Management of slipped capital femoral epiphysis (SCFE) - A nationwide drive to develop evidence based care

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Epidemiology
SCFE is most common in boys (male: female ratio 1.5:1), and typically occurs between 9 and 14 years. The annual incidence is approximately seven cases per 100,000 in 6-18 year olds, which equates to a 1:1,200 lifetime risk. A rising incidence of SCFE has been observed. This has been associated with escalating childhood obesity. It is believed that obese children undergo mechanical ‘failure’ of the physis, due to excessive physiological loads. Other diseases are also believed to ‘weaken’ the physis, such as trisomy 21, hypothyroidism, hypogonadism, renal osteodystrophy, growth hormone therapy and gonadotrophin releasing therapy, although these associations are the result of case reports and uncontrolled series.

Classifications
The most useful classification is based on the ability of the child to walk, and is termed ‘stability’. The hip is considered stable when the child is able to walk, with or without crutches, and unstable when the child cannot walk even with crutches. ‘Stable’ slips have a negligible risk of avascular necrosis (AVN), and ‘unstable’ slips have an AVN rate of up to 50%. There is confusion around the term ‘stability’, as clinical stability may not truly correlate with stability of the physis found at open surgery. The original definition is also widely misused in the literature and everyday clinical care. A meta-analysis of the prognostic significance of ‘stability’ confirmed unstable hips have an AVN risk 9.4 times greater than stable hips. Other classifications relate to the chronicity or severity of slip. Chronicity adds little information of clinical relevance, but severity, based on the slip angle, is of value when considering treatment strategies (Figure 1).

Figure 1: Severity is determined using Southwick Angle. Mild <30 degrees, Moderate 30-50 degrees, Severe > 50 degrees. Southwick Angle = α - α on the normal side.

Hip shape and osteoarthritis
The anatomic abnormality is an anterior slip of the metaphysis relative to the epiphysis through the physis, such that hip flexion results in abutment between the metaphysis and the acetabulum. Severe shape abnormalities of the hip have long been associated with the premature development of osteoarthritis (OA), and there is growing recognition of an association between even modest cases of femoro-acetabular impingement (FAI) and OA. There are few long-term follow-up studies, although it appears that more severe deformities reproducibly result in OA requiring intervention. If all slips are considered, there is a 10% need for reconstruction, by arthroplasty or osteotomy, within 10 years.

The Evidence for SCFE Surgery
Since 1950, there have been 380 retrospective studies, six small narrow prospective studies, and no intervention studies. There is one meta-analysis, and one systematic review examining the surgical treatments. The conclusions are limited...
by the paucity of high-quality evidence. The British Orthopaedic Association (BOA), and British Society for Children's Orthopaedic Surgery (BSCOS) have identified SCFE as an area requiring urgent research19.

Current Controversies in SCFE Surgery

Surgical strategies vary widely, as illustrated in surveys of the membership of the British, Dutch, European and North American Paediatric Orthopaedic Societies20, 21, 22. These surveys demonstrated that there are predominantly three different subgroups of SCFE, each prompting differing treatment considerations based on stability and severity20:

- Mild/Moderate Stable (50%)
- Severe Stable (25%)
- Unstable (25%)

Additionally, treatment of the opposite hip is controversial.

Unstable SCFE: When should unstable slips be operated on?

There is a belief that the timing of surgery influences the rate of avascular necrosis23, 7, 24. Eighty-eight per cent of respondents, in a US survey, supported emergent/urgent (<8 hours) treatment21. However, stabilisation after two to three weeks of bed-rest is commonly practiced in the UK, which has developed from the observation of lower AVN rates by the Stanmore group in London23.

There are several case series which have considered the optimum timing of surgery; the results are mixed25, 23, 7, 24, 26, 27, 28. Advocates of urgent surgery seek to quickly restore the circulation, whilst advocates of delayed treatment seek to prevent a ‘second-hit’ phenomenon, which they believe occurs as a result of operating through already inflamed tissues. A systematic review demonstrated no significant difference whether the treatment was before or after 24 hours although there was a trend towards better outcomes with earlier fixation17. Nevertheless, the advocates of the delayed approach believe that this review asked the wrong question, suggesting that a minimum of one week must elapse to avoid the second-hit phenomenon, and reduce the incidence of AVN21, 25.

Mild/Moderate Stable SCFE: Should growth of the physis be permitted?

