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Hip arthroscopy following slipped capital femoral epiphysis fixation: chondral damage and labral tears findings

Javier Besomi[1,2,3]
Valeria Escobar[2]
Santiago Alvarez[2]
Juanjose Valderrama[4]
Jaime Lopez[3]
Claudio Mella[3]
Joaquin Lara[5]
Claudio Meneses[1,2]

Abstract

Purpose This study investigated the association between chondrolabral damage and time to arthroscopic surgery for slipped capital femoral epiphysis (SCFE).

Methods This was a descriptive retrospective study that enrolled patients with SCFE who underwent hip arthroscopy for femoral osteochondroplasty after SCFE fixation. SCFE type, time from SCFE symptom onset or slip fixation surgery to hip arthroscopy and intraarticular arthroscopic findings were recorded. Acetabular chondrolabral damage was evaluated according to the Konan and Outerbridge classification systems. Nested analysis of variance and the chi-squared test were used for statistical analyses.

Results We analyzed 22 cases of SCFE in 17 patients (five bilateral). The mean age at the time of hip arthroscopy was 13.6 years-old (8–20), and mean time from SCFE fixation to arthroscopy was 25.1 months (3 weeks to 8 years). Labral frying was present in 20 cases, labral tears in 16 and acetabular chondral damage in 17. The most frequent lesion was type 3 (41%) (Konan classification). Two cases had a grade III and 1 had a grade II acetabular chondral lesion (Outerbridge classification). Positive associations were observed between time from SCFE to hip arthroscopy and hip intraarticular lesions evaluated using Konan ($p = 0.004$) and Outerbridge ($p = 0.000$) classification systems. There was no association between SCFE severity (chi-squared = 0.315), stability (chi-squared = 0.558) or temporality (chi-squared = 0.145) type and hip intraarticular lesions.

Conclusion A longer time from SCFE symptom onset and fixation to hip arthroscopy is associated with greater acetabular chondrolabral damage.

Level of evidence: IV

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Introduction

Slipped capital femoral epiphysis (SCFE) is one of the most severe hip disorders affecting adolescents. It involves a displacement of the femoral capital epiphysis relative to the proximal femoral metaphysis through the hypertrophic layer of the growth plate. In most cases the displacement results in a varus, extension or external rotation deformity of the proximal femur in coronal, sagittal and axial planes, respectively.[1,2] SCFE incidence is estimated to be between 0.2 to 11 per 100 000 children.[1-3] It is more frequent in male (60%) than in female children (40%),[4] with a mean age at presentation of 13.5 and 12 years, respectively. Patients usually present with radiating pain in the groin, thigh and/or knee and limp at variable times. On physical examination, the lower extremity may be shorter and externally rotated, with limited range of movement (especially internal rotation); flexion and abduction may also

[1] Pediatric Orthopaedic Surgery Unit, Orthopaedic Surgery Department and Urgencia Escolar Clinica Alemana de Santiago/ Facultad de Medicina Clinica Alemana – Universidad del Desarrollo, Santiago, Chile
[2] Pediatric Orthopaedic Surgery Service Hospital Clinico San Borja Arriaran, Santiago, Chile
[3] Hip and Pelvis Unit, Orthopaedic Surgery Department Clinica Alemana de Santiago – Chile / Facultad de Medicina Clinica Alemana – Universidad del Desarrollo, Santiago, Chile
[4] Knee Surgery Unit, Department of Orthopaedic Surgery Hospital Clinico Mutual de Seguridad and Department of Orthopaedic Surgery Clinica Indisa, Santiago, Chile
[5] Hip Center Clinica Las Condes, Santiago, Chile

Correspondence should be sent to Dr. Javier Besomi, Departamento de Traumatología y Departamento Urgencia Escolar Clínica Alemana de Santiago / Facultad de Medicina Clinica Alemana – Universidad del Desarrollo, Vitacura 5951, 7650568, Santiago, Chile.
E-mail: jbesomi@alemana.cl

be restricted and the Drehmann sign is typical.[1,5] Bilateral involvement is observed in a mean of 25% (18% to 50%) of cases. Contralateral slip occurs within the first 18 months after first index slip.[1,2] The aetiology of SCFE includes clinical (obesity), biomechanic (femoral retroversion and increased physeal obliquity)[1,2,6,7] and physiological (hormonal changes during puberty and endocrine disorders) factors that result in weakness and failure of the physis.[1,2,6] SCFE is diagnosed based on findings from anteroposterior pelvis and frog-leg lateral pelvis radiographs; in the pre-slip stage, MRI is useful for diagnosing changes in physeal signal intensity and periphyseal bone marrow oedema.[1,2] According to the Southwick classification,[1] SCFE can be mild (< 30°), moderate (30° to 50°) or severe (> 50°), which is determined by subtracting the epiphyseal shaft angle of the slipped hip measured in frog-leg lateral pelvis radiographs from that of the uninvolved hip. In the case of bilateral slip, 12° is used as the normal angle.[1,2,8,9] SCFE is considered stable when the patient is able to walk and bear weight with or without crutches and unstable when walking is not possible even with crutches because of intense pain. This classification based on stability has prognostic value; osteonecrosis of the femoral head can occur in up to 50% of cases of unstable SCFE, whereas for stable SCFE the risk is close to 0%.[1,10] SCFE is also classified as acute (symptoms present for three or less weeks), chronic (symptoms present for more than three weeks), acute-on-chronic and pre-slip stage.[1] The main objectives of treatment are physiodesis of the compromised growth plate to prevent slippage progression, correction of the epiphysis and alleviation of pain. The most frequent treatment is percutaneous *in situ* fixation with one central screw or multiple pins for stable SCFE; and reduction, decompression of the joint and fixation for unstable SCFE.[1,2] Complications associated with SCFE include osteonecrosis of the femoral head, chondrolysis, femoroacetabular impingement, osteoarthritis, fixation failure, deformity progression and growth disturbance of the proximal femur.[1,2,11-16]

