

# Evaluation of clinical presentations and short-term results of management of slipped capital femoral epiphysis

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## Abstract

**Background:** Slipped Capital Femoral Epiphysis (SCFE) is an adolescent hip disorder in which there is gradual or acute disruption through the capital physal plate during a period of rapid growth in adolescence, weakening of upper femoral physis and shearing stress from incumbent body weight may cause the femoral head to become displaced from its normal relation to the femoral neck. Much has been learned about the epidemiology, the aetiology and the pathogenesis of this condition. Pinning in situ for most patients with slipped capital femoral epiphysis remains the gold standard for treatment based on reports of increased safety (less osteonecrosis and chondrolysis) with satisfactory clinical function. This study was done to evaluate the clinical presentations and short-term results of management of Slipped capital femoral epiphysis.

**Material and Methods:** A Cross sectional analytical study design was implemented using data obtained from patient records and radiological examinations of patients who were treated in our medical college from January 1993 to January 2003 14 hips (11 patients) with slipped capital femoral epiphysis. Clinical and Radiological data was collected pre and post treatment for analysis. Epidemiological data were also collected and analysed accordingly. **Results:** The male female ratio in the study was 3:1. The average age of onset in Males in this study was 14.5 years and of the females was 11.8 years. The ratio of involvement of left hip to right hip in this study was 3: 1, 27% of children in this study had bilateral slip. The slip angle in AP view was found to be less than that of lateral view in almost all the patients but no specific pattern was noted in the difference in slip angle (slip angle in lateral view minus slip angle in AP view) for different grades of slip. There is a tendency for hips treated with 3 pins/ screws for higher incidence of complication than 2 pins / screws. Early fusion of epiphysis occurred in all cases and is not related to the number of pins /screws used. The average time taken for fusion of epiphysis was 8.28 months. The two cases of chondrolysis seen in this study were in treated hips associated with pin penetration. Rotatory movements are most affected followed by movements in coronal plane. There was 50% improvement in range of movement in both the planes mentioned above at one year follow up. **Conclusion:** Slipped capital femoral epiphysis is more common in boys than girls. Left hip is more commonly affected than the right with involvement of the contralateral hip in 1/3<sup>rd</sup> of the cases. It is essentially a disease of adolescence where obese children are more prone to be affected. Rotatory movements are the most affected which is followed by movements in coronal plane. Frog lateral view reveals slip angle more than the AP view. No relationship was noted between the grade of slip and the percentage of correction obtained after closed reduction. Two hips were associated with pin penetration which subsequently developed chondrolysis.

**Keywords:** Slipped Capital femoral Epiphysis (SCFE), Percutaneous Pinning, Functional outcome

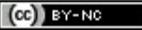
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## INTRODUCTION

Slipped Capital Femoral Epiphysis (SCFE) is an adolescent hip disorder in which there is gradual or acute disruption through the capital physal plate.<sup>1</sup> The usual deformity consists of an upward and anterior movement of the femoral neck on the capital epiphysis, which become displaced posteriorly and inferiorly.<sup>2,3</sup> The short-term goal<sup>4</sup> of treatment of Slipped capital femoral epiphysis is to restore the function of the hip; the long-term goal<sup>5</sup> is to delay the development of degenerative joint disease.

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Pinning in situ for most patients with slipped capital femoral epiphysis remains the gold standard for treatment based on reports of increased safety (less osteonecrosis and chondrolysis) with satisfactory clinical function. Manipulation of moderate to severe slips has been reported with varying success.<sup>6</sup>

## MATERIALS AND METHODS

A Cross sectional analytical study design was implemented using data obtained from patient records and radiological examinations of patients who were treated in our medical college from January 1993 to January 2003 14 hips (11 patients) with slipped capital femoral epiphysis. All were treated with traction and early operative stabilization. The duration of follow up was the time from the onset of symptoms to the most recent evaluation. Grade I, II and III slips were treated with in situ pinning and grade IV slip (one case) was treated by open reduction following cuneiform osteotomy and fixation with pins. The age at diagnosis, gender, presenting complaints with its duration, body weight, height, laterality of the slip, month of presentation and duration of symptoms were requested for each patient. Arc of movements in different planes at presentation were also noted from chart review. Data regarding preoperative physical examination, operative technique, complications, total arc of movement at follow-ups and subjective reports of pain, dysfunction or limp were gathered from the chart review. Radiographs were examined and measured to determine the magnitude of slip preoperatively in 2 planes: antero-posterior (AP) view and frog or true lateral view. When the contralateral side was normal, the slip angle was calculated by subtracting the opposite measurement. If the opposite hip was clinically or radiologically abnormal, normal angles of physeal inclination (145 degrees in AP and IO degrees in lateral) were used for subtraction.