The European Paediatric Orthopaedic Society (EPOS) survey of the management of SCFE identified that most observers used a single screw to stabilise the epiphysis in situ22. Conventional screw fixation places threads on either side of the physis, preventing further displacement and preventing further growth. By preventing growth, the remodelling capacity of the hip is limited. Enabling growth and remodelling, the impingement lesion between the metaphysis and the acetabulum may improve, or even resolve. Likewise, the neck length and abductor function will be maximised. Encouraging results using these techniques have been demonstrated in a few small series29, 30. However, by allowing physeal growth, there is a risk that the SCFE may recur, as the epiphysis grows off the transfusion device (Figure 2).

Severe Stable SCFE: Do severe stable slips necessitate major interventions?

This degree of deformity is unlikely to remodel even with growth preservation25. There has been a reluctance to correct this surgically owing to the risk of catastrophic AVN. The 2009 EPOS membership study reported that only five of the 72 respondents advocated open reduction of severe stable slips22. Long-term follow-up studies have suggested that pinning in situ offers the best outcomes irrespective of the severity of SCFE, owing to the complications, particularly AVN, of more invasive operative intervention14, 31.

Joint preserving techniques of the hip have recently grown in popularity, particularly the dislocation described by Ganz32. Ganz has reported on his technique in SCFE using a modified Dunn technique. None of the hips developed AVN and although three required revision for implant failure, all had universally good results using these techniques have been demonstrated in a few small series29, 30. However, by allowing physeal growth, there is a risk that the SCFE may recur, as the epiphysis grows off the transfusion device (Figure 2).

Figure 2: Fluoroscopy image of a severe slip pinned in-situ with a proximally threaded screw in a 6-year old (left). Radiograph after 3 years of follow-up, and after 3-screw exchanges (right).
Opposite Hip: Should the unaffected hip undergo prophylactic fixation?

A systematic review, which included over 200 studies, estimated that 19% of patients with an initial unilateral SCFE subsequently developed a contralateral slip, usually in the first 18 months after diagnosis. Whilst stabilisation of the contralateral epiphysis mitigates this risk, iatrogenic risks of surgery are present, and include fracture and avascular necrosis.

Two papers attempt to resolve this debate, using the statistical technique of decision tree analyses. They reached opposite conclusions. Schultz advocated prophylactic pinning to maximise long-term outcomes, whilst Kocher determined that the benefits of prophylactic pinning rarely outweighed the iatrogenic risks.

Conclusions

The current management of a SCFE is largely at the discretion and experience of the treating surgeon. Whilst SCFE is relatively rare, it is the most common hip disease of adolescence and may have devastating consequences. It is therefore difficult to defend the lack of high quality studies, and absence of randomised clinical trials.

References

The British Orthopaedic Surgery Surveillance (BOSS) Study is a recently established NIHR-funded nationwide prospective study of rare orthopaedic disease, beginning with new cases of SCFE and Perthes’ disease. Coordinated efforts for rare disease research have revolutionised specialties such as children’s oncology, and the desire is for orthopaedic surgeons to emulate this success with collaboration. Almost all hospitals in the UK treating SCFE are participating and data collection is underway (www.BOSS.surgery). Daniel Perry is a consultant paediatric orthopaedic surgeon at Alder Hey Hospital in Liverpool. He is an NIHR Clinician Scientist and Senior Lecturer at the University of Liverpool. He has an academic interest in epidemiology and clinical trials relating to rare diseases. Daniel is the chief investigator for the British Orthopaedic Surgery Surveillance (BOSS) Study.

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Patient reported outcomes. Other groups have also demonstrated good results using Ganz’s technique. POSNA recently presented this as the ‘ideal’ treatment of stable moderate and severe SCFE, assuming adequate surgical expertise. However, other studies have raised concerns, with high rates of AVN, albeit in a group of unstable SCFE, and a group of mixed stable and unstable SCFE. There were also other significant complications, including implant failure, hip instability and femoral neck non-union. Technical difficulty is usually cited as the primary reason for failure, with the notion that large numbers are required to achieve and maintain competence amongst surgeons. Other non-dislocation joint preserving techniques previously described include cuneiform osteotomies via an anterolateral approach (Fish), and via a lateral approach (Dunn); both are also known to have notable risks of AVN.

It is unclear if the complications of deformity correction are too great to justify deformity correction over conventional pinning in situ. The National Institute for Health and Care Excellence (NICE), have reviewed this subject (IPG511), and recommended that strict governance arrangements and monitoring be in place in centres undertaking these procedures.

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References


