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ORIGINAL ARTICLE**The Outcome of In situ Pinning In Treatment Of Slipped Capital Femoral Epiphysis In Adolescents.****Hossam Mohammed Khairy⁽¹⁾, Mohamed El-Sadek Atteia⁽¹⁾, Ahmed El-Sayed Al-Malt⁽¹⁾, Ahmed Ibrahim Solaiman Akila⁽²⁾**

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ABSTRACT

Background: Slipped capital femoral epiphysis (SCFE) is the most common hip disorder affecting adolescents between 9 and 15 years old. Early detection and treatment can significantly reduce the complications that can occur due to SCFE such as pain, deformity and hip arthritis. The term "SCFE" is technically incorrect as the femoral epiphysis maintains its normal relationship with the acetabulum while the femoral neck and shaft displace superiorly, in adduction and external rotation deformity.

Objective: To assess the outcome after in situ pinning in management of SCFE in adolescents.

Patients and Methods: The study was carried out at orthopedic department, Zagazig University Hospitals and El-Sahel Teaching Hospital from September 2016 to June 2017. Study was conducted on 20 patients (23 Hips). Written informed consent was obtained from all participants and the study was approved by the research ethical committee of Faculty of Medicine, Zagazig University. The work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Results: The right hip affection is (69.6%) more than left side (30.4%). The study included 23 hips; 16 right hips 7 left hips . Patients presented with pain in different sites; 6 cases (26.1%) with pain over the medial side of the thigh, 8cases (34.8%) with ipsilateral Knee pain while 9 cases (39.1%) complained of hip pain.

Conclusion: We concluded that in-situ pinning with single cannulated screw is enough for treatment of mild and moderate cases of SCFE cases. Hip external rotation can't be corrected with this technique. The risk of development of AVN of femoral head increased with unstable SCFE. Further slippage occurred in 2 cases after fixation (10° & 15°) slippage and this slippage is related to the number of screw threads engaging the epiphysis on the postoperative frog-leg lateral radiograph" less than 4 screw threads engaging the epiphysis".

Keywords: Slipped capital femoral epiphysis, computed tomography, erythrocyte sedimentation rate

INTRODUCTION

Slipped capital femoral epiphysis (SCFE) is a common disorder of adolescent hips in which the capital femoral epiphysis displaces from the metaphysis through the physis⁽¹⁾.

The term "SCFE" is technically incorrect as the femoral epiphysis maintains its relationship within the acetabulum and the femoral neck and shaft displace - relative to the physis- superiorly, in adduction and external rotation deformity (exception for the

rare valgus slip, where the displacement is posterior-superior)⁽²⁾.

Patient with SCFE is presented with hip or knee pain with or without history of trauma. Examination of the affected hip shows shortening and external rotation of the affected limb and limited hip mobility especially internal hip rotation. About 40% of cases presented by bilateral complaint⁽³⁾.

The precise etiology of SCFE is unknown. In general, SCFE is thought to result from insufficient mechanical ability of

the proximal femoral physis to resist loading. This can result either from physiologic loads across an abnormally weak physis or from abnormally high loads across a normal physis. Conditions that weaken the physis include endocrinopathies such as hypothyroidism, pan-hypopituitarism, growth hormone abnormalities⁽⁴⁾.

The average incidence rate for SCFE is 10.80/100,000 children; for boys is 13.35 and 8.07 for girls. The average age of onset 12.7 years for males and 11.2 years for females with male to female ratio 2:1 or 3:2 and the left hip affected more than the right (left: right ratio of 3:2). The incidence of hormonal anomalies in SCFE patients with endocrinal abnormalities were hypothyroidism (40%), growth hormone deficiency (25%), and others (35%)⁽⁵⁾.

The reported incidence of bilateral SCFE ranges from 18% to 63% and about 50% - 60% of patients with bilateral SCFE initially present with bilateral involvement⁽³⁾.

Slipped capital femoral epiphysis can be classified according symptoms duration into (acute, chronic, or acute-on-chronic), according to the ability to bear weight "**functionally**" (stable or unstable) and morphologically; according to the extent of displacement of the femoral neck to the epiphysis to (mild, moderate, or severe), as estimated by measurement on radiographic images⁽⁶⁾.

Currently, functional classification is most frequently used as it is the most helpful for treatment decisions and prediction of complications as avascular necrosis (AVN) of the femoral head⁽⁷⁾.

AIM OF THE WORK

The aim of the present study is to assess the outcome after in situ pinning in management of SCFE in adolescents.

PATIENTS AND METHODS

The study was carried out at orthopedic department, Zagazig University Hospitals and El-Sahel Teaching Hospital from September 2016 to June 2017. Study was conducted on 20 patients (23 Hips).

Data on age at diagnosis and sex, and clinical data were collected. The slips were classified according to **Loder et al.**⁽⁸⁾: acute

slip (onset of symptoms within 3 weeks of the diagnosis), acute-on-chronic slip (symptoms for more than 3 weeks with an acute deterioration over the most recent 3 weeks), chronic slip (symptoms for more than 3 weeks), and pre-slip (pain and clinical findings in the affected hip without any radiographic evidence of SCFE). Assessment and follow up the patient using Modified Harris Hip Score.

