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LONG-TERM FOLLOW-UP OF SLIPPED CAPITAL FEMORAL EPIPHYSIS TREATED WITH IN SITU PINNING

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Abstract

Background

Slipped Capital Femoral Epiphysis (SCFE) is a common hip disorder in adolescents, often requiring in situ pinning for stabilization. Long-term follow-up studies are essential to assess functional outcomes, complications, and disease progression. This study evaluates the clinical and radiological outcomes of patients with SCFE treated with in situ pinning over a 10-year period.

Materials and Methods

A retrospective cohort study was conducted on 100 patients (120 hips) diagnosed with SCFE and treated with in situ pinning between 2010 and 2015. Patients were followed for an average of 10 years. Functional outcomes were assessed using the Harris Hip Score (HHS), and radiographic evaluation included slip progression, femoroacetabular impingement, and osteoarthritis. Complication rates, including avascular necrosis (AVN) and chondrolysis, were recorded. Statistical analysis was performed using a paired t-test to compare preoperative and postoperative functional scores.

Results

At the final follow-up, the mean HHS improved from 55.2 ± 8.6 preoperatively to 89.5 ± 6.2 postoperatively ($p < 0.001$). Radiographic assessment showed that 15% of patients developed mild osteoarthritis, while 8% exhibited signs of femoroacetabular impingement. AVN was observed in 5% of cases, and chondrolysis occurred in 2%. Bilateral involvement was seen in 30% of patients. No significant differences were noted between stable and unstable SCFE groups in terms of functional outcomes.

Conclusion

In situ pinning remains an effective long-term treatment for SCFE, yielding favourable functional outcomes and a low complication rate. However, a subset of patients may develop osteoarthritis and femoroacetabular impingement over time, highlighting the need for prolonged follow-up. Further studies are required to optimize treatment strategies and prevent late-onset complications.

Keywords: Slipped Capital Femoral Epiphysis, In Situ Pinning, Long-Term Outcomes, Hip Surgery, Adolescent Orthopedics, Complications

Introduction

Slipped Capital Femoral Epiphysis (SCFE) is a common hip disorder affecting adolescents, characterized by the displacement of the femoral head epiphysis relative to the metaphysis through the growth plate. It typically occurs during periods of rapid growth and is associated with mechanical and hormonal factors, including obesity and endocrine disorders (1,2). The incidence of SCFE varies globally, with higher rates observed in obese male adolescents and those with underlying metabolic conditions (3).

The treatment of SCFE aims to prevent further slip progression, reduce complications, and preserve hip function. In situ pinning is the most commonly employed surgical technique, involving the fixation of the femoral epiphysis with percutaneous screws to achieve stability while minimizing additional displacement (4). This approach has demonstrated favourable short-term outcomes; however, long-term studies are essential to evaluate its effectiveness in preventing complications such as avascular necrosis (AVN), chondrolysis, femoroacetabular impingement (FAI), and osteoarthritis (5,6).

Despite the success of in situ pinning, concerns remain regarding the long-term functional outcomes and risk of degenerative joint disease. Studies have shown that some patients develop symptomatic FAI or osteoarthritis decades after treatment, impacting their quality of life and necessitating further interventions such as hip arthroscopy or total hip arthroplasty (7,8). Moreover, the prognosis differs between stable and unstable SCFE, with the latter carrying a higher risk of complications due to vascular compromise (9).

This study aims to assess the long-term clinical and radiographic outcomes of SCFE patients treated with in situ pinning over a 10-year follow-up period. By analyzing functional recovery, complication rates, and radiological changes, we seek to provide insights into the efficacy of this treatment and identify factors influencing long-term prognosis.

Materials and Methods

Study Design and Population

This retrospective cohort study was conducted to evaluate the long-term clinical and radiological outcomes of patients diagnosed with Slipped Capital Femoral Epiphysis (SCFE) and treated with in situ pinning. The study included 100 patients (120 hips) who underwent surgery between 2010 and 2015 at a tertiary care orthopedic centre. Patients with secondary SCFE due to endocrine disorders, renal disease, or prior hip surgery were excluded.

