

Open reduction of slipped capital femoral epiphysis

Interventional procedures guidance
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Your responsibility

This guidance represents the view of NICE, arrived at after careful consideration of the evidence available. When exercising their judgement, healthcare professionals are expected to take this guidance fully into account, and specifically any special arrangements relating to the introduction of new interventional procedures. The guidance does not override the individual responsibility of healthcare professionals to make decisions appropriate to the circumstances of the individual patient, in consultation with the patient and/or guardian or carer.

All problems (adverse events) related to a medicine or medical device used for treatment or in a procedure should be reported to the Medicines and Healthcare products Regulatory Agency using the [Yellow Card Scheme](#).

Commissioners and/or providers have a responsibility to implement the guidance, in their local context, in light of their duties to have due regard to the need to eliminate unlawful discrimination, advance equality of opportunity, and foster good relations. Nothing in this guidance should be interpreted in a way that would be inconsistent with compliance with

those duties. Providers should ensure that governance structures are in place to review, authorise and monitor the introduction of new devices and procedures.

Commissioners and providers have a responsibility to promote an environmentally sustainable health and care system and should assess and reduce the environmental impact of implementing NICE recommendations wherever possible.

1 Recommendations

- 1.1 The evidence on efficacy of open reduction of slipped capital femoral epiphysis is adequate. With regard to safety, there is a risk of avascular necrosis. Therefore this procedure should only be used with special arrangements for clinical governance, consent and audit or research.
- 1.2 Clinicians wishing to undertake open reduction of slipped capital femoral epiphysis should take the following actions:
 - Inform the clinical governance leads in their NHS trusts. Specifically, local governance arrangements should ensure that the procedure is done only by clinicians with appropriate training and experience.
 - Ensure that patients and their parents or carers understand the potential outcomes of having or not having the procedure, in particular the risk of avascular necrosis and its consequences. In addition, the use of NICE's information for the public is recommended.
- 1.3 Clinicians should enter details about all patients having open reduction of slipped capital femoral epiphysis onto the British Society for Children's Orthopaedic Surgery register. Clinical outcomes should also be reviewed locally.
- 1.4 Training and experience are important in preserving the blood supply to the femoral head. When the procedure is done with surgical dislocation of the hip, clinicians should undertake their initial procedures with an experienced mentor.
- 1.5 Patient selection may be complex and specialists should consider, discuss with clinical colleagues, and record the balance between the potential benefits and risks of this procedure for each patient.

- 1.6 Further research into open reduction of slipped capital femoral epiphysis should clearly describe details of clinical presentation (for example, Loder classification), the degree of slip, its stability, and the surgical technique used; including whether surgical dislocation of the hip was done. Outcomes from 2 years onwards should include degree of correction, occurrence of avascular necrosis and need for subsequent hip surgery (and its timing).

2 Indications and current treatments

- 2.1 The capital femoral epiphysis forms part of the ball-and-socket joint of the hip. In children and adolescents the ball and shaft of the femur are connected by a layer of soft cartilage, known as the growth plate, which allows for growth and hardens at adulthood. A slipped capital femoral epiphysis results in the displacement of the femoral head, usually posteriorly and inferiorly in relation to the femoral neck and within the confines of the acetabulum. This can cause knee or hip pain, limping and significant deformity.
- 2.2 Treatment options depend on the severity of the slip. Treatment of mild-to-moderate slips usually involves percutaneous in situ fixation, with or without prophylactic pinning of the contralateral hip using cannulated screws or Kirschner wires. For more severe acute slips, treatment options include open fixation of the growth plate using a bone graft combined with early intertrochanteric osteotomy to allow a full range of hip movement, or closed reduction and in situ fixation with cannulated screws or Kirschner wires.

3 The procedure

- 3.1 Open reduction of slipped capital femoral epiphysis aims to relocate the capital femoral epiphysis and centre its position in the acetabulum, while minimising the risk of avascular necrosis by preserving blood vessels to the epiphysis.
- 3.2 The procedure can be done in a variety of ways (some with eponymous names such as the Dunn, Bernese and Ganz approaches). Most involve a cuneiform (wedge-shaped) osteotomy of the femoral neck. An important point of the

technique is whether or not the hip is surgically dislocated during the procedure. This is done to create an extended retinacular flap, to provide extensive subperiosteal exposure of the circumference of the femoral neck, and so protect the blood supply to the epiphysis, minimising the risk of avascular necrosis.

- 3.3 With the patient under general anaesthesia, an anterior or anterolateral approach is used to expose the hip and a capsulotomy is done; at this stage, the hip may be dislocated surgically. A section of bone is then removed from the metaphysis of the femoral neck. Reduction is done by adducting and rotating the limb, realigning the epiphysis in its normal position in the acetabulum. The realigned femoral neck is then secured with 1 or 2 cannulated screws or Kirschner wires.

4 Efficacy

This section describes efficacy outcomes from the published literature that the committee considered as part of the evidence about this procedure. For more detailed information on the evidence, see the [interventional procedure overview](#).