Even in mild slips, the morphology of the articular proximal femur changes, with deformity occurring inside the joint. This is classified as cam-type femoroacetabular impingement (FAI) related to SCFE with anterolateral prominent metaphysis and retroversion of the proximal femur, which depending on the severity, can cause direct mechanical damage to the chondrolabral structure of the acetabular rim by impaction (often seen in severe slips with more restricted range of hip movement) or inclusion (often seen in mild and moderate slips) as the metaphyseal femoral bumps against the acetabular labrum and cartilage during hip movement.[13-16] Damage to acetabular cartilage in SCFE can progress and has been linked to hip osteoarthritis.[15-23] As such, techniques to restore the normal anatomy of the proximal femur and avoid impingement have been established in recent decades. Open surgeries such as the modified Dunn procedure[24] and arthroscopic osteochondroplasty can alleviate hip impingement after SCFE, with improvement in hip range of movement and decreased Nötzli α angle, although variable degrees of acetabular labral and chondral damage have been reported.[25-29]

The aim of the present work was to investigate labral and chondral damage in patients with SCFE who underwent hip arthroscopy for femoral osteochondroplasty after fixation, and examine the association with time to arthroscopy and SCFE type. Secondarily, we evaluated hip range of movement and the change in α angle before *versus* after arthroscopic femoral osteochondroplasty. We hypothesized that labral and chondral damage is common in patients with SCFE due to SCFE-related FAI, and is aggravated over time and in more severe slips.

Materials and methods

Study design

This was a descriptive retrospective study in a cohort of patients with SCFE who underwent hip arthroscopy for femoral osteochondroplasty after SCFE fixation between March 2016 and December 2019 at two hospitals (Hospital Clínico San Borja Arriarán and Clínica Alemana de Santiago). The institutional review board at both institutions approved the study.

SCFE fixation surgical technique and postoperative management

Stable SCFE was treated by percutaneous fixation under fluoroscopy with a single 7.0-mm to 7.3-mm cannulated screw. For unstable SCFE, closed or open reduction was performed before fixation. Close reduction involved the Leadbetter[30] or Griffith[31] manoeuvre; or full internal rotation with the patient positioned on a traction table with slight hip flexion. Open reduction involved subcapital osteotomy for severe SCFE[32] or the modified Dunn procedure with surgical hip dislocation.[24] Postoperative radiographs were obtained. The patient was discharged on the first or second day after surgery and walked using a pair of crutches and with protected weight-bearing for eight weeks. The wound was reviewed in the first postoperative week, and stiches were removed in week three. New radiographs were obtained at three and eight weeks. The arthroscopic surgery was elective and scheduled according to the inclusion and exclusion criteria listed below.

Inclusion and exclusion criteria

Inclusion criteria for arthroscopic femoral osteochondroplasty were as follows: decreased hip range of movement; positive impingement (flexion, adduction and internal rotation) test on physical examination; and femoral deformity present in post-fixation radiographs (anteroposterior pelvis, frog-leg lateral pelvis and 90° Dunn radiographs). Exclusion criteria were as follows: patients with osteonecrosis of the femoral head, chondrolysis or complex hip deformity (high-riding greater trochanter with a short femoral neck, with abductor weakness and symptomatic intra/extraarticular impingement) treated with open surgery (surgical hip dislocation, relative femoral neck lengthening, distalization of the greater trochanter,[33] cervical cuneiform osteotomy);[34] previous hip arthroscopy leading to second-look arthroscopy; and hip dysplasia.

Arthroscopic surgical technique and rehabilitation

We used a standard hip arthroscopy technique for arthroscopic femoral osteochondroplasty. Briefly, patients were placed in the supine position on a traction table; under fluoroscopic guidance we first created an anterolateral portal and using a 70° scope (Arthrex; Naples, Florida, Stryker; Kalamazoo, Michigan or Smith & Nephew; Andover, Maryland), we established a second anterior portal under direct arthroscopic visualization. At this point diagnostic arthroscopy was performed. Intraoperative arthroscopic findings under direct visualization were recorded including synovial aspect, acetabular labral and chondral damage, and capital femoral chondral damage. Acetabular chondral lesions were classified according to the Konan classification system[35] (Table 1), whereas the Outerbridge classification of chondral lesions was applied to cartilage in joint-loading areas.[36,37] Transverse capsulotomy and labrum treatment were performed according to tissue integrity (repaired, debridement, or absence). For labrum repair, we used one to three arthroscopic knotless anchors (PushLock 2.9 mm; Arthrex or CinchLock 2.4 mm; Stryker). For peripheral acetabular chondral flaps located next to the chondrolabral junction, we performed resection and reshaping with a shaver (CoolCut Curved Blade; Arthrex, CrossBlade Cutter; Stryker or Dyonics Platinum Blade; Smith & Nephew) and radiofrequency thermal stabilization (OPES ablator; Arthrex or Serfas; Stryker). After the central compartment stage, the lower extremity traction was released and femoral osteochondroplasty was performed in the peripheral compartment using an arthroscopic burr (CoolCut Curved Burr; Arthrex, CrossBlade XL Diamond Bur; Stryker or Dyonics burr; Smith & Nephew). Femoral resection was confirmed by fluoroscopy

Table 1 Summary of Konan classification system for acetabular chondral lesions[35]

Classification	Description
0	Normal cartilage
1	Loss of fixation to subchondral bone ('wave sign')
2	Cleavage tear without articular cartilage delamination
3	Articular cartilage delamination
4	Subchondral bone exposition

and dynamic hip mobility tests were carried out under direct arthroscopic visualization to ensure that the hip was free of impingement. Capsular closure was performed in cases that were operated after 2018 (CapsuleClose Scorpion; Arthrex or Injector II Capsule Closure; Stryker).

Rehabilitation was initiated on the day of surgery using a continuous passive hip movement device. Active exercises, stationary bicycle and walking with a pair of crutches with protected weight-bearing were started on postoperative day one and maintained for three weeks. The patient resumed regular activities (e.g. attending school) at three to four weeks after surgery, using one or both crutches for an additional two to three weeks. New radiographs were obtained at eight to 12 weeks after arthroscopic surgery. Physiotherapy was continued for six months after the surgery and sports activities were allowed starting at six to eight months post-surgery.