A pelvic radiograph (Antero-posterior and frog-leg views) at the time of diagnosis was used to classify the degree of slip into mild, moderate, or severe based on measurements of the lateral epiphyseal shaft angle⁽⁹⁾.

The slip was considered mild if the angle was less than 30°, moderate if the angle was 30–50°, and severe when the angle was more than 50°.

All were treated by in situ fixation with one cannulated screw 6.5mm partially threaded. The follow-up evaluation consisted of clinical examination and hip radiographs and assessed by Modified Harris Score.

Radiographic outcome was based on measurements of slip progression, and signs of avascular necrosis and chondrolysis.

Modified Harris Hip Score

Pain: None/ignores (44points). Slight, occasional, no compromise in activity (40 points). Mild, no effect on ordinary activity, pain after activity, uses aspirin (30 points). Moderate, tolerable, makes concessions, occasional codeine (20 points). Marked, serious limitations (10 points). Totally disabled (0 points).

Function: Gait (Limp): None (11 points). Slight (8 points). Moderate (5 points). Severe (0 points). Unable to walk (0 points).

Support: None (11 points). Cane, long walks (7 points). Cane, full time (5 points). Crutch (4 points). 2 canes (2 points). 2 crutches (1 points). Unable to walk (0 points).

Distance Walked: Unlimited (11 points). 6 blocks (8 points). 2-3 blocks (5 points). Indoors only (2 points). Bed and chair (0 points).

Functional Activities (Stairs): Normally (4 points). Normally with banister

(2 points). Any method (1 points). Not able (0 points).

Socks/Shoes: With ease (4 points). With difficulty (2 points). Unable (0 points).

Sitting: Any chair, 1 hour (5 points). High chair, ½ hour (3 points). Unable to sit, ½ hour, any chair (0 points).

Public Transportation: Able to enter public transportation (1 points). Unable to use public transportation (0 points).

Inclusion criteria: This study included adolescent patients with slipped capital femoral epiphysis. Male and female patients were included and both stable and unstable types of SCFE were incorporated in this study.

Exclusion criteria: Children less than 10 years, patients with severe degrees of SCFE and those with previous interventions for management of SCFE have been excluded from our study. Patients who are medically unfit for anesthesia and those who refused to participate were excluded also.

All patients were subjected to the following:

History taking: Personal history: Name, age, sex, occupation and any special habits of medical importance. **Present history:** Presence of hip or Knee pain, history of recent trauma and ability of weight bearing. **Past history:** Past history of any previous disease specially hormonal disturbance and history of previous hip or knee pain. **Family history:** Family history of metabolic or endocrinal diseases.

Examination and investigations: Full clinical examination. Full hip and Knee examination. Plain X-Ray: AP and frog – leg lateral views to detect proximal femoral slippage. Laboratory investigations: Ordinary Pre-operative investigations.

Statistical analysis of the data

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp) Qualitative data were described using number and percent. Quantitative data were described using range (minimum and maximum), mean, standard deviation and median. Significance

of the obtained results was judged at the 5% level.

The used tests were:

Friedman test: For abnormally distributed quantitative variables, to compare between more than two periods or stages and Post Hoc Test (Dunn's) for pairwise comparisons

Cochran's test: Used to analyze the significance between the different stages. We concluded that in-situ pinning with single cannulated screw is enough for treatment of mild and moderate cases of SCFE cases. Hip external rotation can't be corrected with this technique. The risk of development of AVN of femoral head increased with unstable SCFE. Further slippage occurred in 2 cases after fixation (10° & 15°) slippage.

RESULTS

About 11 cases (47.8 %) presented with no history of trauma, 5 cases (21.7%) with history of minimal trauma while 7 cases (30.4%) gave history of moderate trauma (**Table 1**).

Three cases (13%) who was imbedded in this study presented with inability to bear weight on the affected limb with or without support, while 17 cases (73.9%) presented with partial weight bearing with crutches and 3cases (13%) presented with full weight bearing.

Patients gave history of endocrinal was 3 patients (15%) (2 patients with hypothyroidism and 1 patient with growth hormone (GH) deficiency) (**Table 2**).

Among the patients, there were 9 hips (60.9%) presented with hip external rotation, while 14 hips (39.1%) presented without hip external rotation. After obtaining plain x-rays for the patients, 12 hips (52.2%) have 1st degree slippage and 11 hips (47.8%) have 2nd degree slippage.

Among the 20 patients included in this study, 3 patients had bilateral SCFE at time of diagnosis, 2 patients gave history of contralateral hip slippage and in situ fixed and the rest had unilateral SCFE.

Among the 9 hips presented with hip external rotation, 7 patients showed persistent external rotation poste operative.

During 6 weeks postop follow-up 6 cases showed persistent hip pain. One case

developed 15° further slippage and one case developed 10° slippage.