Specific data related to surgery such as the time elapsed between onset of symptoms and surgery, the type of reduction attempted (closed I open). Number of pins / screws used for fixation were noted.

Improvement in the femoral head shaft angle were measured from the postoperative X-rays in all the patients who underwent closed reduction. Follow up X-rays were reviewed to note down the following: 1. progression of slips, 2. screw I pin penetration, 3. pin breakage, 4. avascular necrosis, 5. Chondrolysis, 6. fusion of epiphysis The hips were classified as chronic (having symptoms for > 3 weeks), acute (having symptoms for <3 weeks), or asymptomatic (bilateral cases in which the asymptomatic hip was either diagnosed at the same time as the opposite [simultaneous] or later [ sequential]) Body weight is classified as obese (95th percentile for age), overweight (90th-95th percentile), above average (50th-89th

percentile), below average (10<sup>th</sup> - 49th percentile) and underweight (<10th percentile).

### Pre-operative treatment

Initially, all patients were admitted for strict bed rest and longitudinal skin traction. Once the patient was transferred to the radiolucent table, the surgeon examined the affected hip under fluoroscopy. By gently rotating the leg, the epiphysis was observed for evidence of mobility.

### Operative procedure

Closed reduction is attempted by gentle abduction and internal rotation under general anaesthesia. After closed reduction the trochanter and upper end of femur is approached laterally. Epiphysis was then fixed to the neck by passing pins/screws (Austin Moore's pin/ Knowles pin / 6.5mm cannulated screw) from the lateral surface of femur below the trochanteric flare through the neck and across the epiphyseal plate.

### After treatment

Patients were discharged from the hospital after suture removal. Weight bearing (partial) was advised after 6 weeks. Intensive hamstring / quadriceps exercises were advised during the post-operative period. Full weight bearing is started by 10-12 weeks. Implant removal is done at one year after the fusion of epiphysis. X-rays were taken at immediate post-op, after 6 weeks, at 6 months, and at 1 year follow up periods. Additional X-rays were taken if specific complaints warrants.

### Observations and Results:

#### 1. Epidemiological results:

Out of the 11 children 3 were females with an average age of 11.88 years (ranging from (27.3%) and 8 boys (72.7%) with a male: female ratio of 3:1 The average age for the males was 14.5 years (ranging from 10 - 13 years), and the average age for the females was 11.88 years (ranging from 10 - 13 years). Eight (72.7%) children had unilateral affection of the hip and 3 (27.3%) had bilateral affection of the hips. Of the unilateral cases 2 (25%) had right hip involvement and 6 (75%) had left involvement. In bilateral cases the second slip was diagnosed within an average period of 9 months (ranging from 10 - 19 months). Six children had (42.85%) chronic, 7 (50%) acute and 1 (0.07%) acute on chronic slip. 6 (60%) children were obese, 1 (10%) overweight, 3 (30%) above average, and none were below average and underweight. The average weight of the children was found to be 50-60 kg. The mean duration of follow up from the onset of symptom was 14.5 months (ranging from 8 months to 24 months).

Grade 1 has one obese child and grade 2 had 5 obese and 2 average weight, Grade 3 had 3 obese and 1 overweight and grade 4 had one average weight child. Most of the hips showed Grade II slip. The number of hips in each grade of slip are as follows:

**Grades of Slip and Weight status of the child**

**Table 1:**

| Grade | No. of hip | Weight Status         |
|-------|------------|-----------------------|
| I     | 1          | 1 Obese               |
| II    | 8          | 5 Obese, 2 Average    |
| III   | 4          | 3 Obese, 1 Overweight |
| IV    | 1          | 1 Average             |

