Original Article

Slipped Capital Femoral Epiphysis amongst Black Sub-Saharan Children: A Multicenter Study in Abidjan (Cote D'ivoire)

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Abstract

Introduction: Slipped capital femoral epiphysis (SCFE) is a frequent hip pathology amongst adolescents under the age of 16. The prognosis, dominated by the risk of avascular necrosis, correlates with the continuation of slippage, which is linked to diagnostic delay. The aim of this study is to investigate the demographic and diagnostic aspects of SCFE in an environment characterised by self-medication and the influence of traditional practitioners. **Materials and Methods:** This study was retrospective and multicentric. Patients were treated between January 2000 and December 2021 at four hospital centres with senior paediatric orthopaedists. This study included all records with patient demographic and diagnostic data. **Results:** Thirty-nine (49 SCFE) out of 52 cases were included. There were two hospitalisations per year. The mean age at diagnosis was 12.5 ± 1.4 years (range: 10–15), with a male predominance (54%). The average duration of diagnosis was 21.8 ± 8.5 weeks (range: 4–53). The mean weight was 48.6 ± 15.5 kg (range: 31–89), and the mean body mass index was 29.2 ± 7.5 kg/m^2 (range: 19.2–37.1). Eleven patients (28.2%) were obese and 21 (53.8%) were overweight. SCFE was unilateral in 29 (74%) and simultaneous bilateral involvement was observed in 8 (20.6%) of cases. The left side was affected in 18 (46.1%) of patients. SCFE was chronic and stable in all cases. The mean slip angle was 41.53° ±20.63° (range: 19–78). Slippage was severe in 17 (34.7%) of cases and moderate in 25 (51%). **Conclusion:** The demographic and diagnostic characteristics of SCFE amongst Ivorian children were similar to those of Western populations.

Keywords: Adolescent, delayed diagnosis, hip pain, slipped capital femoral epiphysis, sub-Saharan Africa

Introduction

Slipped capital femoral epiphysis (SCFE) is the most common hip condition affecting adolescents, who are generally between the ages of 9 and 16.[1-3] It is defined as a displacement of the proximal femoral epiphysis from the metaphysis through the proximal femoral growth plate. The incidence of SCFE ranges from 0.33/100,000 to 24.58/100,000 children.[2,4-6] The prevalence of SCFE varies according to race, country, region and ethnicity.[6-8] From a large series including 1630 children, Loder reported that the incidence of SCFE was, respectively, 3.94 and 2.53 times higher in Black and Hispanic children than in white children.[7] Despite current medical advances, the aetiopathogenesis of SCFE remains unknown. The pathogenesis is multifactorial, with biochemical and mechanical factors increasingly recognised.

Early consultation with an early diagnosis and treatment is the key to avoiding chronic forms with large displacements, which represents a therapeutic challenge with a high risk of avascular necrosis and chondrolysis.[2,9-13] Unfortunately, many studies have reported an average diagnostic delay of around 4–5 months.[10,14,15] This delay in diagnosis leads to a sliding evolution, with complications that expose growing children to early osteoarthritis.

In our sub-Saharan environment, barriers such as the scarcity of specialised centres, the limited number of paediatric surgeons

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and the absence of medical insurance for many parents affect access to modern healthcare. For these reasons, most patients turn to traditional healers before seeking hospital care. While Western literature abounds with data on SCFE, very few sub-Saharan publications are devoted to this pathology.[7] In our country, there are no national registries for reporting orthopaedic conditions, as there are in South Korea[8] and Italy.[16] Are the features of SCFE in Ivorian children similar to those reported in the literature? This study aimed to describe the demographic and diagnostic characteristics of SCFE in an environment marked by self-medication and the influence of traditional practitioners in the population's healthcare pathway.

Materials and Methods

The study was a multicentre, retrospective descriptive study carried out in four hospitals (Yopougon and Cocody Teaching Hospitals, Bingerville Mother–Child Hospital and Sacré Coeur Polyclinic in Abidjan) with senior paediatric orthopaedic surgeons. All records of patients treated for SCFE between January 2000 and December 2021 were retrospectively analysed.

All records containing the variables studied were included in this study. Thirteen records, of which four could not be found and nine incomplete, were not included in this study. According to Loder et al, SCFE was considered stable if the patient was able to walk with or without crutches, and unstable if walking was impossible even with assistance.[17] Depending on the onset of symptoms, SCFE was classified as chronic if symptoms had been evolving for more than 3 weeks, and as acute if they had been evolving for <3 weeks. Slippage severity was categorized as mild (<30°), moderate (30-50°), or severe (>50°) according to the Southwick' head-shaft angle.[18] Data were processed using Excel 2010 software (Microsoft Office 2010). Quantitative variables are presented as mean ± standard deviation.

