THE CONTRALATERAL HIP IN PATIENTS PRIMARILY TREATED FOR UNILATERAL SLIPPED UPPER FEMORAL EPIPHYSIS

LONG-TERM FOLLOW-UP OF 61 HIPS

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We reviewed, at an average age of 46 years, a series of 61 patients treated for unilateral slipped upper femoral epiphysis. At maturity there had been slipping of the contralateral hip in 11 patients (18%) and another 14 (23%) had originally had evidence of bilateral slipping when the primary radiographs were reviewed. In only two of these 25 patients (8%) was the slipping of the contralateral hip symptomatic.

The incidence of early osteoarthritis of the contralateral hip was 7 of 36 with no slip, 5 of 16 with an untreated slip and 1 of 9 with a slip pinned in situ. If all 61 contralateral hips had been prophylactically pinned at the primary admission, 36 of the operations (59%) would have been unnecessary.

We recommend that prophylactic pinning of the contralateral hip should not be standard, but that lateral radiography by the Billing technique be repeated every third to fourth month until closure of the growth plate begins. Hips in which a slip occurs should be pinned in situ.

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It has been reported that between 75% and 90% of patients with slipped upper femoral epiphysis (SUFE) have only unilateral changes at the time of diagnosis (Table I). Subsequent slipping of the contralateral hip may occur in 10% to 50% (Table I), with the time interval from initial diagnosis to slipping of the second hip extended to over three years (Jerre 1950; Carney, Weinstein and Noble 1991). The diagnosis of contralateral slipping is often 'missed' during adolescence, and not established until patients are reviewed as adults (Hägglund et al 1988). At the primary admission the surgeon has to decide on the management of the contralateral hip with no apparent slip. The indications for prophylactic nailing or pinning are still a matter of controversy.

Hägglund et al (1988) reviewed 237 patients treated for unilateral SUFE in southern Sweden and found that 136 (57%) eventually developed a bilateral slip. In 104 of these cases (76%) the diagnosis of contralateral slipping was not made until they were reviewed in adult life and 28 of these hips (27%) had developed osteoarthritis. They concluded that it was justifiable to pin all contralateral hips prophylactically with a single hook-pin. This was also the view of Hansson (1982), who had pinned 32 hips prophylactically with a single hook-pin and found no complications.

By contrast Crawford (1988), after reviewing the literature on SUFE, found a consensus against prophylactic pinning, because "the complications that may be encountered considerably outweigh the benefits in the child who is otherwise normal". He considered that it should be reserved for patients with metabolic and endocrine disorders. Emery, Todd and Dunn (1990) reviewed 95 prophylactic pinnings, using multiple pins, and found a 13.7% incidence of pin penetration and 15.6% of complications at pin removal. They found no cases of chondrolysis or segmental collapse of the femoral head and considered that many of the complications could have been avoided by better surgical technique and the use of a single hook-pin rather than multiple pins.

We have reviewed 61 middle-aged patients with a history of SUFE, originally diagnosed as having unilateral slips. We tried to determine how many had developed contralateral slipping, and whether it would have been

Table I. Earlier reports of unilateral SUFE

	Number of patients	Incidence of unilateral slip (*percentage*) First admission	During adolescence	At latest follow-up
Jerre (1950)	153	*84*	*78*	*58*
Schreiber (1963)	100	*73*	*67*	*35*
Wilson, Jacobs and Schecter (1965)	240	*88*	*75*	*72*
Hägglund et al (1988)	260	*91*	*79*	*39*
Jensen et al (1990)	62	*92*	*77*	*52*
Total	815	*87*	*76*	*53*

possible at the primary admission to identify those patients with an increased risk of this. We also assessed the management at primary admission and its long-term results.

PATIENTS AND METHODS

From 1946 to 1959, 120 patients (85 men and 35 women) were admitted to Sahlgrenska Hospital, Göteborg, with a diagnosis of SUFE. From these we selected 72 for re-examination on the following criteria:
1) On admission, diagnosed as having a unilateral slip.
2) No prophylactic pinning.
3) Any subsequent contralateral slip had either not been treated or had been pinned in situ.
4) Primary radiographs were available.