Data collection

The following demographic and clinical information was collected for each patient: sex, age at SCFE fixation, age at arthroscopy and joint laterality. The type of SCFE was determined according to different classification systems (slip severity: mild, moderate or severe; temporality: acute, chronic or acute-on-chronic; and stability: stable or unstable). Time from SCFE symptom onset to fixation and hip arthroscopy and time from fixation to hip arthroscopy were also noted.

The range of movement of the affected hip and Nötzli α angle (measured in the 90° Dunn radiograph view) were recorded pre- and post-arthroscopy. Pre-arthroscopy range of movement was obtained in the medical evaluation one week prior to arthroscopy and post-arthroscopy range of movement was obtained at the last follow-up evaluation. The α angle was measured by one of the authors (SA) other than the surgeon.

Major complications were recorded including proximal femur transepiphyseal separation by distraction during lower extremity traction for hip arthroscopy, proximal femur growth disturbances, femoral head osteonecrosis, hip dislocation, heterotopic ossification and deep venous thrombosis after arthroscopy.

Statistical analysis

This was performed using STATA v14.0 (StataCorp, College Station, Texas). The mean change in hip range of movement from pre- to post-arthroscopy was evaluated with the Student's *t*-test and the Wilcoxon Mann-Whitney U test. The mean change in α angle from pre- to post-arthroscopy was evaluated with the Student's *t*-test. The chi-squared test was used to evaluate the association between SCFE severity, temporality and stability type and intraarticular lesions classified according to the Konnan and

Outerbridge grading systems. To analyze the association between time from SCFE symptom onset to slip fixation, from slip fixation to hip arthroscopy, or from symptom onset to hip arthroscopy and occurrence of intraarticular lesions (Konnan and Outerbridge classifications), we used nested analysis of variance with intra- and interpatient adjustments, taking into consideration dependence in bilateral cases. Statistical significance was set at $p < 0.05$.

Results

A total of 30 cases of SCFE in 25 patients (five bilateral) were screened, of which 22 cases in 17 patients (five bilateral) met the inclusion and exclusion criteria. Five cases did not meet the inclusion criteria and three did not meet the exclusion criteria, including two patients with unstable SCFE who developed capital femoral osteonecrosis and one with complex hip deformity who was treated with open surgery with relative femoral neck lengthening.

Of the 22 patients, 14 were male and eight were female, with a mean age of 11.5 years (8 to 15) at the time of slip fixation and 13.6 years (8 to 20) at the time of hip arthroscopy. There were 18 (82%) mild, two (9%) moderate and two (9%) severe slip cases. In terms of temporality, seven cases (32%) were acute, nine (41%) were chronic and six (27%) were acute-on-chronic. Stable SCFE was observed in 17 cases (77%) and unstable SCFE occurred in five (23%). Mean time from symptom onset to SCFE fixation was 6.4 weeks (2 to 24); Mean time from symptom onset to hip arthroscopy was 26.7 months (5 weeks to 8.5 years); and mean time from SCFE fixation to hip arthroscopy was 25.1 months (3 weeks to 8 years).

Arthroscopic findings

Synovial hyperemia aspect was present in 19 cases (86%) (Fig. 1). Normal synovial aspect tissue was seen in three cases (14%).

Labral frying was present in 20 cases (91%) and a normal labrum in two cases (9%). Labral tear—defined as an unstable labrum (resulting from loose fixation) or intrasubstance tissue damage requiring treatment of any kind—was present in 16 cases (73%). Labral repair with suture anchors was performed in 15 cases (68%). In one 15-year-old male patient with severe SCFE who was treated with hip arthroscopy three years after fixation, the labrum was unrepairable because of severe intrasubstance degenerative tissue damage, and labrum debridement was performed (Fig. 2).

Acetabular chondral damage was present in 17 cases (77%). According to the Konan classification, five cases were type 0 (23%), four were type 1 (18%), four were type 2 (18%), nine were type 3 (41%), and none were type 4 (Fig. 3). According to the Outerbridge classification, two cases had a grade III acetabular chondral lesion and one had a grade II lesion. In these three cases, acetabular cartilage damage extended to the joint loading area; the mean time from SCFE fixation to hip arthroscopy was six years (3 to 8) and there was one mild, one moderate and one severe slip. Femoral chondral damage was present in four cases (18%) and according to the Outerbridge classification, all were chondromalacia grade I lesions (Fig. 4).

A prominent metaphyseal bump in the proximal femur impinging against the acetabular chondrolabral structure was observed during hip arthroscopy in all cases (Fig. 5). An impingement-free hip was achieved in all cases following femoral osteochondroplasty (Fig. 6).

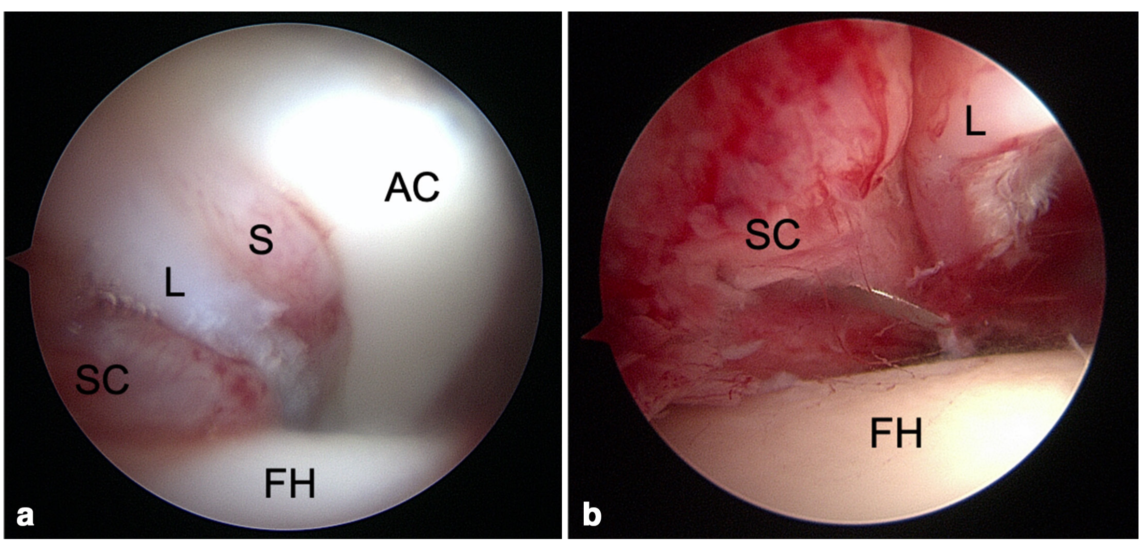

Fig. 1 Synovial hyperemia: arthroscopic view of central (a) and peripheral (b) compartments of the hip joint in a patient with slipped capital femoral epiphysis (AC, acetabular cartilage; FH, femoral head; L, labrum; S, synovial tissue in chondrolabral junction; SC, synovial capsule).

