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Slipped Capital Femoral Epiphysis (SCFE) - diagnosis and treatment

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Abstract

Background

Slipped Capital Femoral Epiphysis is the most common pathology of the hip joint in preschool children and adolescents consisting of migration of the proximal femoral epiphysis, posteriorly and inferiorly, to the metaphysis (neck of the femur), which occurs through the epiphyseal (growth) cartilage. SCFE occurs with a frequency of 0.33 per 100,000 to 24.58 per 100,000 children aged 8–15 years.

Purpose

The aim of the article is to characterize the disease which is SCFE, draw attention to its etiology, diagnostic and therapeutic possibilities.

Materials and methods

The article was based on scientific publications in the Pubmed database. The database was searched on 12 February 2023 using the phrases 'SCFE', 'Slipped Capital Femoral Epiphysis'. After reading the titles of found articles, 23 publications were selected. After the pre-analysis of the abstracts, 15 full-text works were selected to prepare the article.

Results

Most SCFE is idiopathic. The relationship between the development of SCFE and endocrine disorders, renal dysfunction and Down syndrome has been noted. The displacement is presumed to be caused by the application of a large axial load to the relatively fragile growth plate. Symptoms of the disease may include atraumatic pain in the hip, thigh or knee, especially if accompanied by a limp or inability to support weight. The first imaging test performed is a radiograph. If radiographs do not show changes consistent with SCFE but clinical suspicion is high, the physician may consider magnetic resonance imaging (MRI) for further evaluation. The goal of treating the lesions is to prevent further scaling of the head and to correct the deformity and to avoid osteonecrosis and chondrolysis, so various surgical procedures are used.

Conclusions

SCFE is an insidious disease that should always be ruled out in the diagnosis of hip pain in children. Its early treatment prevents later complications.

Keywords: children, bone disease, SCEF, femoral head

Background

Slipped Capital Femoral Epiphysis is the most common pathology of the hip joint in preschool children and adolescents [1] consisting of migration of the proximal femoral epiphysis, posteriorly and inferiorly, to the metaphysis (neck of the femur), which occurs through the epiphyseal (growth) cartilage .

The incidence of SCFE ranges from 0.33 per 100,000 to 24.58 per 100,000 children aged 8–15 years (depending on gender and ethnicity). There is considerable variability within racial groups, including the lower amount of vitamin D produced in darker-skinned children.) Obesity is the most important risk factor for the disease. Other risk factors include male gender, periods of rapid growth, prior radiotherapy to the hip, and retroversion of the acetabulum or femoral head, which increase mechanical shear forces in the pelvis. The average age is 12.0 years for boys and 11.2 years for girls, and obese children develop symptoms earlier than children with normal weight [3].

Most cases of SCFE are idiopathic. Often there is no specific injury in the history. The relationship between the development of SCFE and endocrine disorders (including hypothyroidism, hyperthyroidism, hypopituitarism and growth hormone deficiency), renal dysfunction and Down syndrome has been noted [2]. SCFE in children under 10 years of age indicates the need to perform endocrinological tests. In addition, it has been proven that the development of SCFE may also be affected by sagittal balance disorder and incorrect pelvic position, which increases the shearing forces acting on the epiphyseal growth plate [4].

Materials and methods

The article was based on scientific publications in the Pubmed database. The database was searched on 12 February 2023 using the phrases 'SCFE', 'Slipped Capital Femoral Epiphysis'. After reading the titles of found articles, 23 publications were selected. After the pre-analysis of the abstracts, 15 full-text works were selected to prepare the article.

Results

The exact mechanism of the disease is not yet known. The displacement is presumed to be caused by the application of a large axial load to the relatively fragile growth plate. Thus, conditions such as obesity increase weight bearing and shear forces, and some endocrine or renal disorders may contribute to bone weakness [5].

While the epiphysis of the femoral head remains in the acetabulum, the metaphysis rotates outward and moves forward. The location of the growth plate is of great importance. Its more vertical location increases susceptibility to shear forces and destabilization of the femoral head as a whole.

Histologically, in SCFE, the height and columnar organization of epiphyseal cells is significantly altered. Chondrocytes are enlarged, there is a higher concentration of proteoglycans and extracellular matrix, and there are disorders in endochondral ossification [6].