Of these 72 patients, 61 were available for radiographic and clinical re-examination (85%, 41 men and 20 women). In this group the average age at diagnosis was 13.8 years (9 to 17), the follow-up averaged 32.4 years (26 to 38) and the mean age at follow-up was 46.6 years (39 to 53).

Radiographic measurement. Repeated lateral radiographs of the hips were available for all patients during adolescence. From 1946 to 1952 we used the frog lateral view, and from 1953 the standard lateral view of Billing (1954) (Fig. 1). One of the authors (JW) measured the displacement of the epiphysis, as the slipping angle (SA; Fig. 2). An SA of 6° or less was recorded as normal, of 7° to 12° as uncertain, and of 13° or more as definite displacement (Billing and Eklöf 1984). In the uncertain cases, we assessed the secondary radiographic signs such as remodelling at the junction between epiphysis and femoral neck with bone absorption ventrally and/or bone deposition dorsally. If any secondary radiographic signs were seen slipping was recorded as definite. In 55 patients (90%) the initial radiographs were remeasured; for the other six the epiphyseal plane angle (Billing 1954) had been recorded in the medical records and was converted to the SA by subtraction from 90°.

Radiographic re-examination. Five views were obtained of each hip as follows: 1) non-weight-bearing AP; 2) non-weight-bearing modified frog lateral; 3) weight-bearing AP; 4) weight-bearing anterolateral-oblique; and 5) weight-bearing posterolateral-oblique (Ahlbäck and Rydberg 1985; Hansson et al 1993). These showed the whole circumference of the articular joint space of the hip. We recorded pathological narrowing when the superior joint space was < 3.0 mm or the anterior or posterior joint space was < 2.5 mm, or both were abnormal (Hansson et

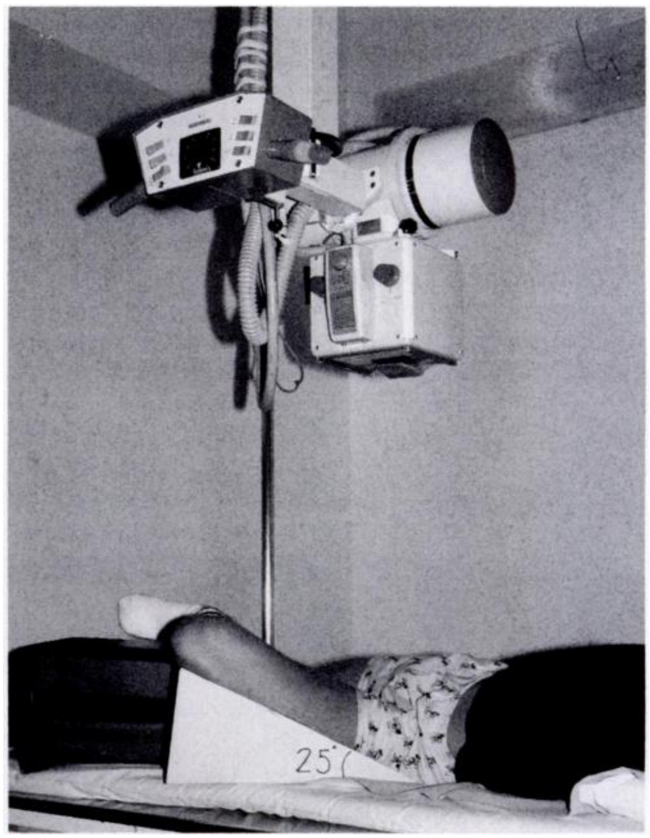

Fig. 1

The modification of the technique described by Billing (1954) to obtain a reliable measurement of the displacement of the epiphysis by a standard and exactly defined position. The patient is supine with the knee flexed 90°, the femur externally rotated 90° and elevated by 25° from the table. The pelvis is rotated by 60° to 70° when this is necessary because of a restricted range of hip motion.