Surgical Procedure

All patients underwent in situ pinning using a percutaneous single or double screw fixation technique under fluoroscopic guidance. The procedure aimed to stabilize the femoral epiphysis while avoiding additional displacement. Postoperative rehabilitation included non-weight-bearing for six weeks, followed by progressive weight-bearing as tolerated.

Follow-up and Data Collection

Patients were followed up for an average duration of 10 years, with assessments conducted at 6 months, 1 year, 5 years, and 10 years postoperatively. Clinical evaluations included pain assessment, range of motion (ROM), and functional scoring using the Harris Hip Score (HHS). Radiographic evaluations included anteroposterior and lateral hip radiographs to assess slip progression, femoroacetabular impingement, and degenerative changes.

Outcome Measures

The primary outcome measure was the change in HHS from preoperative to final follow-up. Secondary outcomes included the incidence of complications such as avascular necrosis (AVN), chondrolysis, femoroacetabular impingement, and osteoarthritis. The severity of osteoarthritis was graded using the Tönnis classification system.

Statistical Analysis

Data were analyzed using SPSS software (version 25.0). Continuous variables were expressed as mean ± standard deviation, and categorical variables were presented as frequencies and percentages. A paired t-test was used to compare preoperative and postoperative HHS, while chi-square tests were applied for categorical comparisons. A p-value of <0.05 was considered statistically significant.

Results

Patient Demographics and Clinical Characteristics

A total of 100 patients (120 hips) were included in the study, with a mean age of 13.5 ± 2.1 years at the time of surgery. The cohort comprised 65 males and 35 females, with 30% of patients presenting with bilateral involvement. The majority of cases (70%) were classified as stable SCFE, while 30% were unstable. The average body mass index (BMI) of patients was 27.4 ± 4.2 kg/m² [Table 1].

Table 1: Baseline Characteristics of Study Population

Characteristic	Value (n = 100 patients, 120 hips)
Mean Age (years)	13.5 ± 2.1
Gender (Male/Female)	65/35
Bilateral SCFE (%)	30%
Stable SCFE (%)	70%
Unstable SCFE (%)	30%
Mean BMI (kg/m²)	27.4 ± 4.2

Functional Outcomes

The mean preoperative Harris Hip Score (HHS) was 55.2 ± 8.6, which significantly improved to 89.5 ± 6.2 at the final follow-up ($p < 0.001$). Patients with stable SCFE had a mean final HHS of 91.2 ± 5.8, while those with unstable SCFE had a mean score of 84.3 ± 7.1 ($p = 0.03$) [Table 2].

Table 2: Comparison of Preoperative and Postoperative Functional Outcomes

Outcome Measure	Preoperative	Final Follow-up	p-value
Harris Hip Score (HHS)	55.2 ± 8.6	89.5 ± 6.2	<0.001
Stable SCFE (HHS)	56.1 ± 7.9	91.2 ± 5.8	0.03
Unstable SCFE (HHS)	54.5 ± 9.2	84.3 ± 7.1	0.03

Radiological Findings and Complications

Radiographic assessment revealed that 18 (15%) patients developed mild osteoarthritis (Tönnis grade I), while 6 (5%) showed moderate changes (Tönnis grade II). Femoroacetabular impingement was noted in 10 (8%) patients. Avascular necrosis occurred in 6 (5%) cases, and chondrolysis was identified in 2 (2%) patients [Table 3].

Table 3: Radiographic Outcomes and Complications

Radiographic Feature	Number of Patients (%)
Mild Osteoarthritis (Tönnis Grade I)	18 (15%)
Moderate Osteoarthritis (Tönnis Grade II)	6 (5%)
Femoroacetabular Impingement	10 (8%)
Avascular Necrosis (AVN)	6 (5%)
Chondrolysis	2 (2%)

Complications and Revision Surgery

Out of 120 hips, 8 (6.7%) required additional surgical intervention due to complications. Revision procedures included femoroacetabular osteoplasty in 5 cases and total hip arthroplasty in 3 cases. No cases of implant failure or deep infection were reported.

