Acta Orthop. Belg., 2013, **79**, 235-238

CASE REPORT

Bilateral epiphyseal migration following fixation for slipped capital femoral epiphyses in a hypothyroid child

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Progression of slipped capital femoral epiphysis following *in situ* screw fixation typically occurs through loosening of the screw in the metaphysis. Epiphyseal migration off the screw due to physeal growth is rare. We report epiphyseal migration off bilateral screws in a child undergoing thyroid replacement therapy. Patients with mild and moderate slipped capital femoral epiphysis and endocrine disease should be followed-up with radiographs taken at intervals which reflect the rate of growth. Fixation should be revised if the tip of the screw approaches the physis and initial fixation with two screws may be considered.

Keywords : SCFE ; slipped capital femoral epiphysis ; hypothyroidism ; progression ; migration ; in situ fixation.

INTRODUCTION

We report a case of epiphyseal migration following *in situ* fixation of bilateral slipped capital femoral epiphysis (SCFE) with single cannulated screws, in a 13-year-old boy undergoing oral hormone replacement for hypothyroidism. The patient had "grown off" the screws in the twelve months following initial fixation. This case emphasises the capacity for bone growth in patients undergoing treatment for hypothyroidism, and the need for close radiographic follow-up after surgery in this high-risk patient group.

CASE REPORT

A 13-year-old boy underwent *in situ* fixation with single 6.5 mm partially threaded screws for acute bilateral SCFE (Fig. 1 & 2). Both slips were grade I (radiographic displacement of the epiphysis was less than 30% of width of the femoral head). The patient was of short stature, and had been commenced on oral thyroxine one month previously for a new diagnosis of hypothyroidism. Hip symptoms resolved immediately postoperatively, and recovery was uneventful.

Twelve months postoperatively, the patient attended the emergency department complaining of left knee pain, similar to that which had prompted the initial presentation. He reported a rapid growth

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No benefits or funds were received in support of this study.
The authors report no conflict of interests.

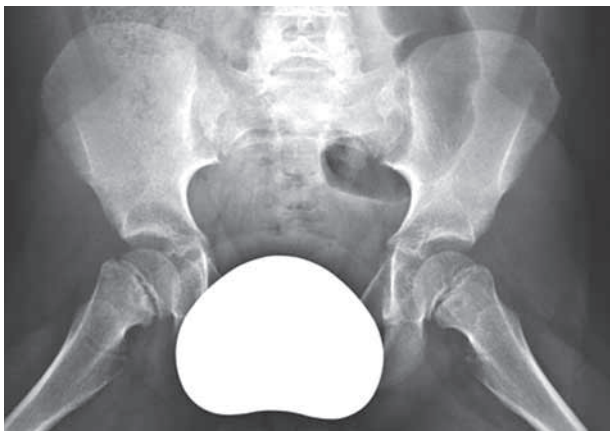

Fig. 1. — Frog lateral pelvic radiograph at presentation

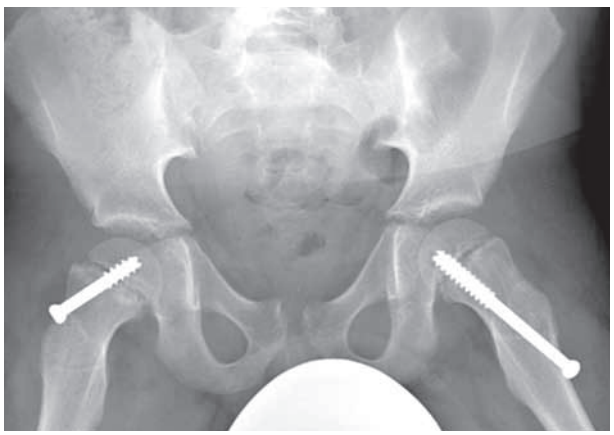

Fig. 2. — Frog lateral pelvic radiograph after *in situ* pinning

in height since commencement of oral thyroxine replacement and his mother commented on the improved quality of his hair. He walked with an antalgic gait and his left hip motion was diminished in all directions associated with pain. A frog lateral pelvic radiograph showed open physes (Fig. 3). Although there was no worsening of the lateral head shaft angle, the left epiphysis had migrated from the tip of the screw due to femoral neck growth, as evidenced by a lucent area in the centre of the femoral head proximal to the screw tip, and a change in screw tip position such that no screw threads fully crossed the physis (compared with three fully-crossing screw threads seen previously (Fig. 2). The absence of radiolucency around the inferolateral screw threads in the femoral metaphysis confirmed

Fig. 3. — Frog lateral pelvic radiograph 12 months after the first fixation operation.

that the findings were of movement of the epiphysis away from the screw tip with neck growth rather than movement of the whole screw in relation to the femur. A diagnosis of incipient progression of left-sided slip was made, and the original screw was replaced with two longer partially threaded screws. Given the absence of symptoms or radiographic slip progression, revision surgery to the right hip was not performed at this stage. Unfortunately one month later, similar symptoms appeared on the right side, and revision to double screw fixation was performed (Fig. 4). Pain resolved immediately following each operation. The patient remains pain free nine months after the most recent operation and radiographs suggest that the physes are fusing.