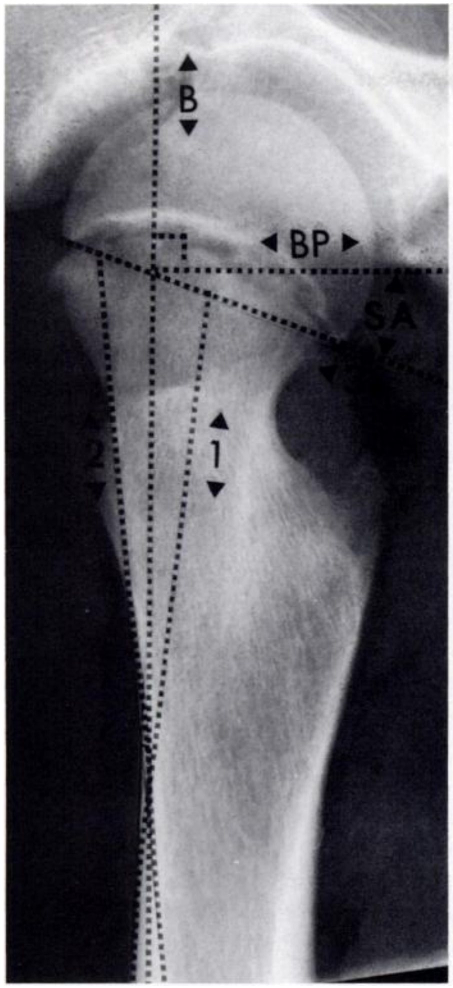

Fig. 2

From the lateral Billing view the slipping angle (SA) is measured. This is the angle between a line (3) along the base of the femoral epiphysis and a line (BP) at right angles to the line (B) which bisects lines parallel to the anterior cortex of the upper part of the femoral diaphysis (1) and parallel to the anterior cortex of the lower part of the femoral neck (2) (Billing and Eklöf 1984).

al 1993). The appearance of signs such as 'gunstock deformity' suggestive of slipping (Stulberg et al 1975) was also recorded.

Clinical examination. The Harris hip score was used for assessment of functional results (Harris 1969). Each hip was evaluated separately; > 90 points was classified as excellent and < 90 points as fair or poor.

Risk factors. To assess risk factors for slipping of the contralateral hip we analysed the effect of the following: 1) sex; 2) age at diagnosis; 3) duration of symptoms before diagnosis; 4) presence of signs of dystrophia adiposogenitalis at primary admission; 5) history of trauma; 6) affected side; and 7) the slipping angle of the primarily slipped hip.

Statistics. Fisher's exact test was used for comparison of the percentage of hips that had developed osteoarthritis and of fair or poor clinical results in each group. For comparisons between groups we used Student's *t*-test on mean values and the chi-squared test on percentages of patients. All the tests were two-tailed and a p value < 0.05 was considered significant.

RESULTS

Primarily slipped hip. At first admission the SA of the primarily slipped hip was 12° in one hip and 13° to 88° in the other 60 (mean 42.4°; median 38°).

Contralateral hip. Of the 61 patients, 25 (41%) showed evidence of a slip of the contralateral hip. At diagnosis the SA was 8° to 12° in nine and 13° to 35° in 16 hips. The mean of the whole group was 15.6° and the median 14°. This slipping of the contralateral hip had been asymptomatic in 23 patients (92%) and symptomatic in two. In 11 cases the slip had been diagnosed during adolescence at an average interval from primary diagnosis of the first hip of 14 months (2 to 26). In the other 14 patients, contralateral slipping was diagnosed only at review of the initial radiographs: in these the SA was 8° to 12° in four, and 13° to 20° in ten. None of the patients in whom the initial radiographs of the contralateral hip had been normal with no slipping, had developed any signs suggesting that slipping had occurred.

