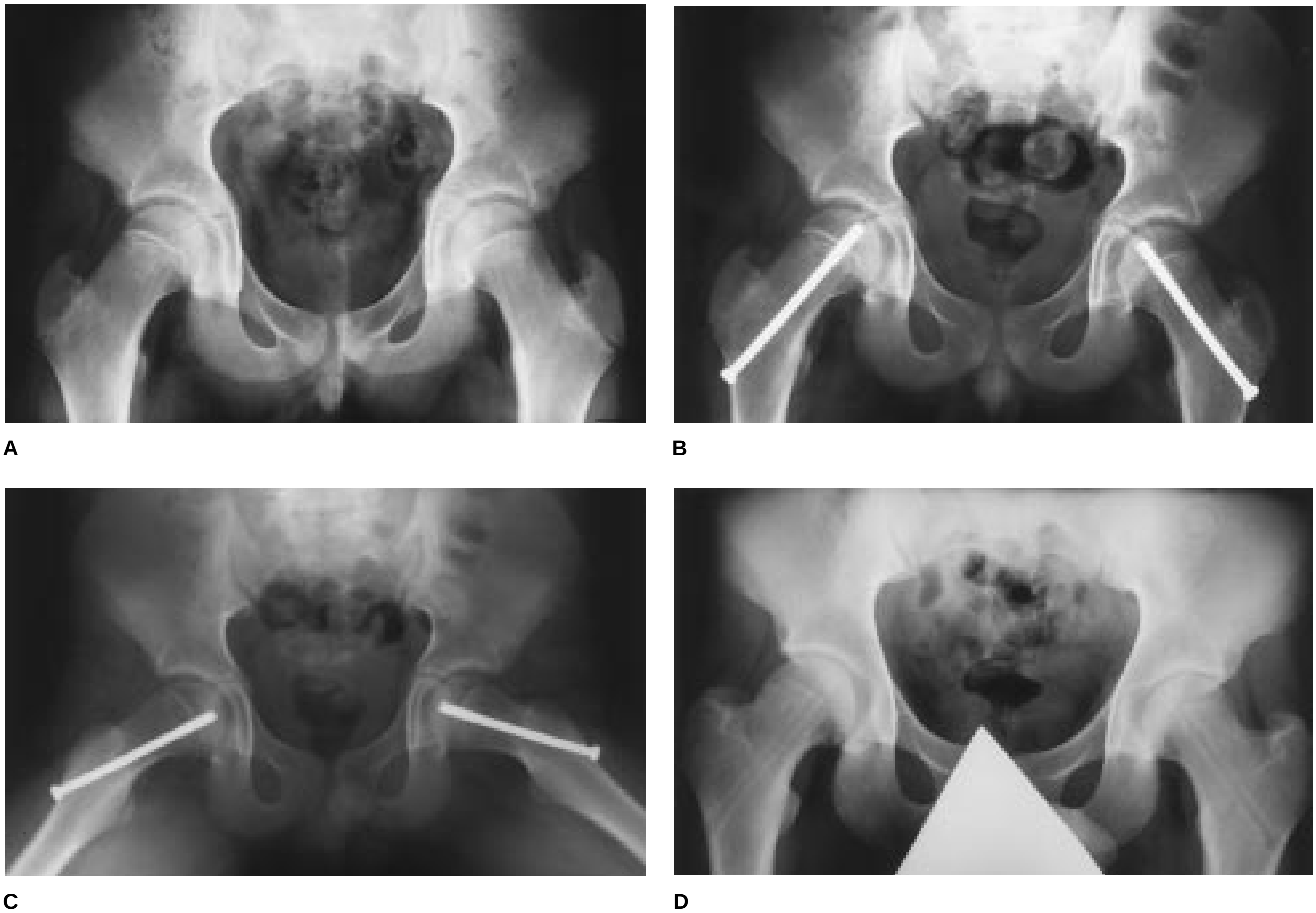


Fig. 6 Images of the pelvis of a 17-year-old boy (bone age, 13 years) with tetralogy of Fallot and bilateral groin pain. **A,** Anteroposterior radiograph shows bilateral mild SCFE. **B,** Postoperative radiograph shows satisfactory central position of the screws. **C,** Postoperative frog-leg lateral radiograph demonstrates satisfactory screw position (i.e., directed anterior to posterior and engaging the center of the epiphysis perpendicular to the physis). **D,** Screws were removed percutaneously 3 years 4 months after the initial operation. Postoperative radiograph shows a satisfactory result.

the open method, compared with screw fixation.

Open epiphysiodesis also has potential disadvantages. The epiphysis is not well stabilized until early fusion occurs. Blood loss is greater, anesthesia is longer, and the surgical scar is larger than with single-screw fixation.

Ward and Wood[18] reported on 17 consecutive patients with SCFE treated by bone-graft epiphysiodesis. The graft resorbed, moved, or fractured in 8 cases (47%), and further slippage occurred in 10 (59%). As a result of their study, the authors no longer recommend bone-graft epiphysiodesis for the treatment of SCFE.

Hip Spica Cast In Situ

Immobilization in a bilateral hip spica cast has been advocated by some as an acceptable alternative to operative treatment for SCFE. Betz et al[20] reported on 32 patients (37 hips) with SCFE who were treated in this manner. A reduction of the slip was not attempted, and use of the cast was continued until the metaphyseal juxtaphyseal lucency, a zone of rarefaction on the metaphyseal side of the physis, was no longer visible on the radiographs. The duration of immobilization in the cast varied from 8 to 16 weeks (mean, 12 weeks). No cases of avascular necrosis occurred, but slip progression occurred in 2 hips, and chondrolysis developed in 7 (19%).

