Patients With Unstable Slipped Capital Femoral Epiphysis Have Antecedent Symptoms

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Abstract

Background The characteristics of patients who sustain unstable slipped capital femoral epiphyses (SCFEs) are not well described compared to their counterparts who sustain stable SCFE. Although patients with unstable slips are usually identified owing to acute symptoms, it is unclear whether these patients have premonitory symptoms that could heighten the awareness of treating physicians to the possibility of an unstable slip and lead to timely diagnosis and treatment.

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All ICMJE Conflict of Interest Forms for authors and *Clinical Orthopaedics and Related Research* editors and board members are on file with the publication and can be viewed on request. Each author certifies that his or her institution approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained. This work was performed at Children's Hospital Boston, MA, USA.

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Questions/purpose We determined whether most patients experienced pain and limp before developing an unstable SCFE.

Methods We retrospectively reviewed 582 patients and identified 82 (41 boys, 41 girls; 85 hips) with unstable SCFEs. Patient records were reviewed for sex, age at onset, weight at onset, and presence and location of pain and/or limp before the unstable slip. Boys averaged 13 years of age at the time occurrence and weighed on average in the 77th percentile. Girls averaged 12 years of age at the time of occurrence and weighed on average in the 79th percentile.

Results For all patients, 73 of 82 (88%) had pain in their hips, thighs, or knees for an average of 42 days before sustaining unstable SCFEs. Sex distribution was equal for patients with unstable SCFEs.

Conclusions Patients who sustained unstable SCFEs had premonitory pain in the limb. Early recognition and an appropriate diagnosis provide a critical opportunity to prevent a morbid unstable SCFE.

Level of Evidence Level IV, diagnostic study. See Instructions for Authors for a complete description of levels of evidence.

Introduction

Slipped capital femoral epiphysis (SCFE) affects one in 5000 to 10,000 children, with substantial variability among ethnic groups [11, 12, 15, 17]. SCFEs may be classified by the stability of the physis, as described by Loder et al. [14]: in patients with unstable SCFE, the epiphysis displaces acutely, and the child is unable to bear weight and will present for emergent care with extreme pain. However,

Ziebarth et al. [21] found this classification scheme can capture patients whose physes are actually stable during surgery. Several studies report 5% to 15% of all patients with SCFE have “unstable” slips [5, 11, 13]. It is important to define the unstable SCFE and identify patients with an unstable slip as these patients have an increased risk of morbidity compared to those with a stable SCFE. Avascular necrosis of the hip occurs in 14% to 58% of these patients [7, 13, 19]. Chondrolysis may occur, but its incidence is unknown for unstable SCFE [9, 12]. Residual hip deformity may be severe. Unstable slips require urgent surgical stabilization; timing may be critical in improving outcomes [4, 6, 9].

The epidemiology and physical characteristics of the patients who sustain stable SCFEs have been well studied and recently updated [1, 11, 12]. These studies suggest the age of onset is declining for all slips from a mean of 12.9 to 12.1 years from 1983 to 2000 (median year) [15]. Sex distribution favors males at a ratio of 1.4:1 up to 2:1 [1, 2, 10, 11]. Further, children with stable SCFEs continue to be overweight or obese [1, 2, 10, 11, 16].

Less is understood about the characteristics of children who sustain unstable SCFEs. Children with unstable SCFEs may experience lower extremity symptoms before the occurrence of an unstable SCFE [4]. The descriptor used in older literature for the unstable SCFE [3] was acute (< 3 weeks of symptoms) or acute on chronic (acute displacement with symptoms > 3 weeks), suggesting many patients may experience hip, thigh, or knee pain or may limp before an unstable SCFE. The incidence and duration of premonitory symptoms are unclear. One small series reported the occurrence of premonitory symptoms may be 81% [4]. Others have suggested a short duration of symptoms of 0.3 months [7].

We therefore determined how frequently and for what duration patients experienced pain or limp before developing an unstable SCFE.

Patients and Methods

We retrospectively identified all patients treated for unstable SCFEs between 1990 and 2006. Using our institutional database, we identified 528 patients with a diagnosis of SCFE using ICD-9 Code 732.2 and the keywords “SCFE” and “slipped capital femoral epiphysis.” We filtered this search using the keywords “acute,” “unstable,” and “acute on chronic” and identified 156 patients with potentially unstable SCFEs. We chose the definition of unstable SCFE described by Loder et al. [14]. We excluded 61 patients who were able to bear weight at the time of admission, two patients who sustained high-energy trauma, and one with untreated endocrinopathies, as

these patients were substantially younger and skewed the age data. We also excluded 10 patients treated at our institution for complications or sequelae of unstable SCFEs initially stabilized at other institutions since data at the onset of SCFE were missing. These 74 exclusions left 82 patients (85 hips) with unstable SCFEs. Part of this patient cohort was previously studied to identify risk factors for avascular necrosis in unstable SCFE [20]. That study included 70 of the 82 patients included here; the 12 exclusions were due to inadequate followup required for that study’s design. The minimum followup for this study was 1 month (mean, 32 months; range, 1–120 months). No patients were recalled specifically for this study; all data were obtained from medical records and radiographs. Institutional review board approval was obtained before review of records and radiographs.