Early diagnosis of SCFE is associated with statistically better treatment outcomes. Unfortunately, the diagnosis is often made late, which is associated with more serious deformities and joint damage. Patients have an average of 4 to 5 months of symptoms before diagnosis. The cause of late diagnosis is largely non-specific symptoms of the disease, and additionally, an overweight patient may have other possible causes of dysfunction of the lower limbs.

Symptoms

Atraumatic pain in the hip, thigh or knee, especially if accompanied by limping or weight loss, should always be brought to the attention of a physician in pre-adolescent, adolescent or young adult patients. Pain most commonly occurs in the hip (52%); however, it can also be reported in the groin (13.9%), thigh (35%) or knee (26%, most commonly caused by irritation of the medial obturator nerve) [7].

On physical examination, there is limited internal rotation of the affected hip and limited passive hip flexion (may cause pain) and limping. The patient may show Drehmann's sign, i.e. obligatory external rotation with passive flexion of the hip joint to the angle of 90 degrees [8]. In addition, there may be a positive Trendelenburg sign, inability to bear weight on the affected limb, and even atrophy of the thigh muscles.

Diagnostics

The first step in the diagnosis of SCFE is a thorough history and physical examination. The first imaging test performed is a radiograph. It is especially needed in patients aged 8-15 who complain of recurring limping and pain in the lower limbs (in the area of the hip, groin, thigh or knee). When SCFE is suspected, the images should include both hips in the anterior-posterior projection and in the axial projection according to Lauenstein (frog position, i.e. with legs abducted, hips and knees bent) [9].

In the picture suggesting the diagnosis of the disease, you can notice:

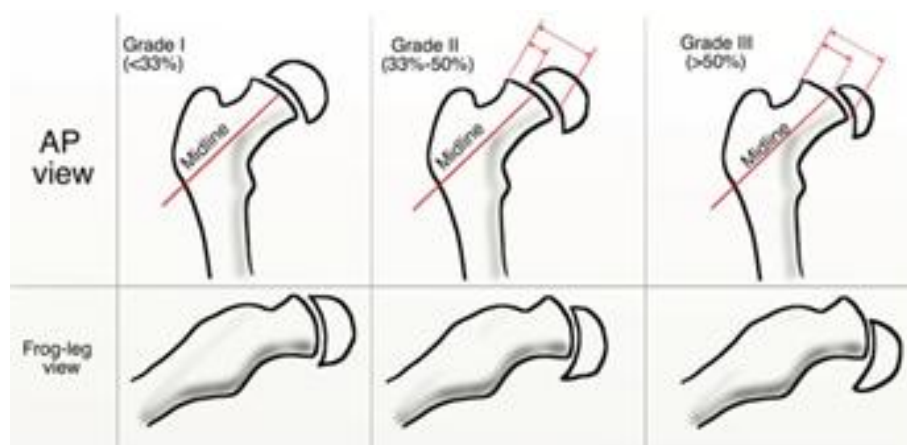
- extension of the epiphysis,
- relative reduction in the height of the base,
- tangent sign - loss of intersection of the epiphysis through the lateral cortical line along the femoral neck (Klein's line)
- overlapping of bone shadows in the metaphysis (caused by posterior slipping of the epiphysis).

If radiographs do not show changes consistent with SCFE but clinical suspicion is high, the physician may consider magnetic resonance imaging (MRI) for further evaluation. [6] MRI may be helpful in diagnosing early cases that show metaphyseal swelling and growth plate dilatation. It can also detect avascular necrosis (AVN) and chondrolabral defects. Computed tomography, on the other hand, provides a three-dimensional view of the hip joint, precisely assessing the nature of the dislocation, and enables precise planning of treatment. In addition, laboratory tests should be performed to exclude hormonal disorders.

An important aspect that should be taken into account when making a diagnosis and planning treatment is the physiological stability of the affected bone. Therefore, SCFE can be divided into stable and unstable (Loder classification).

In addition, on the basis of X-ray images, we can subdivide the cases based on the Southwick slip angle classification:

- Pre-slip (growth plate widening; no displacement)
- Mild slip (up to 1/3 displacement or up to 30° head tilt)
- Moderate slip (1/3 to 1/2 displacement or 30° to 60° slip angle)
- Severe slip (> 1/2 displacement; exfoliation angle > 60°).