Risk factors. We found few risk factors which could be used to identify a subgroup with an increased risk of developing a slip of the contralateral hip (Table II). The original SA in the primarily slipped hip, however, was higher in patients who had bilateral slipping, but the difference was not significant. Bilateral slipping was more frequent in boys than in girls but again this difference was not statistically significant.

Of the 25 hips in which contralateral slipping had occurred at a later stage, 16 had received no treatment and nine had been pinned in situ with one Nyström pin. In these nine, five were uncomplicated and one patient had a subtrochanteric fracture 28 days after surgery with

Table II. Risk factors for contralateral slipping in 61 patients primarily diagnosed as having a unilateral slip. None of the differences was statistically significant

	Bilateral (n = 25)	Remained unilateral (n = 36)
Male: female	19:6	22:14
Age at diagnosis (yr; mean ± SD)	14.1 ± 1.9	13.6 ± 1.8
Duration of symptoms before diagnosis (mth; mean ± SD)	3.8 ± 3.3	5.0 ± 6.4
Dystrophia adiposogenitalis	9	9
History of trauma	12	15
Left hip as first slipped hip	14	23
Right hip as first slipped hip	11	13
Slipping angle of first slip (degrees; mean ± SD)	46.6 ± 23.1	39.3 ± 20.7

no history of trauma, one hip developed an increased SA after pin removal and required reoperation, and two others required reoperation for pin slipping or lost anchorage in the epiphysis.

Radiographic results. At late follow-up, radiographs showed that 13 of the contralateral hips (21%) had loss of joint space (Table III). Five of these had not previously been diagnosed at first examination. The incidence of signs of osteoarthritis was 7 of 36 hips without slipping, 5 of 16 with an untreated slip and 1 of 9 with a slip pinned in situ. We found no statistically significant differences between these three groups.

Clinical results. At late review, the clinical results were fair or poor (Harris hip score < 90) in eight of the contralateral hips (13%) (Table IV) and six of these had developed osteoarthritis. There were fair or poor results in 5 of 36 hips without slipping, 2 of 16 with an untreated slip and 1 of 9 with a slip pinned in situ. Again there was no significant difference between the three groups.

Table III. Radiographic findings at late review of the contralateral hip in 61 patients primarily diagnosed as having unilateral slipping. There were statistically no significant differences between the three groups

	Joint space	
	Normal	Narrow
No slip and no treatment (n = 36)	29	7
Slip and no treatment (n = 16)	11	5
Slip, pinned in situ (n = 9)	8	1

Table IV. Clinical results by Harris hip score at late review of the contralateral hip in 61 patients primarily diagnosed as having unilateral slipping. There were no statistically significant differences between the three groups

	Harris score	
	≥ 90	< 90
No slip and no treatment (n = 36)	31	5
Slip and no treatment (n = 16)	14	2
Slip, and pinned in situ (n = 9)	8	1

DISCUSSION

The two main arguments for prophylactic pinning of contralateral hips have been that there is a considerable risk of late slipping (Schreiber 1963; Debrunner 1965; Hansson, Hägglund and Ordeberg 1987), and that the diagnosis may be missed during adolescence, or not made until severe displacement has occurred (Hägglund et al 1988). The reported incidence of contralateral slipping varies considerably, partly because differing radiographic techniques and criteria have been used. Displacement is in a true posterior direction, perpendicular to the plane of anteversion (Billing 1954; Griffith 1976), and the diagnosis is therefore only reliable on a lateral view. In our series, repeated lateral radiographs were obtained during adolescence for all 61 patients and contralateral slipping had occurred at a later stage in 25 (41%). This slipping was asymptomatic in 23 patients (92%), which may explain why the diagnosis had been missed during adolescence in 14 of them (56%).