Results

Of the 52 files identified, those of 39 patients with 49 cases of SCFE were included. The annual frequency was two cases. The sex ratio was 1.4:1. The average age of patients at diagnosis was 12.5 ± 1.4 years (range: 10–15). The mean body mass index was 30.2 ± 11.5 kg/m^2 (range: 23–67). SCFE was unilateral in 29 patients (74%). No family history of SCFE was observed. The patients complained of atypical thigh or knee pain in 8 (16.3%) and 6 (12.2%) cases, respectively. The average time to diagnosis was 21.8 ± 8.5 weeks (range: 4–53). SCFE was chronic and stable in all patients (100%). Thirty-one patients (79.5%) had open triradiate cartilage. The average slip angle was 41.53° ± 20.63° (range: 19°–78°). Demographic and diagnostic characteristics are summarised in Table 1. No ultrasonography was performed during the diagnostic process. A summary of demographic data with those of other series is shown in Table 2.

Table 1: Patient's demographics and diagnostic data

	Number of cases (%)
Gender	
Male	23 (59)
Female	16 (41)
Age (years), mean±SD	
Male	12.6±1.62
Female	12.1±1.37
Patient's complaints	
Pain	
Hip/groin	26 (67)
Thigh	9 (23)
Knee	4 (10)
Limping	19 (49)
Treatment received	
None	9 (23)
Medical	16 (41)
Self-medication	8 (20)
Traditional	6 (15)
Side affected	
Right	13 (33)
Left	18 (46)
Bilateral	8 (20)
Traumatism	
Yes	3 (8)
No	36 (92)
Weight (kg), mean±SD	48.6±15.5
Average BMI (kg/m^2)	
18–25 (normal)	7 (18)
25–30 (overweight)	23 (54)
>30 (obesity)	11 (28)
Status of triradiate cartilage	
Open	41 (84)
Closed	8 (16)
Slip angle (degrees)	
<30° (mild)	7 (14)
30–50° (moderate)	25 (51)
>50° (severe)	17 (35)

SD: Standard deviation, BMI: Body mass index

Discussion

The demographic and diagnostic features observed in this series are similar to those in the literature, despite the heterogeneity of the populations studied and the methodologies adopted. There are very few sub-Saharan studies on the epidemiology of SCFE amongst African children. These few studies[7,19-22] reported hospital data and focused on small sample sizes, similar to our own [Table 2].

The small sample size observed in the current study is multifactorial: (1) the diagnosis was overlooked or missed by several clinicians (first-contact practitioners, paediatricians and inexperienced radiologists) due to its rarity. According to some Western authors, the diagnostic error ranges from 19.6% to 53%;[10,15,23,24] (2) non-publication of diagnosed cases and (3) the absence of a national register for reporting orthopaedic conditions, as in South Korea,[8] Japan,[25] Italy[16] or the Netherlands.[26] The literature reports variations in prevalence according to country, region, race and ethnicity. The reasons for these variations in marked regional differences in incidence are

Table 2: Summary of demographics and clinical data of SCFE patients in this study and those of other series

First author	State of the study	Study period (years)	Number of cases	Mean age of patients (years)	Average diagnostic delay (weeks)	Number of obese/over-weight patients	Simultaneous bilateral involvement (%)
Africa							
This study	Côte d'Ivoire	22	39	12.5	21.8	11/21	20.5
Niane[22]	Sénégal	7	26	16	42.8	-	8.3
Yinusa[21]	Nigeria	6	31	12.5	-	-	13
Uchenna[19]	Nigeria	10	40	12.5	19	-	20
Mbonda[20]	Cameroun	-	1	10	52	-	-
Firth[27]	South Africa	7	70	12.4	8.5	-	14
	UK	-	67	11.9	12.8	-	9
Western world							
Noguchi[25]	Japan	3	314	-	-	-	-
Green[23]	USA	9	102	11.9	20	-	35
Weigall[37]	Australia	5	120	13.1	-	67/53	14.1
Witbreuk[26]	Netherlands	13	609	-	-	-	-
Herngren[32]	Sweden	7	379	-	-	207	7
Fedorak[5]	Hawaï (USA)	10	125	12.3	5	6/42	23
Longo[16]	Italy	15	4893	-	-	-	-
Loder[36]	USA	11	142	12.2	-	-	-
Kim[8]	South Korea	13	586	11.1	17	-	-

SCFE: Slipped capital femoral epiphysis

unclear but may reflect genetic, environmental and anatomical differences between different populations.[1,8] Seasonal variations have also been reported by other authors.[27,28] We also believe that they are linked to the organisation of different local health systems.

