Management of slipped capital femoral epiphysis: What hardware we can use in osteosynthesis in situ?

Alessandra Merenda,1 Francesco Falciglia,1 Cristian Aletto,2 Angelo Gabriele Aulisa,1,3 Renato Maria Toniole1

1Department of Orthopedy and Traumatology, Bambino Gesù Paediatric Hospital, Rome; 2Department of Musculoskeletal Disorders, Faculty of Medicine and Surgery, University of Salerno, Baronissi; 3University of Cassino and Southern Lazio, Cassino, Italy

Abstract

Slipped Capital femoral epiphysis (SCFE) is a hip disorder involving children during prepubescence age. Obesity, growth spurts, and endocrine disorders are among the risk factors for SCFE, whose aetiology is thought to be multifactorial. To avoid gait abnormalities, chronic hip pain, femoracetabular impingement, avascular necrosis of the femoral head, and early hip osteoarthritis, SCFE must be treated early. Epiphysiolsis is primarily treated surgically to prevent secondary slippage locking the physis, but this can also prematurely close the growth plate and prevent remodeling of the proximal femur. The aim of the study is to review the literature on surgical devices used to manage SCFE and identify any potential benefits or drawbacks. Various authors looked into and suggested various hardware to prevent iatrogenic epiphysiodesis. According to the results of these studies, patients with epiphysiolsis can grow their femoral necks following stabilization with dynamic hardware that doesn’t compress the proximal femur’s growth plate.

Correspondence: Alessandra Merenda, Department of Orthopedy and Traumatology, Bambino Gesù Paediatric Hospital, Piazza di Sant’Onofrio 4, 00165, Rome, Italy. E-mail: alessandra.merenda@opbg.net

Key words: Epiphysiolsis; slipped femoral head; SCFE; FAI; growth.

Funding: None.

Contributions: AM FF elaborate and wrote the review according to the recent literature about the topic; CA revised and translated the text; last revision for important intellectual content and final approval were made by AGA and RMT.

Conflict of interests: The authors declare no conflicts of interest.

Availability of data and materials: All data generated or analyzed during this study are included in this published article.

Ethics approval and consent to participate: Not applicable.

Informed consent: Not applicable.

Received for publication: 30 September 2022.
Revision received: 4 October 2022.
Accepted for publication: 4 October 2022.

Publisher’s note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article or claim that may be made by its manufacturer is not guaranteed or endorsed by the publisher.

©Copyright: the Author(s), 2022
Licensee PAG Press, Italy. La Pediatria Medica e Chirurgica 2022; 44(s1):297

doi:10.4081/pmc.2022.297

This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License (CC BY-NC 4.0).
The most adopted classification divides the SCFE into “stable” or “unstable” basing on the patient’s ability to walk.

A patient with stable SCFE is usually an obese adolescent with a short story of poorly localized hip pain, but able to walk. A patient with unstable SCFE, instead, has severe hip pain that does not allow walking.

The disease can be also divided according to the time of onset: i) pre-slipping: enlargement of the growth plate without a real slippage associated with hip or knee pain especially in the intra-rotation of the hip; ii) subacute: symptoms for 3 weeks and slippage generally under 30°; iii) acute (15% of cases): severe slippage generally associated with simple injuries in previously symptomatic patient; iv) chronic (about 84% of cases): symptoms present longer than 4 weeks. X-ray with modification of the neck in the area of the slippage (bump causing impingement); v) acute on chronic (<1% of cases): it is an undiagnosed chronic form with acute symptoms without ability to walk.

The treatment of epiphysiolysis is mainly surgical, the gold standard remains fixation in situ. This treatment avoids secondary slippage locking the physis, but it may cause premature closure of the growth plate and can interfere with proximal femur remodeling.

Materials and Methods

The aim of the study is reviewing the literature about surgical devices used to manage SCFE underlying their advantages or disadvantages.

In literature the best treatment for hip epiphysiolysis is still debated, is due to the high risk of long-term and irreversible complications that lead to early disability and possible hip reconstruction surgery.

Post-operative complications of SCFE include progression of slippage, osteonecrosis of the femoral head and chondrolysis.