- 4.1 In a case series of 64 patients treated by open reduction without dislocation, the mean IOWA Hip Score (scores range from 0 to 100 with higher scores indicating better outcomes) was 94.5 at mean follow-up of 4.9 years.
- 4.2 In a case series of 28 patients treated by open reduction with dislocation, mean improvements in Hip disability and Osteoarthritis Outcome Scores (ranging from 0 to 100 with higher scores indicating better outcomes) for pain, other symptoms, activities of daily living and quality of life were 78.6, 78.0, 78.5 and 74.8 respectively, for patients with unstable slips at mean follow-up of 38.6 months (p values <0.001). In patients with stable slips, mean improvements in Hip disability and Osteoarthritis Outcome Scores for pain, other symptoms, activities of daily living, sports and quality of life were 45.7, 48.6, 40.9, 58.1 and 51.4 respectively (p values <0.001).
- 4.3 In a case series of 110 patients (115 hips) treated by open reduction without dislocation, 'good' results for subjective, clinical and radiological outcomes were reported in 89% (62/70), 84% (59/70) and 71% (50/70) of hips respectively, in hips with chronic slips and open growth plates at mean follow-up of 12 years and

11 months. In the same study, 'good' results for subjective, clinical and radiological outcomes were reported in 74% (28/38), 71% (27/38) and 55% (21/38) of hips respectively, in hips with acute-on-chronic slips at mean follow-up of 12 years and 11 months. In hips with chronic slips and partially fused growth plates, 'good' subjective, clinical and radiological results were reported in 29% (2/7), 14% (1/7) and 14.3% (1/7) of hips respectively.

- 4.4 In a case series of 65 patients (66 hips) treated by open reduction without dislocation, 46% (22/48) of patients had equal leg lengths at minimum follow-up of 10 years.
- 4.5 In a case series of 23 patients treated by open reduction with dislocation, the mean preoperative slip angle was 47.6° whereas the mean postoperative slip angle was 4.6 (p<0.0001). In the same study the mean degrees of flexion were 107.3° in treated hips and 114.8° in contralateral hips that were prophylactically pinned, at mean follow-up of 29 months (p value not significant). The mean degrees of internal rotation in treated hips and contralateral hips were 37.8° and 35.6° respectively at mean follow-up of 29 months (p value not significant).
- 4.6 Specialist advisers listed key efficacy outcomes as gait parameters, pain scores, Pediatric Outcomes Data Collection Instrument scores, non-arthritic hip scores, satisfactory radiological features (Stulberg I/II), incidence of salvage procedures, prevention of secondary arthritis, and a lack of leg length discrepancies.

5 Safety

This section describes safety outcomes from the published literature that the committee considered as part of the evidence about this procedure. For more detailed information on the evidence, see the [interventional procedure overview](#).

- 5.1 Avascular necrosis without chondrolysis was reported in 3% (2/70) of hips with chronic slips and open growth plates, 16% (6/38) of hips with acute-on-chronic slips, and 14% (1/7) of hips with chronic slips and fused growth plates, in a case series of 110 patients (115 hips) treated by open reduction without dislocation. In the same study avascular necrosis plus chondrolysis was reported in 1% (1/70) of hips with chronic slips and open growth plates, 8% (3/38) of hips with

acute-on-chronic slips, and 14% (1/7) of hips with chronic slips and fused growth plates. Chondrolysis alone was reported in 7% (5/70) of hips with chronic slips and open growth plates, 3% (1/38) of hips with acute-on-chronic slips, and 43% (3/7) of hips with chronic slips and fused growth plates.

- 5.2 Avascular necrosis was reported in 26% (7/27) of patients at a mean of 21.4 weeks in a case series of 27 patients treated by open reduction with surgical dislocation.
- 5.3 Osteoarthritis was reported in 40% (19/48) of hips at mean follow-up of 16 years in a case series of 65 patients (66 hips) treated by open reduction without dislocation: 19% (9/48) of hips developed grade I osteoarthritis, 6% (3/48) developed grade II osteoarthritis and 15% (7/48) developed grade III osteoarthritis.
- 5.4 Reoperation, 6 to 8 weeks after surgery, was needed in 8% (3/40) of patients because of breakage of screw or wire fixations in a case series of 40 patients treated by open reduction with dislocation.
- 5.5 Permanent partial paralysis of the sciatic nerve was reported in 1 patient in the case series of 65 patients (66 hips) treated by open reduction without dislocation.
- 5.6 Wound infections were reported in 3% (2/66) of hips in the case series of 65 patients (66 hips) treated by open reduction without dislocation.
- 5.7 Non-union of the femoral neck was reported in 9% (4/43) of patients in a case series of 43 patients treated by open reduction with dislocation. All patients were treated by revision surgery.
- 5.8 Heterotrophic ossification was reported in 8% (3/40) of patients in the case series of 40 patients treated by open reduction with dislocation. No further details were provided.
- 5.9 In addition to safety outcomes reported in the literature, specialist advisers are asked about anecdotal adverse events (events which they have heard about) and about theoretical adverse events (events which they think might possibly occur,

even if they have never done so). For this procedure, specialist advisers listed the following anecdotal adverse events: stiffness and fracturing around implants. They considered that the following was a theoretical adverse event: non-union of the femoral neck.

6 Committee comments

- 6.1 The committee noted that different techniques have been used to carry out open reduction of slipped capital femoral epiphysis. It was advised that the procedure has evolved over the years with a particular view to reducing the risk of avascular necrosis.

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Endorsing organisation

This guidance has been endorsed by [Healthcare Improvement Scotland](#).