SCFE is an adolescent disorder. Loder and Skopelja[6] have reported that the majority of cases diagnosed before the age of 9 or after the age of 16 have other associated systemic pathologies that modify the conditions of bone maturation and cartilage fusion. This may be explained by the different endocrine profiles of the sexes.

The prevalence of overweight and obesity reported by many authors[5,9,29] was found in this study. Some authors consider obesity to be an aetiopathogenic factor in SCFE, while others believe it is more a factor favouring bilaterality.

In our series, the unilateral form accounted for two-thirds of cases, with a clear left-sided predominance, as in the majority of series reported in the literature.[6,13] This has been explained by some authors by the greater stress exerted on the left lower limb in right-handed people, who make up the majority of the general population. Carlioz reported that the left pelvic limb represents the limb of impulse and support in 70% of cases.[30]

The prevalence of immediate bilateral involvement varies widely between series, ranging from 18% to 63%.[8,16,31] It accounts for 20% of cases in our series, 15%, 22% and 35%, respectively, in the series by Pihl *et al*.[15] in Denmark, Loder[7] and Green *et al*.[23] in the USA. This contrasts with a study by Herngren *et al*. which showed that only 7% of Swedish children presented with bilateral involvement at the time of consultation.[32] Bilateral involvement from the outset seems to be influenced by the means used to search for them, as well as by the consideration of small, early changes in the growth plate and/or metaphysis on the side opposite the initial lesion.

Trauma was reported in almost 25% of cases by Witzel and Raschka[33] as an aetiological factor in three of our patients, and only one in the series by Pihl *et al*.[15]

With regard to the stability of SCFE, a high proportion of stable forms have been reported in the literature. This is the case with the series by Samelis *et al*.[9] and Fedorak *et al*.,[5] with proportions of 95% and 94%, respectively. In the present series, all cases were stable.

Literature[5,7,13] has reported the predominance of chronic forms, as in the current series, despite the presence of painful symptoms that should have led to diagnosis at a time close to the acute phase. The delay in consultation is associated with a number of factors in our context: (1) patients' underestimation of clinical symptoms or tendency to self-medicate and (2) our population's reliance on traditional healers as the first line of defence, as they believe that all pathological disorders have a mystical origin. In the series by Uchenna *et al*.[19] in Nigeria, 30% of SCFE patients consulted traditional healers as a first-line treatment, as did 15% of patients in the present series. Ariës *et al*.[34] in Ghana and Tiaho *et al*.[35] in Côte d'Ivoire noted that between 30% and 58% of patients consulted traditional healers before going to hospital, for sociocultural reasons and economic constraints. In Samoa, for example, the external rotation deformity created by SCFE is culturally well accommodated by the traditional practice of sitting cross-legged on the floor, as this facilitates sitting.[5]

However, Loder *et al*.[36] demonstrated that diagnostic delay and slip severity were not related to socioeconomic level.

Furthermore, in the series by Rahme *et al*.[10] in the USA and Weigall *et al*.[37] in Australia, 11% and 14% of patients first consulted a chiropractor or physiotherapist, respectively; (3) lack of interest or indifference on the part of parents, justifying this symptomatology by pointing out that children spend all their time outside the home, and that they have to bear the consequences of their wandering; (4) the remoteness and inadequacy of specialised centres and (5) the small number of specialists in paediatric orthopaedics. With a population of over 29 million, 38.3% of whom are under the age of 15, the country has fewer than 10 paediatric orthopaedists based in the city of Abidjan.

Delayed diagnosis of SCFE is universally reported, irrespective of time and place.[9] Diagnostic delays observed in 30%–50% of cases have been reported in the literature, with mean delays of 5–10 months; however, extremes of up to 36 months have also been reported.[9,10,13,15,38,39] Both patient and physician delays have been reported mainly in previous studies.[15,40] The causes are multiple. Pain radiating to the knee or distal thigh may have led to misdiagnosis.[13,41,42] Kocher *et al*.[13] noted a significant association between a longer delay in diagnosis and the location of the pain. In the series by Herngren *et al*.,[32] 44 children with knee pain had a median duration of symptoms to diagnosis 2 months longer than children with hip or groin pain. However, a study by Uvodich *et al*. reported that knee pain was not a significant predictor of delayed diagnosis.[12]

The delay in diagnosis leads to more severe slippage and poorer long-term outcomes. A number of authors have identified a significant relationship between delay in diagnosis and severity of slip.[3,10,13,38,39,43] According to Kocher *et al*.[13] the severity of slippage increases by approximately one level (e.g. from mild to moderate) for each month of delay. In contrast, no diagnostic delay was observed in a series by Fedorak *et al*. in the United States.[5] Niane *et al*.[22] reported a proportion of 58% of severe cases. In our series, a third of patients exhibited severe slippage. These severe forms were observed in only 8% of cases in the series by Samelis *et al*.,[9] probably because of the diagnostic resources and the early consultation.