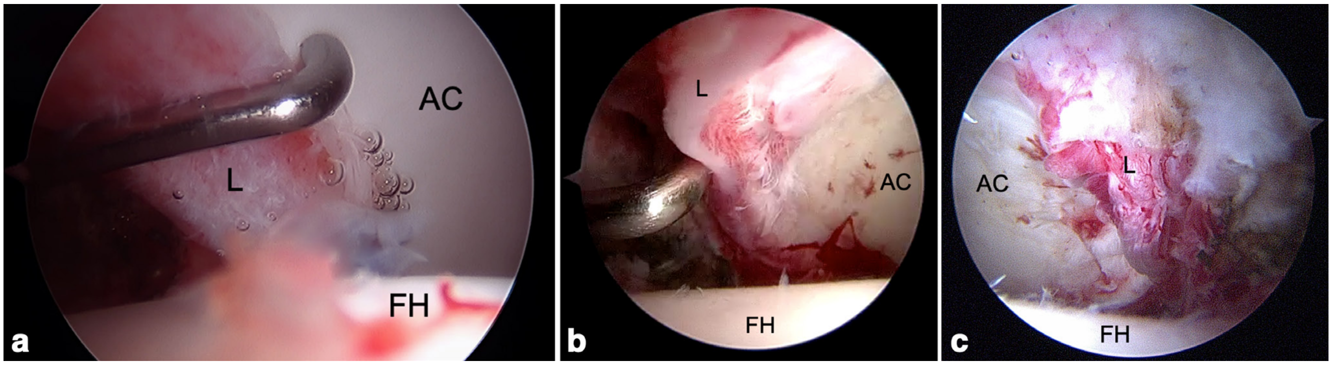

Fig. 2 Direct arthroscopic view of the labrum: fibrillated and stable (a) and unstable (b) labrum and severe intrasubstance tissue damage in the labrum (c) (AC, acetabular cartilage; FH, femoral head; L: labrum).

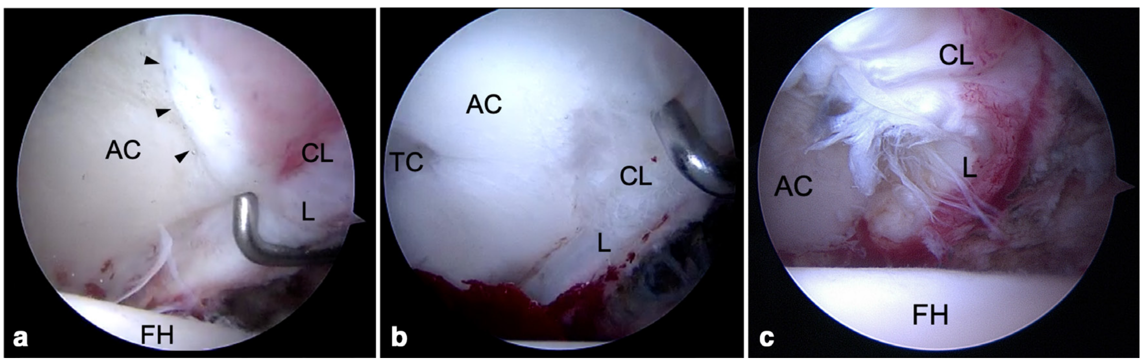

Fig. 3 Acetabular cartilage under direct arthroscopic view: Konan type 1 (a), type 2 (b) and type 3 (c) acetabular chondral lesions. Arrowheads in (a) delineate the area of loss of fixation of peripheral acetabular cartilage (AC, acetabular cartilage; CL, chondrolabral junction; FH, femoral head; L, labrum; TC, triradiate cartilage).

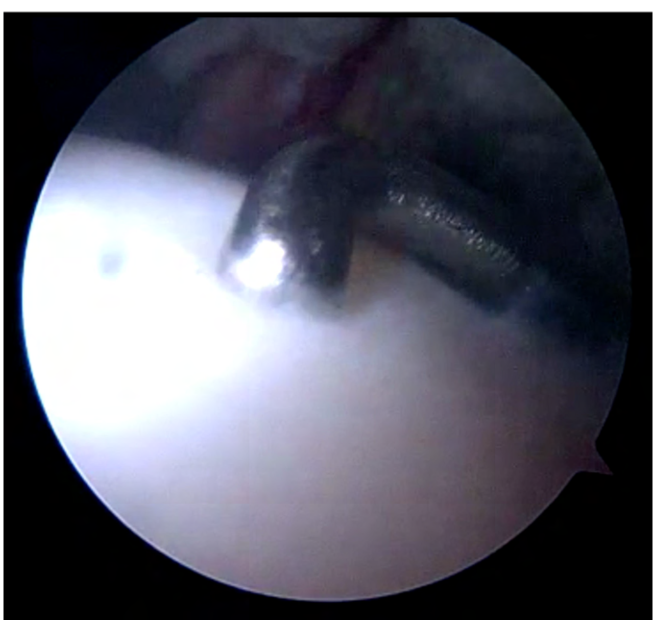

Fig. 4 Direct arthroscopic view of femoral head cartilage with grade I chondromalacia (Outerbridge classification).