**2. Radiological results**

**Slip angle:** Preoperatively the average slip angle was largest in lateral view at an average of 30.64 degrees (ranging from 0-62 degrees) followed by the AP view at 20.14 degrees (ranging from 0- 50 degrees). The average difference between the degree of slip in lateral view and AP view is 10.5 degrees (ranging from 2-30 degrees). The grade wise difference in degree of slip between lateral and AP views are as follows:

**Table 2:**

| Grade of slip | Difference in slip angle between AP and lateral view |
|---------------|--|
| II            | 8 degrees  |
| III           | 18.25 degrees  |
| IV            | 10 degrees   |

No definite pattern was noted to determine any significance between the difference in slip angle and the grade of slip.

**Reduction:** Closed reduction was done in 12 hips with varying degrees of reduction in 11 hips and no reduction in one hip. One patient had 10 degrees overcorrection in AP view which also had chondrolysis following pin penetration. Reduction was not attempted on one hip with grade I slip and One hip with grade IV slip underwent open reduction following cuneiform osteotomy.

**3. Functional results**

**Arc of movement:** Following were the arc of movements of different grades of slip at presentation to the outpatient clinic

**Table 5:**

| Grade   | Flexion- Extension | Abduction-Adduction | Rotation     |
|---------|--------------------|---------------------|--------------|
| I       | 100 degrees        | 40 degrees          | 40 degrees   |
| II      | 81.8 degrees       | 46.25 degrees       | 39.3 degrees |
| III     | 105 degrees        | 48.75 degrees       | 42.5 degrees |
| IV      | 115 degrees        | 40 degrees          | 35 degrees   |
| Average | 91.78 degrees      | 46.07 degrees       | 40 degrees   |

The values show a significant restriction of movement in adduction-abduction plane and in the rotatory plane. The arc of movement at last follow up in patients without complications were as follows:

**Table 6:**

| Grade   | Flexion-Extension | Abduction-Adduction | Rotation      |
|---------|-------------------|---------------------|---------------|
| I       | 105               | 70 degrees          | 70 degrees    |
| II      | 111.66 degrees    | 61.66 degrees       | 67.5 degrees  |
| III     | 106.25 degrees    | 62.5 degrees        | 56.25 degrees |
| IV      | 125 degrees       | 70 degrees          | 65 degrees    |
| Average | 110.41 degrees    | 63.33 degrees       | 63.75 degrees |

Therefore the improvement in the arc of movement in different planes are as follows:

The grade wise percentages of correction obtained in lateral view are as follows:

**Table 3:**

| Grade of slip | % of correction obtained on lateral view         |
|---------------|--|
| II            | 34-16% (2 patients missed due to lack of X-rays) |
| III           | 66.3% -  |
| IV            | 50% -  |

No pattern in the relationship was seen between the grade of slip and the percentage of correction obtained in the lateral view.

**Implants**

The relationship between number of pins/screws used and occurrence of implant penetration are as follows.

**Table 4:**

| No. of pins/screws used | % of hips |
|-------------------------|-----------|
| 1                       | 14.2%     |
| 2                       | 64.2%     |
| 3                       | 21.4%     |

None developed progression of slip. There was no significant relationship between the number of pins used and the time taken for closure of epiphysis. As frequent X-rays were not taken, the specific period of fusion for the hips could not be determined. The average time taken for fusion of epiphysis was 8.28 months.

**Complications**

Two patients developed implant penetration. Both had their slipped hip fixed with pins. None of the screws showed penetration into the joint. Both patients with pin penetration eventually developed chondrolysis. None of the patients developed pin breakage, AVN, or growth disturbance.

**Table 7:**

| Grade           | Flexion- Extension | Abduction- Adduction | Rotation     |
|-----------------|--------------------|----------------------|--------------|
| I               | 5 degrees          | 30 degrees           | 30 degrees   |
| II              | 29.86 degrees      | 15.41 degrees        | 28.2 degrees |
| III             | 1.25 degrees       | 13.75 degrees        | 13.75degrees |
| IV              | 10 degrees         | 30 degrees           | 30 degrees   |
| Average         | 11.52 degrees      | 22.29 degrees        | 25.48degrees |
| %of improvement | 12.55%             | 48.38%               | 63.7%        |

The above results show an increase in the range of motion especially in the abduction-adduction plane and in the rotatory plane.

