

# Slipped Capital Femoral Epiphysis: The European Perspective

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**Abstract:** Treatment of slipped capital femoral epiphysis remains a contentious and debated issue. The opinion for the correct method of treatment can differ not only between different continents and nations, but also between units and surgeons within individual units. We aim to review the European perspective on the treatment of slipped capital femoral epiphysis and consider the trends for treatment among the European orthopaedic surgical community.

**Key Words:** slipped capital femoral epiphysis, management, Europe

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Slipped capital femoral epiphysis (SCFE) is a rare disorder with potentially serious consequences related to both the condition and the subsequent surgical management. The incidence of SCFE can vary widely according to the ethnicity of the population,<sup>1</sup> but the rate in many areas appears to be increasing, likely due to changes in childhood obesity.<sup>2–4</sup>

The correct management for SCFE is a contentious topic, with vigorous debate ongoing with regard to the best investigation, timing and treatment for this condition.<sup>5</sup> The decision-making process is frequently guided by the classification of stability<sup>6</sup> and the severity<sup>7</sup> of the slip.

Stability refers to the ability of the patient to bear any weight on the affected leg, even with the assistance of crutches. The consequence is the increased risk of avascular necrosis (AVN) of the capital femoral epiphysis in the unstable slip. This was estimated in a recent meta-analysis as a 9.4-fold increase in the rate of AVN in the unstable SCFE, in comparison with the stable.<sup>8</sup>

Severity refers to the amount of anterolateral displacement of the metaphysis on the capital femoral epiphysis. The Southwick angle<sup>7</sup> is most frequently used, measuring on a lateral radiograph the difference between the axis of the

femoral shaft and the perpendicular to the epiphysis on the affected and unaffected sides. The degree of severity relates directly to the amount of residual deformity that may remain once the hip is stabilized, which can lead to impaired function, femoroacetabular impingement,<sup>9</sup> and probable subsequent osteoarthritic changes.<sup>10,11</sup>

## WHAT DO WE REALLY KNOW?

Although there has been considerable research into this topic, the majority of papers have been retrospective, with no interventional studies performed till date.<sup>12</sup> The British Orthopaedic Surveillance Study (BOSS)<sup>13</sup> is an NIHR funded nationwide study in the United Kingdom to investigate rare orthopaedic conditions (starting with SCFE and the Perthes disease). Currently ongoing, this study will provide a more true understanding of this particular cohort of patients and potentially allow development of further prospective interventional studies in the future.

No clear consensus exists for the treatment of SCFE. In the case of rare conditions, the treatment may differ greatly according to the center and the experience of the treating surgeon. Several of the pediatric orthopaedic societies within Europe have aimed to better understand the treatment protocols of their members, through use of surveys of practice from the British Society of Children's orthopaedics<sup>14,15</sup> (BSCOS), Werkgroep Kinder Orthopaedie<sup>15</sup> (Netherlands), and the European Paediatric Orthopaedic Society<sup>16</sup> (EPOS). The French Society of Paediatric Orthopaedics<sup>10</sup> (SoFOP) also reported on a series of severe slips, describing the practice of their members in this condition.

The 2 main subgroups of SCFE for which treatment needs to be considered are the stable SCFE (which can be further divided into mild/moderate stable and severe stable) and the unstable SCFE. We shall review the current European practice as understood by the published literature.

## THE MILD/MODERATE STABLE SLIP

For the stable slip with only mild to moderate displacement, the main question is with regard to the method of fixation of the slip. The vast majority use a single screw for fixation of the physis, with 96% of BSCOS and 78% of EPOS respondents favoring this technique. This position is supported by a systematic review by Loder and Doietz<sup>17</sup> in 2012, which looked at the (mainly level IV) evidence available, and concluded that a single screw was the best technique available for fixation in situ.