Hip range of movement

Hip flexion improved from a mean of 109° (100° to 120°) pre-arthroscopy to 115° (100° to 130°) post-arthroscopy; the flexion correction was 6° ($p = 0.013$). Hip internal rotation improved from a mean of 14° (-15° to 30°) pre-arthroscopy to a mean of 29° (10° to 45°) post-arthroscopy. Internal rotation correction was a mean of 15° ($p = 0.0002$). External rotation was unchanged after arthroscopy, with a mean pre- and post-arthroscopy value of 50° ($p = 0.993$). Hip abduction improved from a mean of 50° (25° to 60°) pre-arthroscopy to a mean of 55° (40° to 60°) post-arthroscopy, although the increase was not significant ($p = 0.132$) (Table 2 and Fig. 7).

α angle

The mean pre-arthroscopy α angle was 77° (53° to 112°) and post-arthroscopic femoral osteochondroplasty α angle was a mean of 52° (37° to 72°). The mean correction angle was 25° (6° to 40°; $p = 0.0000$) (Figs. 8 and 9).

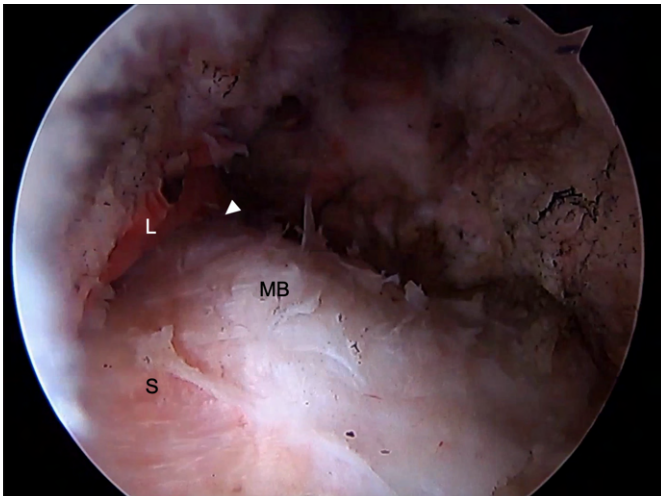

Fig. 5 Arthroscopic view of peripheral compartment of the hip joint in a patient with slipped capital femoral epiphysis (SCFE), showing femoroacetabular impingement by inclusion (arrowhead) from the metaphyseal bump of the proximal femur against the acetabular labrum (L, labrum; MB, metaphyseal bump; S, slip zone of SCFE).

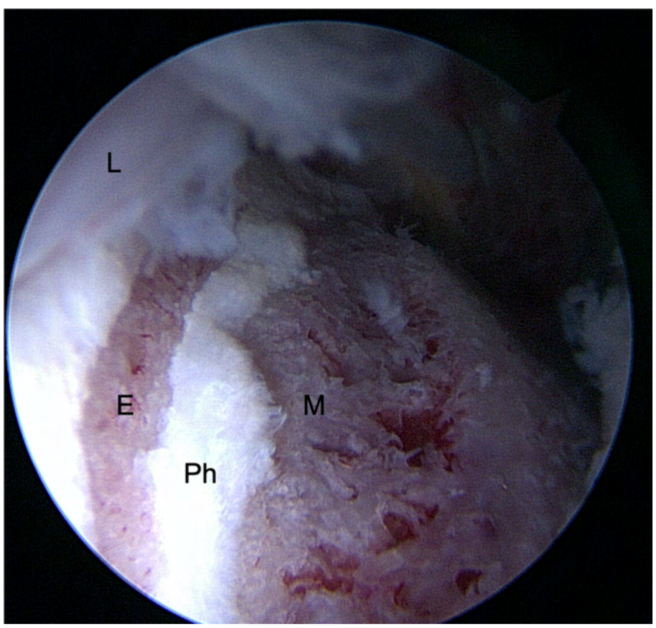

Fig. 6 Arthroscopic view of peripheral compartment of the hip joint in a patient with slipped capital femoral epiphysis after osteochondroplasty (E, proximal femur epiphysis; L, labrum; M, proximal femur metaphysis; Ph, proximal femur physis).

Table 2 Mean values for hip range of motion pre- and post-arthroscopy

	Pre-arthroscopy	Post-arthroscopy	Correction	p-value*
Flexion	109	115	6	0.013
External rotation	50	50	0	0.993
Internal rotation	14	29	15	0.0002
Abduction	50	55	5	0.132

*Student's t test and Wilcoxon Mann–Whitney test

Association analysis

There were no associations between SCFE severity (chi-squared = 0.315), stability (chi-squared = 0.558) or temporality (chi-squared = 0.145) type and hip intraarticular lesion grade evaluated with the Konan and Outerbridge classification systems. There was also no association between time from symptom onset to slip fixation and hip intraarticular lesions (Konan, p = 0.926 and Outerbridge, p = 0.696). On the other hand, there were positive associations between time from symptom onset to hip arthroscopy and hip intraarticular lesions (Konan, p = 0.004 and Outerbridge, p = 0.000) and between time from slip fixation surgery to hip arthroscopy and hip intraarticular lesions (Konan, p = 0.004 and Outerbridge, p = 0.000) (Fig. 10).

Complications

No major complications were observed after hip arthroscopy, except asymptomatic heterotopic ossification in a 15-year-old male patient.

Discussion

Abnormal contact of the proximal femur with the acetabulum during hip movement in SCFE can lead to hip osteoarthritis.[13-23] In a study of 222 cases, good results were reported for pinned SCFEs, with a low risk of FAI and osteoarthritis after an average follow-up of 11 years;[38] however, in our opinion there are some concerns about outcome evaluation criteria to define the presence of FAI deformity employed in that study. In 121 SCFE cases followed up for > 20 years, 79% experienced FAI and 100% showed radiological signs of osteoarthritis.[23] In 176 hips treated by SCFE fixation, persistent pain was reported in one-third of patients and 12% required reconstructive hip surgery.[39] Even in mild slips, cam-type FAI related to SCFE has been observed in 3D geometric models.[13,40]