DISCUSSION

SCFE is displacement of the proximal femoral epiphysis. Its pathogenesis is poorly understood. The slip occurs through the hypertrophic zone of the physis, typically in children undergoing the pubertal growth spurt. It has been suggested that subtle hormone imbalances render the physes of certain children more susceptible to slippage (*14*). Further weakening of the physis and thus susceptibility to SCFE occurs in certain endocrine conditions, most commonly hypothyroidism (*9*). The usual treatment for mild and moderate acute SCFE is percutaneous *in situ* fixation. The goal of treatment is to prevent

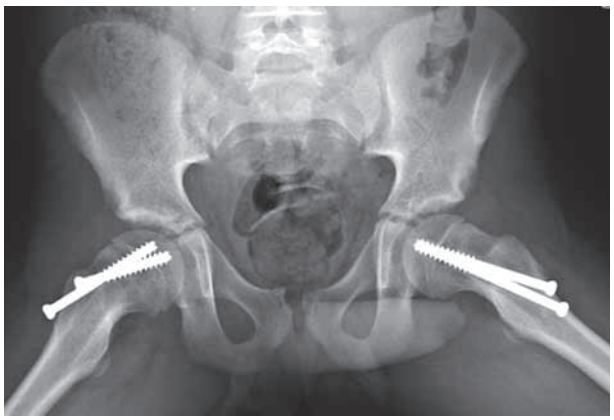

Fig. 4. — Frog lateral pelvic radiograph after the second revision operation.

slip progression until closure of the physis, whilst avoiding complications such as avascular necrosis, joint penetration and chondrolysis.

Failure of fixation and slip progression may occur due to loosening of the shaft of the screw within the metaphysis, loosening of the tip of the screw within the epiphysis or the epiphyseal migration "growing off" the implant. We found only one previously reported case of epiphyseal migration off a cannulated screw (*3*).

Various studies have examined the effectiveness of different choices of implant and different configurations of fixation.

Choice of implant

Laplaza and Burke analysed retrospectively patients treated by *in situ* fixation with threaded Steinman pins, Knowles pins, or cannulated screws (*8*). Evidence of the epiphysis "growing off" the pins was seen in 29% and 18% of the hips treated with Steinmann and Knowles pins, respectively. No further growth was seen in patients treated with cannulated screws. The authors recommended the use of one cannulated screw in the management of mild to moderate SCFE.

Partially versus fully-threaded screws

Miyanji *et al* (*10*) tested *in vitro* SCFE fixation with single partial (16 mm) threaded 7.3 mm diameter screws against fully-threaded screws. No significant biomechanical difference was found between the two systems, although the authors commented that removal of fully-threaded screws may be easier. Other authors have reported good results from a gliding hip screw technique (partially-threaded screws with all threads in the epiphysis, and longer screw length to accommodate physeal growth) (*1,7*).

Number of screws

Biomechanical testing using animal models of SCFE has shown a trend towards increased stiffness (*5*) and creep-resistance (*6*) when using double screw fixation rather than single screw fixation. Segal *et al* found a significant increase in stiffness under torsional loading of double screw compared to single screw fixation (*12*). Nevertheless, significantly higher metalwork-related complication rates with multiple screws (*2*) have led the majority of authors to advocate single screw fixation. Amongst advocates, Goodman *et al* reported no cases of slip progression in a series of 21 patients each treated with a single screw (*4*). It should be noted that none of the patients had concomitant endocrinopathy. Sanders *et al* reported 7 cases of slip progression following cannulated screw fixation, all of which had loosening of the implant in the neck with the implant remaining secure in the epiphysis (*11*).

Screw position

Carney *et al* described slip progression in 20% of cases treated with single screw fixation (*3*). All of the cases of slip progression showed less than 5 screw threads engaged in the epiphysis on immediate postoperative radiographs, leading the authors to recommend screw advancement until 5 threads engage the epiphysis. However, their findings were confounded by a significant association between age and number of epiphyseal threads. Patients who are older at the time of presentation with SCFE can be expected to have less remaining capacity for physeal growth and to undergo physeal closure sooner, decreasing the risk of slip progression following treatment. Independently of the above, they

can also be expected to have more developed epiphyses thus accommodating more screw threads. Further difficulty in interpreting the study results arises from the lack of reporting the number of threads engaged in the metaphysis, given that all but one cases of slip progression occurred through loosening of the screw in the metaphysis. An *in vitro* study by Upasani *et al* gave different results (*13*). They used 7.3 mm diameter 16 mm partially threaded screws (5 screw threads total), and showed the most stable configurations to have 2 to 3 threads either side of the physis, giving both metaphyseal and epiphyseal hold. The authors suggested that screws with longer threaded sections may confer even more stability. Other work has found no association between screw position in terms of proximity to the centre of the epiphysis and slip progression (*3*,*4*).

The case described here illustrates the high capacity for physeal growth, epiphyseal migration off the screws, and failure of SCFE fixation in children undergoing treatment for hypothyroidism. Close monitoring is necessary to identify this condition and prevent slip progression. The frequency of clinical and radiographic follow up should reflect the rate of growth in the patient's height. Fixation should be revised if the femoral neck grows longer and the physis approaches the tip of the screw. If the patient develops symptoms on one side, it may be advisable to replace the screws on both sides with longer ones. Finally, as described above, evidence regarding the benefits of double screw fixation and the ideal number of epiphyseal screw threads in preventing slip progression is inconclusive. However, the rarer mode of slip progression through epiphyseal migration off the screw results from longitudinal growth at the physis, against which increased numbers of epiphyseal screw threads may afford greater protection. It would be reasonable to consider using higher numbers of epiphyseal threads in patients with endocrine disease. To achieve this in the setting of less-developed femoral epiphyses from growth retardation, double screw fixation may be required. At this time it is not known whether any protective effect of double screw fixation in patients with endocrine disease outweighs the increased risk of complications.

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