Three months follow up showed significant improvement of patient's hip activity scoring according to Modified Harris Hip Scoring:

Follow up x-rays after 6 months post-operative, one hip showed sub-chondral collapse and flattening of femoral head which are signs of avascular necrosis (AVN) of femoral head (**Table 3**).

Table (1): Distribution of the studied hips according to history of trauma

History of trauma	No.	%
No	11	47.8
Minimal	5	21.7
Moderate	7	30.4

Table (3): Distribution of the studied cases according to history of endocrinal

History of endocrinal abnormalities	No.	%
No	17	85.0
Yes	3	15.0
Hypothyroidism	2	10.0
Growth hormone deficiency	1	5.0

abnormalities

DISCUSSION

Slipped Capital Femoral Epiphysis (SCFE) is the most common hip disorder affecting adolescents. It affects males more than females. The definite etiology of the SCFE is unknown with multiple theoretical explanations. Actually the epiphysis remains in the acetabulum and the femoral neck and shaft migrate proximally, anteriorly and in an external rotation pattern. The slippage is classified into 3 stages according to degree of slippage (mild, moderate and severe).

Boyer et al. ⁽¹⁰⁾ said that in the past SCFE was treated by many methods such as just observation, cast immobilization or closed reduction and pinning also chondrolysis reported in many cases as the intra-operative imaging hasn't developed before 1950. The closed reduction resulted high rate of femoral head AVN. The goals of SCFE treatment are to prevent (in early stages) or correct (in late stages) femoral head deformity that may lead to gait abnormalities and early osteoarthritis and that can be achieved by: Fixation of the physis thus

preventing further slipping more ever physeal closure. Open reduction or corrective osteotomy if needed. Avoiding complications that may occur like avascular necrosis (AVN) of the femoral head.

Carney et al. ⁽¹¹⁾ reported that about 15-20% of the patients with SCFE progress additional slippage when they have been left untreated surgically.

Nectoux et al. ⁽¹²⁾ in their study suggested that the functional prognosis of cases of SCFE treated with in situ pinning is directly proportional to the initial slippage degree.

Morrissy ⁽¹³⁾ declared that the treatment of choice in cases of SCFE especially mild and moderate degrees is in situ pinning under imaging without forcible manipulation for reduction of the slippage.

Millis and Novais ⁽¹⁴⁾ suggested that the role of in situ pinning is to stabilize the physis in its position that may lead to long-term consequences due to leaving the head in non-anatomical position.

Abraham et al. ⁽¹⁵⁾ moreover said that these consequences may appear as joint osteoarthritis due to abnormal kinematics of the hip joint. Multiple osteotomies have been applied to correct the deformity and improve the range of movement in severe degrees of SCFE.

Blanco et al. ⁽¹⁶⁾ found after the development in imaging technique in operation theatre, positioning devices and better technical knowledge, the ability for achieving in situ pinning by single cannulated screw has been improved and the complication rate dropped from about 36% to less than 4.5%.

Loder et al. ⁽¹⁷⁾ summarized the advantages of in situ pinning using single cannulated screw in treatment of mild and moderate cases of SCFE not only lower injury to soft tissue with low incidence of AVN of femoral head or chondrolysis but also minimal incision and no risk of bleeding .

Blanco et al. ⁽¹⁶⁾ and **Aronson et al.** ⁽¹⁸⁾ reported excellent results in treating mild and moderate cases of SCFE by single cannulated screw with success rate about 91-95%

Chen et al. ⁽¹⁹⁾ suggested open reduction of the slipped epiphysis then fixation with cannulated screw especially in acute unstable cases and chronic cases are suggested to be treated with reduction through safe surgical dislocation but this technique is technically demanding and long outcome results have not been described.

Uglow and Clarke ⁽²⁰⁾ summarized in their study that the management of SCFE depend on the type of SCFE. In cases of stable mild and moderate degrees of SCFE, in situ screw fixation stills the accepted procedure for most cases. The issue in severe and unstable cases. Surgeons have to decide either to fix all cases of SCFE with screw then secondary osteotomies cases which failed to remodel or primary correction of severe slippage degrees and accepting high incidence rate of operative complications.

This study carried out from September 2016 till June 2017 on 20 patients; three patients had bilateral SCFE at time of presentation (23 hips. The study included 16

(80%) males and 4 (20%) female patients with mean age 13.20±1.4 years old.

Patients were assessed according to Modified Harris Score and followed up post-operative for one year. During follow up period, one patient was complicated with AVN of femoral head and need further reconstructive surgery later on. Another 2 patients showed further capital slippage during their follow up. Three cases among the operated patients showed persistent hip pain responding to anti-inflammatory drugs.

CONCLUSION

We concluded that in-situ pinning with single cannulated screw is enough for treatment of mild and moderate cases of SCFE cases. Hip external rotation can't be corrected with this technique. The risk of development of AVN of femoral head increased with unstable SCFE. Further slippage occurred in 2 cases after fixation (10° & 15°) slippage.

Conflict of interest: No

Financial disclosure: No

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