The hip spica cast does not rigidly stabilize the SCFE and can be cumbersome for the family to manage, particularly since the typical patient is obese. Several investigators have reported a high incidence of slip progression, chondrolysis, and pressure sores. As a result, we do not recommend the hip spica cast for treating chronic SCFE.

Reduction and Stabilization

Intraoperative manipulative reduction to correct the deformity, followed by internal fixation in the corrected position, has been discussed in the orthopaedic literature. Most investigators have reported an unacceptably high incidence of avascular necrosis after intraoperative manipulation for reduction of a chronic SCFE. While this reduction may be possible (although not recommended) in the case of an unstable SCFE, a stable slip, by definition, cannot be corrected by intraoperative manipulation.

Open Reduction and Stabilization

A cuneiform osteotomy through the growth plate may be the ideal method to anatomically correct the deformity in SCFE, but is it safe? The cuneiform osteotomy corrects the retroversion deformity and improves hip range of motion, but most investigators have reported a high incidence of avascular necrosis with this technique. Fish[21] performed a cuneiform osteotomy for SCFE on 61 patients (66 hips) and, after a mean follow-up of 13 years 4 months, reported excellent results in 55 hips (83%), good in 6 (9%), fair in 2 (3%), and poor in 3 (5%). Broughton et al[22] reported the results of cuneiform osteotomy in 110 patients (115 hips) with SCFE, 77 of whom had stable slips. At follow-up (mean, 12 years 1 month), there were three cases of avascular necrosis alone, two cases of avascular necrosis and chondrolysis, and eight cases (10%) of chondrolysis alone.

Gage et al[23] evaluated the complications of cuneiform osteotomy in 71 patients (77 hips), including 60 who had been treated with a subcapital cuneiform osteotomy. Avascular necrosis developed in 35%, and chondrolysis developed in 42%. As a result of this study, these authors abandoned the subcapital osteotomy and recommended osteotomy through the base of the femoral neck with internal fixation of both the SCFE and the compensating osteotomy with the use of Knowles pins.

Stabilization In Situ and Corrective Osteotomy

Kramer et al[24] described the surgical technique for the compensating osteotomy at the base of the femoral neck and evaluated their results in 55 patients (56 hips). At the minimum follow-up of 2 years, 9 hips (16%) were rated poor, and 3 (5%) were rated treatment failures.

Southwick[10] described an intertrochanteric osteotomy to correct the retroversion deformity of SCFE with a minimal risk of avascular necrosis. The osteotomy is done through the lesser trochanter, and a wedge of bone is removed to correct the deformity. The osteotomy is stabilized with internal or external fixation, and the SCFE is stabilized with a hip spica cast for 8 weeks. Southwick evaluated the data on 55 patients with SCFE treated by intertrochanteric osteotomy and found no cases of avascular necrosis, although 6 cases (11%) of chondrolysis occurred. Frymoyer[25] reported his experience with the Southwick osteotomy for stable SCFE and noted a high frequency of chondrolysis, which occurred in five of nine hips (56%) treated with this technique.

Long-term Follow-up

Carney et al[26] reported on 124 patients (155 hips) with SCFE after a mean follow-up of 41 years. Some of the patients had undergone an attempted closed reduction of the chronic slip. The results in the 142 stable slips correlated with the initial severity of the SCFE. The average Iowa hip-rating score at follow-up was 89 for mild slips, 81 for moderate slips, and 73 for severe slips. Similarly, the incidence of avascular necrosis and chondrolysis was lowest in the mild slips.

Carney et al classified the treatment modes into four groups: symptomatic (bed rest, crutches, or no treatment), spica cast, pinning, and osteotomy. Compared with the patients who received symptomatic treatment or were treated with pinning, those who underwent osteotomy had worse outcomes with regard to the Iowa hip-rating score, the radiographic grade, and the incidence of chondrolysis. The authors concluded that reduction by either open or closed means should no longer be recommended because of the high incidence of avascular necrosis. Pinning in situ, regardless of the severity of the slip, provides the best long-term function, with a low risk of complications, and most effectively delays the development of degenerative arthritis.

Summary

Despite the fact that SCFE is the most common adolescent hip disorder, its management continues to be controversial. The etiology remains unknown, but mechanical factors produced by obesity certainly play an important role in causing this condition. While classification systems in the past have been based on the duration of symptoms, we endorse the use of the recent classification of SCFE as either stable or unstable. In general, the diagnosis of SCFE can be made on the basis of the radiographic findings; other imaging studies are usually not necessary, although sonography may play a role in the earlier detection of a mild slip.[9]

Most authors agree that treatment of SCFE is needed once the diagnosis has been made, either to prevent further slow slippage or to prevent an acute slip with further activity. The priorities in management are to stabilize the slip and to prevent the complications of avascular necrosis and chondrolysis. Because preventing these complications is so important, we do not currently believe there is a role for early realignment procedures. A stable SCFE will not reduce with intraoperative manipulation, and open reductions have been associated with too many complications. Similarly, complications are too common if a corrective osteotomy is done at the same time the SCFE is stabilized in situ.

As a result, we currently believe that the most acceptable treatment for stable SCFE is stabilization in situ, usually with single-screw fixation. Bone-graft epiphysiodesis, the use of multiple pins, and hip spica immobilization can also stabilize a SCFE in situ. Multiple-pin fixation and hip spica casting are not recommended because of the higher risk of chondrolysis. We prefer single-screw fixation to bone-graft epiphysiodesis, although both have numerous reports of good and excellent results. Single-screw fixation involves less blood loss, a smaller scar, and a shorter duration of anesthesia. An additional benefit is that it can be done on an outpatient basis.

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