In no hip in which careful review of the initial radiographs had been assessed as showing no slip, did later radiographs up to and including late review suggest that a slip had occurred. The retrospective diagnosis of initial slipping was often made only after study of the series of radiographs obtained during adolescence. In many cases only measurement of a number of lateral radiographs taken a few months apart established the diagnosis. Of 25 cases, 16 contralateral slips were diagnosed by measurement of an SA > 13° and in nine with an SA of 7° to 12° by secondary radiographic signs. We believe that measurement of the SA is helpful in establishing the diagnosis, but that at the early stage it is essential to look for other radiographic signs which suggest slipping if hips with minimal displacement are to be pinned in situ. In some cases, the time interval from unilateral diagnosis to contralateral slipping was as long as two years and contralateral slipping cannot be ruled out until radiographs show that the growth plate has started to fuse.

Our review of 14 radiographs obtained during adolescence from which the diagnosis was primarily missed showed SA of 8° to 12° in four and 13° to 20° in ten. Retrospectively, these results suggest that the diagnosis could have been established primarily in most of these 14 hips, by careful measurement and assessment of other radiographic signs of early slipping.

We found no evidence for the view (Hägglund et al 1988) that the displacement of the contralateral hip is frequently severe at diagnosis. In our series the average SA of the contralateral hip was only 15.6° (8 to 35), compared with 42.4° (12 to 88) in the primarily slipped hip. The probable reason for this success with early diagnosis of contralateral slipping was that our patients with apparently unilateral slipping were followed carefully with regular lateral radiographs until the growth plate had started to fuse.

If our patients in this study had had prophylactic pinning of the contralateral hip at the primary admission, 36 of the 61 hips (59%) would have had an unnecessary operation; we do not consider this to be justifiable, especially in view of previous studies reporting that prophylactic pinning is associated with complications both at the primary pinning and at pin removal (Emery et al 1990). Prophylactic pinning may, however, benefit a limited number of patients, and we therefore used 'risk factors' (Table II) to try to identify patients with increased risk of contralateral slipping. None of the factors which we studied showed statistically reliable differences but, like Carney et al (1991), we found a slightly increased risk in patients with severe displacement of the primary side at diagnosis. Eighteen patients were originally diagnosed on clinical examination as possibly suffering from endocrine disorders (dystrophia adiposogenitalis) but, like Burrows (1957), we found no statistical evidence that these patients were more likely to develop a bilateral slip.

For most patients with unilateral slipping, there appears to be no reliable method of predicting contralateral slipping and there is therefore no absolute indication for prophylactic pinning. We recommend that it should be considered only for patients with two years or more until completion of growth (assessed by skeletal age) who would require many radiographs before contralateral slipping could be ruled out. In most hips, routine lateral radiographs taken by the method of Billing will reveal displacement at an early stage. A lateral radiograph of the contralateral hip taken every third to fourth month until the growth plate has started to fuse is sufficient.

Our review extended to an average age at follow-up of 46 years and we used a well-defined radiographic technique to study the whole of the joint space of the hip. This method has high reproducibility and has been shown to reveal early degenerative changes (Hansson et al 1993). We found that 21% of the contralateral hips had developed abnormal narrowing at late review (Table III), which is a considerably higher incidence than that reported for a general Swedish population under 55 years of age (Danielsson, Lindberg and Nilsson 1984). We found no statistically significant evidence however that the incidence of osteoarthritis in the contralateral hip was related to the occurrence of slipping or to management by pinning in situ (Table III). Of 36 hips with no detectable slipping, seven (19%) had degenerative change. This suggests that development of osteoarthritis in these patients is not directly related to displacement. Our clinical results were fair or poor in 8 (13%) of contralateral hips (Table IV). Five of these eight had no slip: prophylactic pinning of these would have been very unlikely to have prevented the development of osteoarthritis.

Our results, as well as a number of previous studies, suggest that the benefit of treatment of the contralateral hip requires more evaluation of middle-aged patients treated for SUFE. On present evidence we recommend that contralateral hips should be pinned in situ only when a slip occurs, and that a single hook-pin be used. Exceptionally, a minor slip seen on the lateral radiograph of a patient who has almost completed growth, could be managed by following the patient with repeated lateral radiographs until the growth plate has fused.