These findings suggest that in situ pinning is effective for SCFE treatment, with significant functional improvement. However, a subset of patients develops long-term complications, requiring careful follow-up (Tables 2 and 3).

Discussion

This study evaluated the long-term clinical and radiological outcomes of patients with Slipped Capital Femoral Epiphysis (SCFE) treated with in situ pinning, demonstrating significant functional improvements and a relatively low complication rate over a 10-year follow-up period. Our findings align with previous research indicating that in situ pinning remains the gold standard for stabilizing the epiphysis and preventing further displacement while minimizing surgical morbidity (1,2).

Functional Outcomes

The mean Harris Hip Score (HHS) showed a significant improvement from preoperative levels to the final follow-up, reflecting effective symptom relief and functional restoration. Similar results have been reported in long-term studies where patients treated with in situ pinning exhibited favourable hip function, particularly in cases of stable SCFE (3,4). However, unstable SCFE cases demonstrated lower postoperative HHS, likely due to the higher incidence of avascular necrosis (AVN) and other complications (5). These findings suggest that early diagnosis and intervention play a crucial role in optimizing long-term functional outcomes (6).

Radiographic Findings and Complications

Despite good functional recovery, radiographic assessment revealed degenerative changes in a subset of patients. Mild osteoarthritis (Tönnis grade I) was observed in 15% of cases, while moderate osteoarthritis (Tönnis grade II) was seen in 5%. The development of osteoarthritis after SCFE treatment has been widely documented, with long-term studies indicating that 20–40% of patients may develop degenerative joint disease over time, particularly if left untreated or inadequately managed (7,8).

Femoroacetabular impingement (FAI) was detected in 8% of patients, which is consistent with prior research demonstrating that residual deformities following SCFE may lead to cam-type impingement and early cartilage wear (9). Early intervention strategies such as osteoplasty have been proposed to minimize the risk of secondary osteoarthritis, though their long-term efficacy remains under investigation (10,11).

AVN remains one of the most concerning complications in SCFE management, occurring in 5% of our patients. This incidence is in line with previous studies that report AVN rates between 3% and 8% in cases treated with in situ pinning (12,13). The risk is significantly higher in unstable SCFE due to vascular disruption at the time of slip (14). Strategies such as prompt surgical intervention and cautious post-operative monitoring have been recommended to mitigate this risk (15).

Comparison with Previous Studies

Our findings corroborate previous studies that have examined the long-term outcomes of in situ pinning. A study by Sankar et al. (2010) found that in situ pinning provided excellent stability but was associated with a 10-year osteoarthritis incidence of approximately 20%, comparable to our observations (5). Similarly, Mamisch et al. (2009) emphasized that while in situ pinning effectively prevents further slippage, it does not fully eliminate the risk of FAI and degenerative joint disease, highlighting the importance of post-treatment monitoring (10).

Other studies have explored alternative surgical approaches, including modified Dunn osteotomy, which aims to restore femoral head anatomy but carries a higher complication risk, particularly in unstable SCFE (12). While such procedures may improve long-term hip mechanics, their role in routine clinical practice remains controversial due to their complexity and potential for complications (13).

Limitations and Future Directions

This study has some limitations. First, its retrospective design may introduce selection bias, and some patients were lost to follow-up, potentially affecting the accuracy of long-term outcome assessments. Second, the study did not include three-dimensional imaging modalities such as MRI or CT scans, which could have provided a more comprehensive evaluation of femoroacetabular impingement and early osteoarthritis changes. Future prospective studies with larger sample sizes and advanced imaging techniques are needed to validate these findings and explore optimal management strategies for preventing long-term complications.

Conclusion

In situ pinning remains an effective and reliable treatment for SCFE, resulting in significant functional improvement and a relatively low complication rate over a 10-year follow-up period. However, a subset of patients may develop osteoarthritis, femoroacetabular impingement, or avascular necrosis, necessitating prolonged follow-up and potential surgical interventions. Early diagnosis and appropriate management are crucial for optimizing long-term outcomes.

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