Intraarticular chondral and labral damage has been reported even in mild slips in 50% to 100% of SCFE cases treated with arthroscopic femoral osteochondroplasty[25-29] (Table 3). Notably, in these five studies, there was less intraarticular damage when hip arthroscopy was performed earlier. In nine cases with mild or moderate SCFEs in which hip arthroscopy was performed at a mean time of 4.8 years (18 months to 14 years) after SCFE fixation, 100% showed intraarticular damage (labral tears in 89% and some acetabular chondral damage in 100% of cases).[28] Another study reported intraarticular damage in half of the 14 cases of mild SCFE treated with hip arthroscopy at a mean time of 3.7 weeks (0.7 to 14.1) after SCFE fixation (three cases (21%) with labral frying without requiring repair and four cases (29%) with some acetabular cartilage damage).[29] In accordance with previous

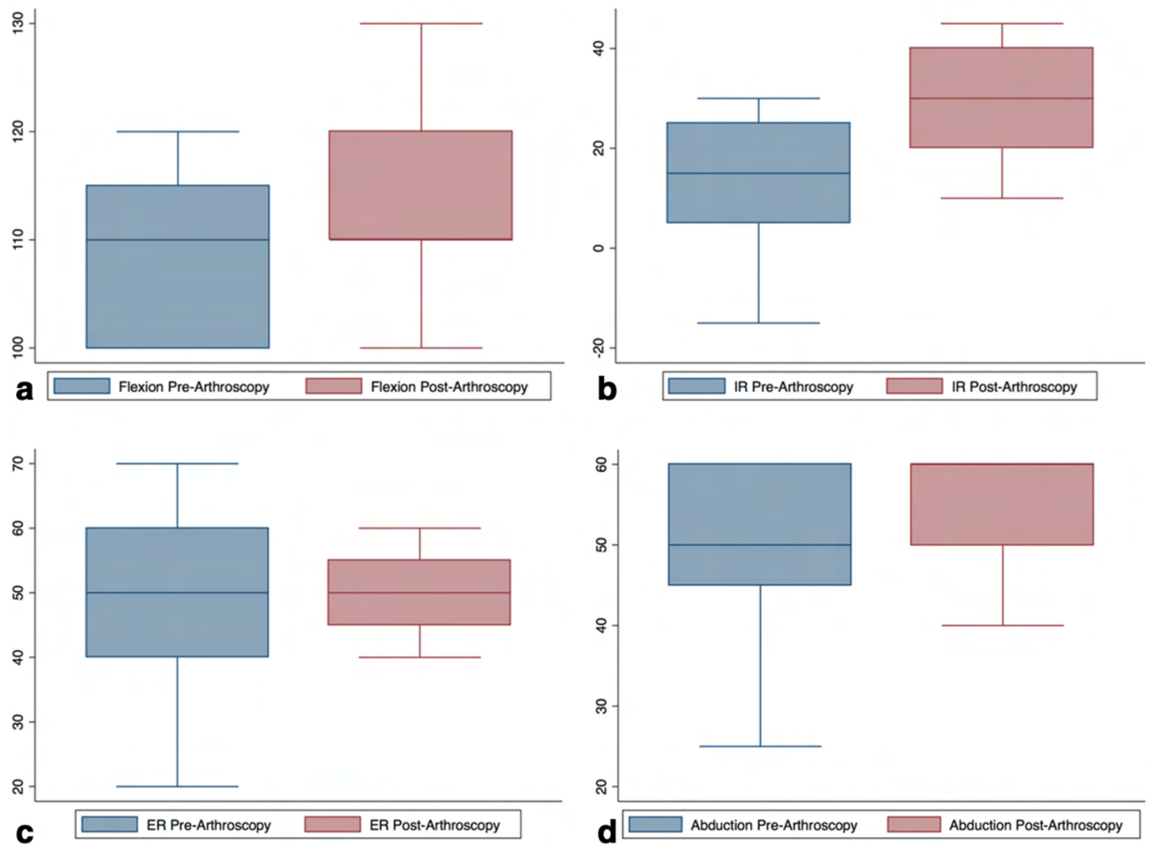

Fig. 7 Mean joint range of movement values in slipped capital femoral epiphysis cases pre- and post-hip arthroscopy: a) flexion; b) internal rotation (IR); c) external rotation (ER); d) abduction.

reports,[14,24,28,41] we did not find any association between the severity of slippage and intraarticular damage. This may be attributable to the small sample size or because from the biomechanical standpoint, the inclusion of the femoral metaphyseal bump into the central compartment of the joint seen in mild slips may be as harmful to the acetabular labrum and cartilage as the impaction seen in severe slips.

Synovitis is a common finding in hip arthroscopy for SCFE.[25-27] However, our histologic analysis of one case revealed increased synovial vascularization without inflammatory cell infiltration. Therefore, in our view synovial hyperemia is a more accurate description than synovitis. A prominent metaphyseal bump has been observed under direct arthroscopic visualization of SCFE,[25-29] which was confirmed in our study. Improvement in hip range of movement has been described in SCFE after arthroscopic femoral osteochondroplasty, with flexion correction from 5° to 30° and internal rotation correction from 10° to 20°;[25-29] and α angle correction from 57° to 88° pre-arthroscopy to 37° to 52° post-arthroscopy.[25-29] The improvements in hip range of movement and α angle after arthroscopic femoral osteochondroplasty in our SCFE cases are consistent with these previous findings. The α angle correction is especially relevant because in patients with SCFE this is the most important predictor for the development of osteoarthritis and FAI.[18,23]

Anatomical slip reduction is not always achieved in surgery and in some SCFE cases (e.g. for stable SCFEs) reduction attempts are not recommended because of an increased risk of osteonecrosis.[1] This is all the more controversial because there is evidence that the Loder stability classification[10] does not correlate with intraoperative stability.[42] Therefore, arthroscopic femoral osteochondroplasty has been proposed as a minimally invasive surgical technique for SCFE to avoid FAI related to mild and moderate slips.[25-29] Femoral retroversion is a morphological deformity that occurs in moderate and severe slips; osteotomy and more invasive open surgeries are indicated for the restoration of normal morphology because arthroscopy is usually inadequate. Proximal femur remodelling in SCFE remains controversial. Some studies have reported bone remodelling in SCFE,[43-47] especially in the absence of cam-type deformity.[48] However, others have shown that this is insufficient to avoid FAI[20,26] and even with remodelling,