## DISCUSSION

### Epidemiological values

The male female ratio in the study was 3:1. Hagglund *et al*<sup>7</sup> in a study in Sweden found the ratio to be 2:1 and Loder *et al.*<sup>8</sup> in an international study from 1954-1991 got the ratio as 3:2. The age of onset is during adolescence - a period of maximal skeletal growth. The average age of onset in Males in this study was 14.5 years and of the females was 11.8 years. Studies by Exner, Hagglund *et al.*<sup>1</sup>, and Loder *et al.*<sup>2</sup> have shown the range to be 13-15 years for males and 11-13 years for females. The ratio of involvement of left hip to right hip in this study was 3: 1. Loder *et al.*<sup>9</sup> in their study got left: right ratio as 3:2 and Hagglund *et al.*<sup>10</sup> got the ratio as 2:1. Why there is predilection for left hip is unknown. So far no definite explanation for the disproportionate involvement of the left hip has been given. 27% of children in this study had bilateral slip which is in accordance to large scale studies<sup>i</sup> done earlier. Bilateral involvement has been reported in different studies to be ranging from 17% to 80%.<sup>11,12</sup> Symptom duration is discussed infrequently in the literature (4 months for white children). Many factors<sup>(ii,iii)</sup> may influence symptom duration. These include the rapidity with which medical care is available, the child rearing patterns that influence the subjective interpretation of pain. Slipped capital femoral epiphysis is overwhelmingly a disease of obesity<sup>5</sup>. 70% of the children in this study were in the upper 10<sup>th</sup> percentile for weight. Slipped capital femoral epiphysis develops in heavier children at a younger age than lighter children. However, such a pattern was not found in this study. This can be attributed to the very small patient population included in the study.

### Radiological study values

The lateral view in X-ray reveals the actual amount of slip. The slip angle in AP view was found to be less than that of lateral view in almost all the patients but no specific pattern was noted in the difference in slip angle (slip angle in lateral view minus slip angle in AP view) for different grades of slip.<sup>15</sup>

The study population is too small to determine the significance of pin related complications (pin penetration,

chondrolysis, further progression of slip). However, in this study there is a tendency for hips treated with 3 pins/ screws for higher incidence of complication than 2 pins / screws.<sup>9</sup>

Kruger and colleagues<sup>16</sup> found that two pins were better than one for fixation of epiphysis. Belkoff and colleagues<sup>17</sup> found that single screw fixation<sup>18</sup> yields more strength than 2 pin fixations. Another study<sup>19,20</sup> showed that fixation with 2 screws did not yield significant increase in stiffness (only 3 3 %) than one screw.

Early fusion of epiphysis occurred in all cases and is not related to the number of pins /screws used. The average time taken for fusion of epiphysis was 8.28 months which is similar to other studies. Loder *et al.*<sup>20</sup> showed in his study that fusion of epiphysis takes place within 18 months of presentation for treatment of first hip.

The two cases of chondrolysis seen in this study were in treated hips associated with pin penetration. Studies in literature have shown a higher incidence of chondrolysis with pin penetration.

### Functional results

Rotational deformity is a well-recognized symptom in slipped capital femoral epiphysis. Rotatory movements are most affected followed by movements in coronal plane. There was 50% improvement in range of movement in both the planes mentioned above at one year follow up. This can be attributed to the subsidence of muscular spasm around the hip joint and to the remodelling of the metaphysis

## CONCLUSION

Slipped capital femoral epiphysis is more common in boys than girls. Left hip is more commonly affected than the right and Xray in approximately one third of the cases shows bilateral involvement. It is essentially a disease of adolescence where obese children are more prone to be affected. Bilateral involvement was found to be in 27% of the children in our study. Rotatory movements are the most affected which is followed by movements in coronal plane. Frog lateral view reveals slip angle more than the AP view. No relationship was noted between the grade of slip and

the percentage of correction obtained after closed reduction. Two hips were associated with pin penetration which subsequently developed chondrolysis. There were no cases of progression of slip or implant failure. There is a tendency of hips treated with 3 pins/screws for higher incidence of complications than hips treated with 2 pins/screws. Early fusion of the epiphysis was seen in all the treated hips; the average.

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