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The remaining EPOS members mainly indicated a preference either for multiple screws, K-wires, or alternative techniques, such as the Hansson pin. There is a question of the how much the remodeling potential is limited when a mild/moderate SCFE is fixed with threads across the physis, suggesting that this may lead to a greater residual deformity of the head-neck junction.<sup>18</sup> Devices to stabilize the epiphysis without inhibiting further growth have been described. These include the Hansson hook pin,<sup>19</sup> proximally threaded screws,<sup>20</sup> and sliding screws,<sup>21</sup> although the use differs according to country and is, at present, less widespread.

### THE SEVERE STABLE SLIP

For the severe but stable slip, the contentious issue is between fixation in situ and corrective osteotomy. Fixation in situ is with a severe slip is not likely to remodel sufficiently; a significant residual deformity would be expected.<sup>22</sup> The concern with regard to the corrective osteotomy is the risk of AVN in a hip that was previously viable, albeit with a deformity.

There are a variety of described osteotomies aimed at gaining correction of the deformity seen in SCFE. These include the intracapsular cuneiform osteotomies of Dunn<sup>23–25</sup> and Fish<sup>26,27</sup> as well as the modification of the Dunn technique to use the anterior approach.<sup>28</sup> Each of these has a risk of AVN, varying from 12% to 26%, although the series described are combinations of stable and unstable slips, so the rates of avascularity may partly be related to the slip, rather than the treatment.

Surgical dislocation, as described by Ganz<sup>29</sup> has been shown as an effective method for achieving acute correction of the deformity through osteotomy with zero rates of AVN in the initial series from the center that developed the technique.<sup>30</sup> Subsequently several centers have continued to use the technique, with some reporting low rates of 7% to 10%,<sup>31–33</sup> whereas others have demonstrated challenges of the technique with AVN rates of 26% to 30%.<sup>25,34,35</sup> The decision to undergo corrective osteotomy is therefore not taken lightly, but will be affected by the training of the surgeon and the throughput of the center as to whether the risks are taken to outweigh the benefits. Longer term, larger cohort studies from non-inventor (or noninventor trained) centers are needed for this technique.

For the severe stable slip, the EPOS survey showed that 67% would favor fixation in situ with a single screw; similarly the BSCOS survey showed 71% would make the same decision. Primary corrective osteotomy was used in the severe stable slip by 25% of the BSCOS respondents and 16% of the EPOS survey. A greater proportion of the EPOS group used extracapsular osteotomies rather than intracapsular osteotomies (10% extra vs. 6% intra). In contrast, intracapsular osteotomies were favored in the BSCOS survey (7% extra vs. 16% intra; 2% were “referred on” for an osteotomy). The SoFOP<sup>10</sup> reported a multi-centre series of severe slips managed largely at university hospitals, of which the stable slips were fixed in situ in

39.5% of cases, whereas 51% underwent primary corrective osteotomy (all intracapsular) with the majority preferring to use the anterior approach for the Dunn osteotomy.

Osteochondroplasty of the head/neck (secondary cam) deformity has been used either through open anterior approaches, arthroscopic debridement or through surgical dislocation. A recent systematic review of these methods suggested effective improvement in impingement due to residual deformity, although with a higher risk of complications in the dislocation group.<sup>36</sup> Arthroscopic debridement of the head/neck deformity is also technically challenging in the SCFE patient due to patient habitus and the morphology of the cam deformity, and should only be used by arthroscopically trained surgeons. More severe slips may be less suitable to arthroscopic management as the resection required may risk fracture.<sup>37</sup>

### THE UNSTABLE SLIP

For the unstable slip, the main concern is the risk of significant AVN of the capital femoral epiphysis. The timing of surgery and the method that reduction is obtained with (or not) may both affect the outcome from this regard.