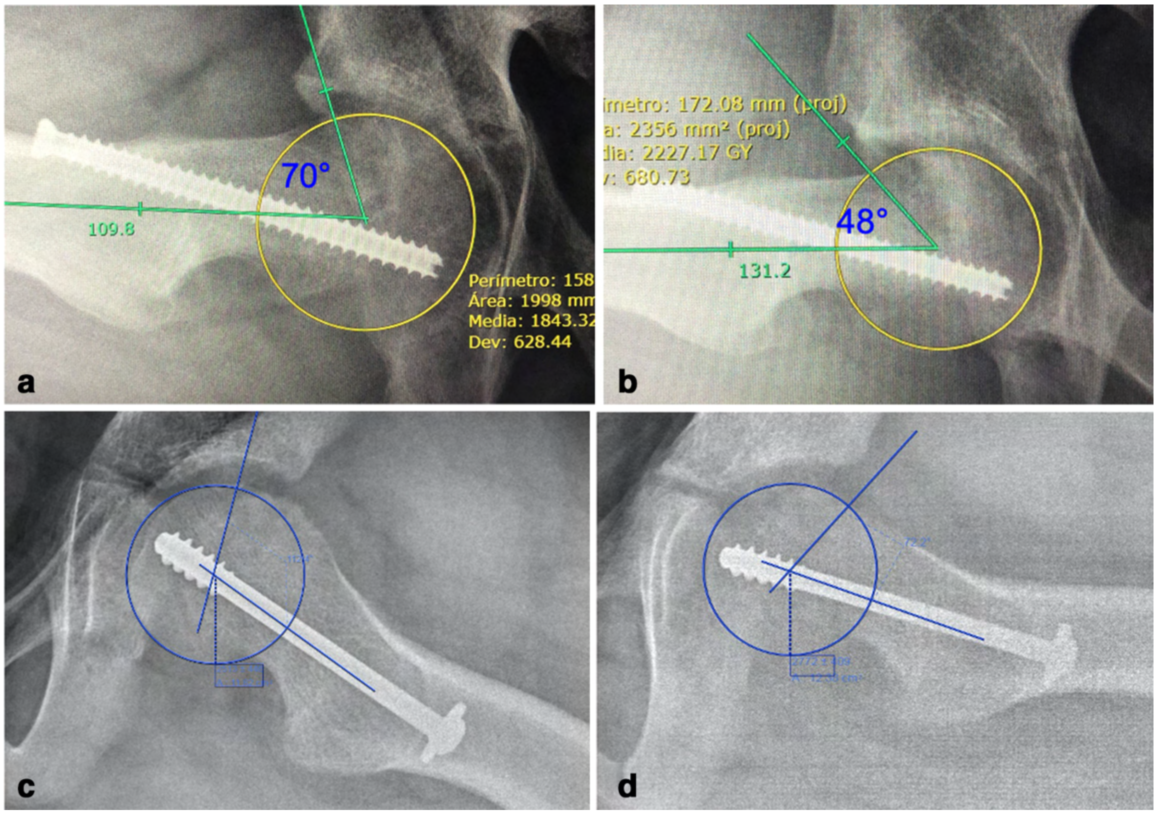

Fig. 8 Dunn 90° radiograph views pre- (a, c) and post- (b, d) arthroscopic femoral osteochondroplasty with α angle measurements in two slipped capital femoral epiphysis cases.

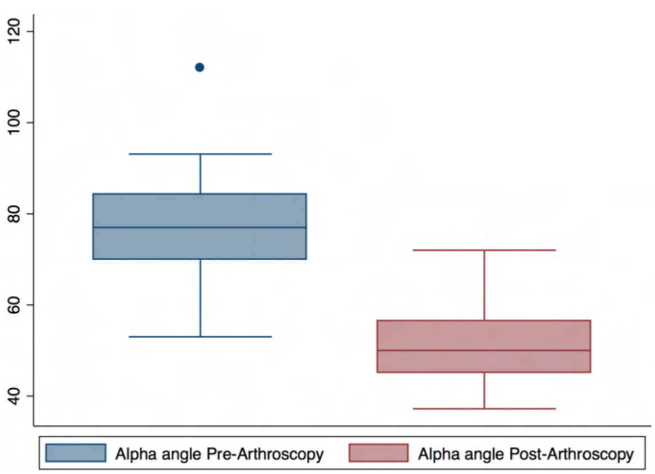

Fig. 9 α Angle measured pre- and post-arthroscopic femoral osteochondroplasty in slipped capital femoral epiphysis cases.

there is already damage to the acetabular cartilage.[13,15,46] Additional studies are need to determine how to achieve remodelling without impingement in the treatment of SCFE.[26]

Our study had several limitations. The sample size was small and there was no control group; moreover, the study did not have a double-blind design. Additionally, femoral retroversion was not included in the analysis and we did not evaluate functional outcomes. However, improvements in functional outcomes measured using the modified Harris Hip Score (mHHS), hip outcome score (HOS) activities of daily living scale and HOS sports scale have been reported.[28] In a recent study of 18 symptomatic patients with FAI sequelae related to SCFE with a mean age of 19 years old (13 to 42) and mean time from slip fixation to arthroscopy of seven years (1 to 30), a longer time between SCFE symptom onset and arthroscopy was associated with lower functional outcomes (mHHS and Non-arthritic Hip Score).[41] The authors attributed this to chondrolabral damage, and this is supported by our results. However, intraarticular damage appears before patients develop symptoms during regular activities and once these occur, the optimal time window for treatment may be lost. In the same study,[41] 83% of degenerative or calcified labrum were unsuitable for repair *versus* 4.5% in our case series; the authors also reported advanced chondral damage (Outerbridge grade III to IV) in 22% of cases that required salvage microfracture treatment, which was not needed in any of our patients. In another study, acetabular chondral damage was observed in hip arthroscopy 18 months after SCFE fixation in all five patients (average age of 12 years) with mild or moderate SCFEs