Rys. Trauma and orthopaedic classifications. Springer London Ltd. Lasanianos, N. G. (2016).

When making a diagnosis of SCFE, one should remember about the differential diagnosis with diseases such as [13]:

- Fracture of the femur
- Avascular necrosis of the femoral head
- Legg-Calve-Perthes disease
- Osteomyelitis
- Septic arthritis
- Transient synovitis
- Adductor muscle strain
- Avulsion fracture of the anterior iliac spine

Treatment

The choice of treatment is influenced by the severity of the lesions, stability, anatomical and mechanical factors, the depth of the acetabular cup and the patient's activity level.

The goal of treating the lesions is to prevent further scaling of the head and correct the deformity and avoid osteonecrosis and chondrolysis.

The classic treatment of SCFE involves percutaneous fixation of the epiphyseal with screws. This technique is designed to prevent displacement from increasing until the growth plate is finally closed, and is widely used for both stable and unstable SCFE, regardless of the degree of deformity.

One or two screws can be used with this technique. The advantage of two screws is greater biomechanical stability, but there is a higher risk of complications, including disruption of the articular surface.

The screw should be inserted centrally to the femoral head in both anteroposterior and lateral views. When inserting the screw, be careful not to insert it medially from the intertrochanteric line, as this may cause a collision in the flexion between the cup and the screw head.

The tip of the screw should not interfere with the articular surface in all views, as this could cause secondary damage to the joint.

Some physicians use Kirschner wire instead of screw fixation in younger children, as this may have less of an impact on the occurrence of bone growth disorders after surgery, which may cause changes in the biomechanics of the hip joint, ultimately resulting in secondary osteoarthritis.

Capsulotomy, or incision of the joint capsule, has been shown to reduce intracapsular pressure in unstable SCFE. However, there is no conclusive evidence that it reduces the incidence of avascular necrosis.

Another method of surgical treatment is the use of the modified Dunn procedure. The aim of this procedure is to correct the deformation of the proximal part of the femur and stabilize the epiphysis while protecting the blood supply to the femoral head. It consists in open exfoliation reposition. This is a controversial method due to its extensiveness, but there are indications that it may work well in the case of moderate to severe exfoliation.

Cases of severe SCFE deformity with >30-45 degree flaking that is painful or limiting in function, in the absence of hip osteoarthritis or osteonecrosis, may also be treated by proximal femoral osteotomy. Several osteotomies of the proximal femur have been described in the literature, the most common being the intertrochanteric (Imhauser) osteotomy. The greatest correction of the deformity is possible with a wedge osteotomy of the femoral neck. Subtrochanteric osteotomy (Southwick) has also been described.

Osteochondroplasty is indicated for mild to moderate cases of chronic SCFE deformity where a prominent metaphyseal tumor causes pain and limited range of motion. Osteochondroplasty can be performed arthroscopically with a drill or by limited anterior arthrotomy using a modified Smith-Peterson approach. [9-12]

After surgery, patients have to relieve the affected limb for 6-12 weeks using crutches or walkers. This allows you to maintain the treatment result and achieve proper union. Physical therapy involving a series of movement and strengthening exercises to restore extension, adduction and internal rotation of the hip should be started on the first postoperative day. [13]

Prognosis

Quite common and serious complication of SCFE is avascular necrosis. It may result from damage to blood vessels or the formation of a hematoma (either spontaneously or as a result of surgery), which disturbs the blood supply to the head of the femur. The incidence of necrosis is lower after stabilization of the head with a screw than in the case of closed reposition [14].

Another complication is chondrolysis of the joint surface, after its damage during surgery or in the case of the development of a long-undiagnosed disease.

Femoroacetabular impingement may also occur, which results from an abnormal shape of the proximal femur or protruding edge of the acetabulum. This can lead to the early onset of hip osteoarthritis.

There is also a significant risk of later contralateral SCFE in patients with unilateral SCFE, and predictive risk factors include younger age, a lower modified Oxford Score, and a smaller difference in the physomyeliac angle between the affected and unaffected hip. [15]

Conclusions

SCFE is an insidious disease entity affecting children and adolescents. Although the exact mechanisms of the disease are not known, there are many solutions in the treatment. The focus should be on early diagnosis and prevention of after-effects.

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