SCFE is commonly treated with stabilization of the epiphysis through the percutaneous fixation of the physis. Percutaneous in situ fixation generally produces good clinical outcomes for stable slips, however, it has been found that they can often occur future complications, leading to femoro-acetabular impingement and damage to the articular cartilage resulting in development of osteoarthritis.

Femoroacetabular Impingement (FAI) is a common evolution of SCFE surgical management and affecting 32% to 90% of all patients (Figure 1). However the high prevalence of femoral acetabular impingement in adulthood, could be considered not as a complication but as the outcome of natural history of SCFE.

In the treatment of unstable (moderate to severe) slips, the modified Dunn procedure has been proposed to reduce the high incidence of osteonecrosis.

Discussion

The goal of epiphysiolysis treatment is stabilizing the epiphysis avoiding premature closure of the growth plate (epiphysiodesis). We can obtain it using hardware that, without exerting compression, stops sliding and allowing the altered cartilage to recover its functionality.

In mild epiphysiolysis with angulation <30°, fixation with smooth devices or screws are recommended. Histological, ultrastructural and clinical studies reported a normal remodeling of the physis after fixation with smooth devices with architectural restoration and production of proteoglycans and collagen fibrils.

The hardware used to avoid iatrogenic epiphysiodesis (dynamic device) were investigated and proposed by various authors. One of the first was the Hansson hook-pin. It was a smooth nail with an internal hook that came out to anchor the epiphysis. The smooth part passed through the growth cartilage without create compression between the epiphysis and metaphysis. The “Olmed short threaded screw”, was another device that was placed in the epiphysis, avoiding compression on femoral lateral cortex and without injury the growth plate. These two systems, for their technical characteristics, showed difficulties in case of removal.

Sailhan et al. reported the results of a cannulated screw with two components, the proximal smooth part was inserted into the epiphysis and into the growth plate, while the thread part in the neck leaving the head protrude 1-2 cm from the lateral cortex. The limits were that, with the growth of the neck, it was necessary to tighten the screw, otherwise grip on the epiphysis may be loosed with the risk of new slips.

Kumm et al., Guzzanti et al. and Wenssas et al. reported the results of a 7 mm diameter cannulated screw reducing the length of the thread from 16 mm to 10 mm. The threaded part was inserted into the epiphysis and the smooth one of the screw in the cartilage of growth, the head must protrude 15-20 mm from the lateral cortex of the femur (Figure 2).

With the growth of the neck the head will approach the cortex; it may happen that the screw had to be replaced in patients very young in which the neck grows more than 20 mm.

Pega Medical (Laval, Canada) has introduced Free Gliding (FG) screw to enable neck growth in SCFE-treated patients. The implant assembly includes a distal component that will be fixed to the lateral cortex and a proximal component that will anchor the femoral head. The telescopic design would elongate with growth avoiding screw protrusion at the lateral cortex and pin advancement revision.

The results of FG screw were compared with the standard compression screws, the FG screw allows neck growth unlike the standard screws which cause contralateral head to protrude. by Free Gliding the limit of this hardware is the difficulty to removal, the times of application and the cost seven times higher than standard screws.

Data from these studies confirm that the femoral neck in patients with epiphysiolysis can grow after stabilization with dynamic hardware that does not produce compression on the growth plate of the proximal femur (Figure 3).

Only recently the residual deformity associated with slipping

![Figure 1. Femoro-acetabular impingement after SCFE.](image-url)
of the healed femoral epiphysis was clearly related to femoro-acetabular impingement and to subsequent degenerative changes that lead to osteoarthritis.

Conclusions

The treatment techniques for SCFE are in constant evolution in the light of the major understanding of the pathogenesis of the intermediate (femoral-acetabular impingement) and long-term (osteoarthritis) consequences of this hip disorder.

In mild forms, early stabilization with non-compression fixation avoids the sliding of the physis, allowing the physeal histological healing and the resumption of neck growth femoral.

In the forms with moderate and severe slippage, when the alterations of the epiphyso-metaphyseal complex may not be reversed, arthroscopic treatment is an available solution to manage long-term complication as femoral acetabular impingement.

References