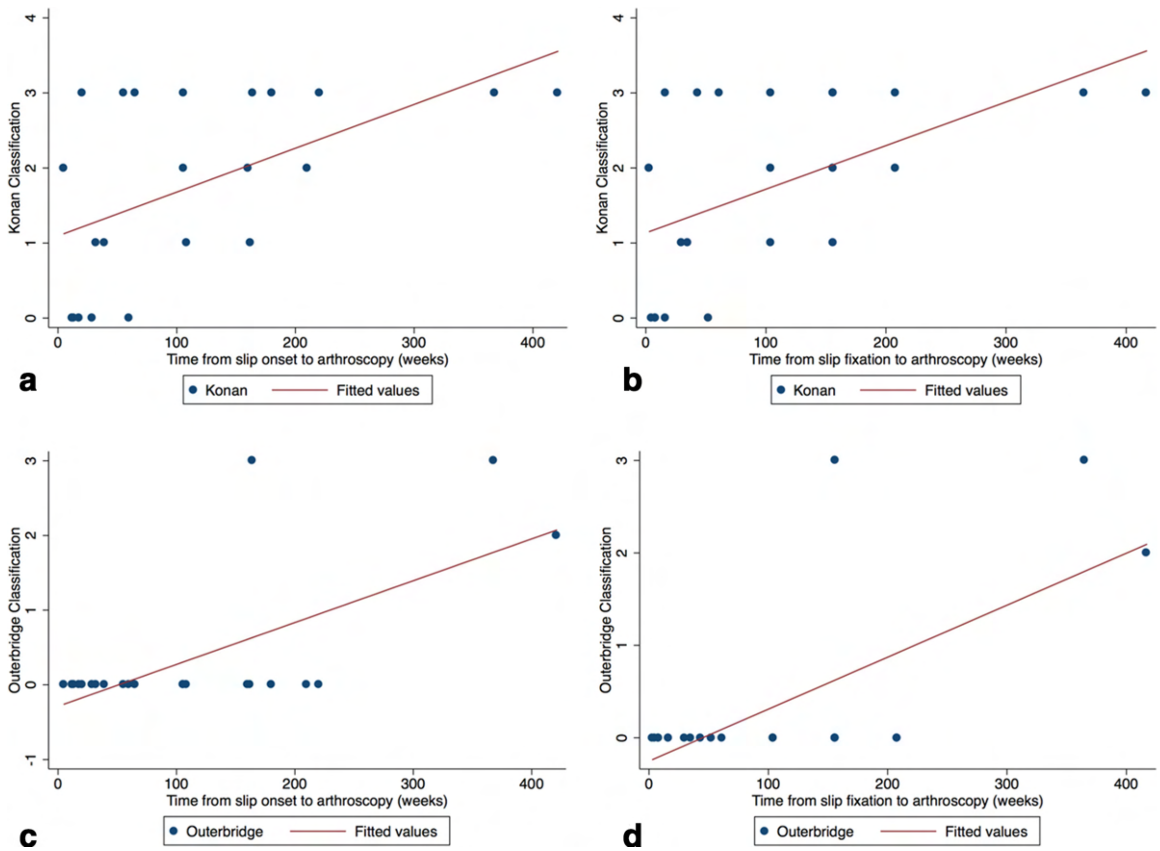

Fig. 10 Correlation analysis: time from onset of slipped capital femoral epiphysis (SCFE) symptoms (a) and slip fixation surgery (b) to hip arthroscopy and Konan-type lesions. Time from onset of SCFE symptoms (c) and slip fixation surgery (d) to hip arthroscopy and Outerbridge grade of acetabular cartilage lesions.

Table 3 Summary of intraarticular damage reported in hip arthroscopy for slipped capital femoral epiphysis (SCFE)

Author	Year	Cases (n)	Age, yrs	SCFE type	Time from fixation to arthroscopy (mean or range)	Intraarticular damage		
						Labrum	Acetabular cartilage	Overall, %
Leunig et al[25]	2010	3	12	Mild	Same time	100% (fibrillation)	100%	100
Lee et al[26]	2013	5	12	Mild and Mod	18 mths	100%	100%	100
Chen et al[27]	2014	34	13	Mild, Mod, Severe	Not reported	100%	76%	100
Wylie et al[28]	2015	9	17	Mild and Mod	18 mths to 4 yrs	89%	100%	100
Tscholl et al[29]	2016	14	12	Mild	3.7 wks	21% (fibrillation)	29%	50
Current study	2020	22	13	Mild, Mod, Severe	25 mths (3 wks to 8 yrs)	91% Fibrillation/73% labral tear	77%	91

Mod, moderate

who were asymptomatic;[26] and in gadolinium-enhanced MRI examinations (dGEMRIC) of hips after SCFE fixation, cartilage abnormalities were not correlated with patient symptoms.[49]

This is the first study showing a positive association between intraarticular damage and time to arthroscopy in SCFE. We also found that in very young patients, there is a risk of hip osteoarthritis within three years of SCFE symptom onset. A recently published review recommends the inclusion of femoral osteochondroplasty in the SCFE treatment algorithm in cases of hip impingement.[16]

Conclusion

In our SCFE case series, 91% of young patients had some intraarticular damage at the time of hip arthroscopy. The most frequent lesion was labral frying; 73% of cases had labral tears that required treatment (most often labral repair) and 77% had acetabular chondral damage (most often articular cartilage delamination). A longer time from symptom onset or SCFE fixation to hip arthroscopy was associated with greater damage. We did not observe any associations between the severity, stability and temporality of SCFE types and intraarticular damage. There were significant improvements in hip range of movement and α angle correction after arthroscopic osteochondroplasty in patients with SCFE.

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COMPLIANCE WITH ETHICAL STANDARDS

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Informed consent: Informed consent was obtained from all individual participants included in the study.

ICMJE CONFLICT OF INTEREST STATEMENT

J. Lopez reports Stryker consultant with fees for consulting, lectures and speaker bureaus, without relation nor conflict of interest with the submitted paper.

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AUTHOR CONTRIBUTIONS

JB: Principal author, Study design, Main surgeon, Performed measurements, Statistical analysis, Manuscript preparation.

VE: Performed measurements, Manuscript preparation.

SA: Performed measurements.

JV: Study design, Statistical analysis, Manuscript preparation.

JL: Performed measurements, Surgeon, Manuscript preparation.

CM: Study design, Manuscript preparation.

JL: Study design, Manuscript preparation.

CM: Study design, Manuscript preparation.

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