Early reduction and fixation of the unstable slip has been suggested to prevent further injury to the retinacular vessels and reduce the risk of AVN.<sup>38</sup> Lower rates of AVN in unstable slips fixed <24 hours after onset of symptoms have been described in comparison with >24 hours (7% vs. 20%).<sup>39</sup> There is a period during which the physis is thought to be more vulnerable to AVN in the days following an acute slip (although the basic scientific evidence for this is lacking), with increased risks of AVN if reduction and fixation are attempted.<sup>40</sup> The Southampton group in the United Kingdom described a series in which no AVN was seen when treated with manipulation and fixation in <24 hours.<sup>41</sup> This led to their suggested algorithm of treating unstable slips with manipulation and fixation if seen within 24 hours, but waiting for 3 weeks on bed rest/skin traction if this window was missed.<sup>42</sup>

Intracapsular hematoma and compression of the vessels has also been implicated as a cause for AVN in the unstable slip, with increased pressures seen during manipulative reduction.<sup>38</sup> Parsch described a method of capsulotomy to evacuate the hematoma, followed by open reduction and fixation as an emergency, with a rate of only 5% AVN (the lowest in the current literature) seen in a series of unstable slips.<sup>43</sup>

In total, 88% of the BSCOS survey respondents would choose to operate on an unstable slip within 24 hours if seen with <6 hours onset compared with only 41% if onset of symptoms has been for >24 hours.<sup>14</sup> The preferred timing for the latter scenario showed a variety of responses with the majority of preferring to wait until after 7 days. Similarly 85% of the Netherlands WKO would treat within the first 24 hours.<sup>15</sup> Within the EPOS survey, 81% would effect a reduction either through positioning on the fracture table (46%) or with a deliberate manipulation (35%). Eleven

percent reported the use of an open reduction/capsulotomy in the unstable slip.

### PROPHYLACTIC FIXATION OF THE CONTRALATERAL HIP

The contralateral hip may be involved in up to 19% of cases of unilateral SCFE, most frequently seen within 18 months of the first slip.<sup>44</sup> Age at onset, severity of slip, endocrine disorders, and potential loss to follow-up may all affect the decision to treat the nonaffected side.<sup>45</sup> This must be weighed up against the risks of chondrolysis, joint penetration, symptomatic metalwork, or fracture.<sup>46</sup> When presented with an otherwise uncomplicated but severe slip, the EPOS and BSCOS surveys were similar with 29% and 27%, respectively, preferring to fix prophylactically.

### CONCLUSIONS

The decision-making process in SCFE is based largely on level IV and level V evidence. There is a degree of concordance in the decision-making used in the treatment of SCFE across Europe, but it is the ongoing development of larger prospective studies (which take into account the rarity of the condition and the heterogeneity of treatment approaches) that will allow better understanding of the patient group and the interventions used.

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## Commentary

**D**rs Wright and Ramachandran have written a paper summarizing the European perspective on slipped capital femoral epiphysis (SCFE). In their review of the varied approaches to treatment of this acquired hip problem of adolescence, they document a number of important facts concerning this condition based on literature review and society questionnaires. They clearly differentiate the risk of avascular necrosis between stable and unstable hips.

In unstable SCFE, avascular necrosis may be related to (1) timing of treatment, (2) intracapsular decompression, (3) early osteotomy, and (4) degree of displacement. It is difficult from the literature to establish absolute recommendations for treatment. Long-term studies by BOSS, BSCOS, and EPOS will be required in order to differentiate the relationship of early treatments to the onset of subsequent degenerative arthritis.

Although it is clear that severity of deformity is related to rapidity of onset of degenerative arthritis,

it is not established to what degree deformity altering operations have a predictable effect in decreasing the risk of degenerative joint disease when applied broadly. The orthopedic community in all countries will benefit from large studies characterizing the effect of deformity altering procedures on hip longevity. It is quite clear that stabilization of the proximal femoral epiphysis with single screw treatment in stable SCFE is the treatment of choice in mild and moderate cases.

As one looks for firm data on which to base decisions about treatment of severe stable SCFE and unstable SCFE, one finds the literature lacking but improving. We await a time of certainty as we continue to treat children with SCFE in the best and safest way possible.

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