Conclusions. If all contralateral hips are pinned in patients with unilateral SUFE about half of the operations will be unnecessary. Instead, we recommend that special lateral radiographs be obtained every three to four months until the growth plate has started to fuse. Only hips which later show a slip should be pinned in situ.

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REFERENCES

Ahlbäck SO, Rydberg J. Radiology of degenerative hip disease. In Sevastik J, Goldie I, ed. *The young patient with degenerative hip disease.* Stockholm: Almqvist and Wiksell International, 1985:33-40.

Billing L. Roentgen examination of proximal femur end in children and adolescents: standardized technique also suitable for determination of collum-, anteversion-, and epiphyseal angles. *Acta Radiol* 1954; Suppl 110:1-80.

Billing L, Eklöf O. Slip of the capital femoral epiphysis: revival of a method of assessment. *Pediatr Radiol* 1984; 14:413-8.

Burrows HJ. Slipped upper femoral epiphysis: characteristics of a hundred cases. *J Bone Joint Surg [Br]* 1957; 39-B:641-58.

Carney BT, Weinstein SL, Noble J. Long-term follow-up of slipped capital femoral epiphysis. *J Bone Joint Surg [Am]* 1991; 73-A:667-74.

Crawford AH. Slipped capital femoral epiphysis. *J Bone Joint Surg [Am]* 1988; 70-A:1422-7.

Danielsson L, Lindberg H, Nilsson B. Prevalence of cox-arthrosis. *Clin Orthop* 1984; 191:110-5.

Debrunner AM. Prophylaktische Spickung der 'gesunden' Seite bei Epiphyseolysis capitis femoris. *Arch Orthop Unfallchir* 1965; 57: 243-57.

Emery RJH, Todd RC, Dunn DM. Prophylactic pinning in slipped upper femoral epiphysis: prevention of complications. *J Bone Joint Surg [Br]* 1990; 72-B:217-9.

Griffith MJ. Slipping of the capital femoral epiphysis. *Ann R Coll Surg Engl* 1976; 58:34-42.

Hägglund G, Hansson LI, Ordeberg G, Sandström S. Bilaterality in slipped upper femoral epiphysis. *J Bone Joint Surg [Br]* 1988; 70-B:179-81.

Hansson LI. Osteosynthesis with the hook-pin in slipped capital femoral epiphysis. *Acta Orthop Scand* 1982; 53:87-96.

Hansson LI, Hägglund G, Ordeberg G. Slipped capital epiphysis in Southern Sweden 1910-1982. *Acta Orthop Scand* 1987; Suppl 226: 9-63.

Hansson G, Jerre R, Sanders SM, Wallin J. Radiographic assessment of coxarthrosis following slipped capital femoral epiphysis. *Acta Radiol* 1993; 34:117-23.

Harris WH. Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by mold arthroplasty. *J Bone Joint Surg [Am]* 1969; 51-A:737-55.

Jensen HP, Steinke MS, Mikkelsen SS, Tomsen PB. Hip physiolysis: bilaterality in 62 cases followed for 20 years. *Acta Orthop Scand* 1990; 61:419-20.

Jerre T. Study in slipped upper femoral epiphysis with special reference to late functional and roentgenological results and to value of closed reduction. *Acta Orthop Scand* 1950, Suppl 6.

Schreiber A. Epiphyseolysis capitis femoris: Beitrag zur Frage der Beidseitigkeit-Gleichzeitiges Vorkommen von Wirbel-säulenveränderungen. *Z Orthop* 1963; 97:4-11.

Stulberg SD, Cordell LD, Harris WH, Ramsey PL, MacEwen GD. Unrecognized childhood hip disease: a major cause of idiopathic osteoarthritis of the hip. In: *The Hip.* Proc 3rd meeting of The Hip Society. St Louis: CV Mosby Co, 1975:212-28.

Wilson PD, Jacobs B, Schecter L. Slipped capital femoral epiphysis: an end-result study. *J Bone Joint Surg [Am]* 1965; 47-A:1128-45.