Uvodich *et al*.[12] noted that 49% of initial consultations did not result in a correct diagnosis of SCFE. In our context, missed diagnoses are related to a lack of knowledge of SCFE by many primary care professionals. Indeed, we agree with other authors that healthcare professionals often only request the AP pelvic radiograph when examining a non-traumatic limping adolescent. In fact, of the 18 patients who consulted the paediatric orthopaedist for radiographic assessment, only five had a lateral (frog-leg) view of the hip. Radiographic interpretation is essential for the diagnosis of SCFE. However, errors were made in the analysis of pelvic radiographs, although some patients consulted early with mild slippage.

In fact, only Kleins' line (a line drawn along the superior femoral neck and intersecting the lateral femoral epiphysis on the AP view), known as Trethowan's sign, has been consistently researched. According to Green *et al*.[23] and Weigall *et al*.,[37] 60% of diagnostic errors are related to radiological analysis based on Klein's line. For this reason, Hosseinzadeh *et al*.[42] and Green *et al*.[11] recommend considering the modified Klein line (epiphyseal width lateral to the Klein line with a difference of 2 mm or more between the hips), with a sensitivity of 79% compared with 40% for the Klein line. A number of other signs can help in the interpretation of radiographs.

Metaphyseal blanching or Steel's sign is an increased density of the proximal metaphysis near the epiphysis due to bone overlap.[44] Capener's sign indicates less overlap between the posterior wall of the acetabulum and the metaphysis of the femoral neck on the AP view.[45] Recently, Rebich *et al*. proposed a new S-sign which looks for a discontinuity in a curvilinear line between the inferior metaphysis and the epiphysis of the femur on the lateral view of the frog leg. According to Rebich *et al*., the Trethowan sign coupled with the S-sign has better sensitivity (96.5%) and specificity (85%) for the diagnosis of SCFE.[46]

According to certain authors,[3,38,47,48] in addition to radiography, ultrasound has also been used for the positive diagnosis of SCFE. It is used to measure the distance between the upper metaphyseal margin and the femoral head. For distances of 7 mm or less, a slip angle of <30° is equivalent; between 7 and 11 mm, the angle is <50°; for distances >11 mm, the slip angle is >50°.[38] According to these authors, it is superior to radiography for visualising small displacements and analysing signs of neck remodelling in advanced epiphysiolysis. We do not have experience of ultrasound diagnosis of SCFE in our practice. In other jurisdictions, late or missed diagnosis of SCFE is not only clinically significant but also a major source of litigation with economic repercussions. Indeed, the Medical Defense Union, which is just one of the medical indemnity providers to doctors in the UK, has reported that there are 5–10 claims related to delayed diagnosis in SCFE each year, which can be settled for up to £500,000.[14]

We concur with other authors, particularly those from developing countries, that efforts to educate parents and train healthcare professionals are needed to improve the time to diagnosis and prevent litigation.

This study has a number of limitations related to its retrospective nature. Despite its multicentre nature, the census was not national and the sample was small; we were unable to collect data from private clinics; we believe that some cases could have been considered fractures (Salter–Harris type I) and treated as such in non-specialised facilities. The study does not include data on physical examination findings and anatomical factors. Metabolic and endocrine abnormalities were not investigated due to economic constraints. In addition, we did not perform statistical analyses.

Conclusion

Although the incidence of SCFE is high in Black people, this study revealed an annual frequency of only two cases,

indicating the scarcity of this condition in our practice. Previously thought to be more common in adolescent males, SCFE is now known to be characterised by a long delay in diagnosis, with a predominance of left unilateral, chronic and stable forms. Moderate and severe forms, linked to the delay in diagnosis, account for more than three quarters of cases. To reduce the delay in diagnosis, education of the population and training of paediatricians and first contact practitioners in the pain characteristics and radiographic aspects of SCFE are necessary. Any lameness or pain in the hip/pelvis, thigh or knee in adolescents should be suspected, and AP radiography of the pelvis and Lauenstein's incidence of the hips should be recommended. A national multicentre prospective study with a larger sample size would allow us to better define the characteristics of SCFE in our country, including the search for biochemical and mechanical abnormalities.

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Level of Study: This was a level IV, retrospective study.

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Conflicts of interest

There are no conflicts of interest.

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