We reviewed the records for all 82 patients. We recorded the age at injury, sex, and weight. Height data were not routinely available to compute BMIs. All weights were converted to normative sex- and age-adjusted percentiles. Normative weight-for-age charts, updated and published by the NIH in 2000 [8], were used to graphically plot and evaluate weight distribution. We recorded the occurrence of a contralateral SCFE, including a second unstable contralateral SCFE. We recorded the presence of hip, thigh, and/or knee pain before the unstable SCFE, though the exact site of pain was often not available in the record. Any mention of limping was recorded (noted in eight of the 82 patients). We recorded the duration of pain. There were 41 boys and 41 girls. The girls had a mean age of 12 years (range, 9–15 years) when they sustained their unstable SCFEs. The boys had a mean age of 13 years (range, 7–16 years) at the time of their unstable SCFEs. Weight data were recorded for 38 girls, who weighed an average of 55 kg (SD, 14 kg), representing the 79th percentile in weight for age. Twenty-two of 41 girls (54%) were over the 90th percentile for weight. Seven of 41 girls (17%) were under the 50th percentile for weight. Weight data were obtained for 36 boys, who weighed an average of 62 kg (SD, 15 kg), representing the 77th percentile in weight for age. Nineteen of 41 boys (46%) were over the 90th percentile for weight. Six of 41 boys (14.6%) were under the 50th percentile for weight. Three patients sustained bilateral unstable slips. A subsequent contralateral slip occurred in nine of 41 girls (22%) and 11 of 41 boys (27%); most of these were stable SCFEs, although one subsequent SCFE was unstable in each sex group. Unstable SCFEs occurred on the left side 71% of the time. Avascular necrosis occurred in 16 hips (20%).

Pain data were recorded in 81 of 85 hips (95%) as definitively present or absent. If the data were not reported, the patient was counted as having no pain and duration of pain of zero to avoid skewing the mean to a higher value.

Anatomic site of pain was only reported in the records for 15 of 85 hips and limp in seven of these same 15 hips. Limp alone was recorded in one hip with no pain. These data were insufficiently reported in the patients' records to subclassify location of pain or frequency of limp for unstable SCFE. We therefore elected to describe and analyze these symptoms in pooled fashion.

We determined mean, SD, and CI for continuous data as an entire cohort and as male and female subcohorts. 95% CI data provide a way to evaluate how continuous variables fit in the range of reported values in the literature for age at presentation. Sex distribution and normalized weight for age were provided in tabular format to allow comparison of raw data with references from the literature, but statistical comparison between cohorts was not appropriate. We used the Microsoft® Excel® statistics package (Microsoft Corp, Redmond, WA, USA) for data analysis.

Results

Thirty-five of 41 girls (85%) described a limp and/or pain in the hip, thigh, or knee for an average duration of 35 days before onset of their unstable SCFEs (Table 1). Thirty-seven of 41 boys (90%) had similar lower extremity symptoms for an average of 48 days before onset of their unstable SCFEs.

Discussion

Unstable SCFE can lead to osteonecrosis of the hip in 14% to 58% of hips [7, 13, 19]. Chondrolysis and residual femoral deformity may also lead to further morbidity. The characteristics of patients who sustain unstable SCFEs are not well described compared to their counterparts who sustain stable SCFEs. Early identification of patients at risk for unstable SCFE may help to prevent these morbid outcomes. We therefore determined whether most patients experienced pain and/or limp before developing an unstable SCFE.

Table 1. Occurrence of symptoms (hip, thigh, and/or knee pain or limp) before unstable SCFE

Group	Number of patients with symptoms before onset of unstable SCFE	Average duration of symptoms (days)*
Boys	38/41 (89%)	48 ± 64
Girls	35/41 (85%)	35 ± 37
Total	73/82 (88%)	42 ± 53

* Values are expressed as mean ± one SD; SCFE = slipped capital femoral epiphysis.

We acknowledge limitations of our retrospective study. First, we had hoped to define more precisely the characteristics of patients who developed an unstable SCFE; however, height data were absent and irrecoverable despite review of every available patient record; therefore, conversion to standard BMI values was not possible. We believe the normative weight for age data are valuable and they have been utilized in important studies in the past but are not suitable for direct comparison to BMI data reported in most modern series. We selected the weight-for-age data reported by the CDC in 2000 [8]; we believed this most accurately reflected the characteristics of the study group and would normalize any generational changes in weight as a function of age when compared to previous studies. Second, weight data were incomplete in 10% of patients (three girls, five boys) and these absent data could skew the reported weight-for-age data; these patients were included because the sex, age, and symptom data were complete. Third, our patients were classified based on the definition of the unstable SCFE of Loder et al. [14]. Some researchers have expanded or contracted the definition of Loder et al. [14] by reclassifying at the time of surgery based on stability [21] or by using ultrasound to assess stability and effusion [18]. This could have resulted in the inclusion of SCFEs that were not unstable using these alternative definitions: Ziebarth et al. [21] reported 76% specificity for the Loder classification in predicting gross mechanical instability found at surgery. Our group previously reported the risk factors for avascular necrosis for this patient cohort and all had direct evidence of instability of the slip [20]; 12 patients from this cohort were excluded for inadequate followup for that study, but these records were adequate for this study. Lastly, a symptom of pain before SCFE was recorded for 81 of 85 hips (95%), but anatomic localization of this pain and the presence or absence of limp were poorly reported. As one would expect, a prospective study would eliminate each of these inconsistencies in data collection and permit a direct comparison to the cohort with stable SCFE.

We found 88% of patients had hip, thigh, and/or knee pain, usually for weeks, before minor traumas resulted in unstable slips. While we suspected that many patients with unstable SCFEs might have premorbid symptoms, we were surprised to discover that the overwhelming majority did, in fact, have a limp or pain in the limb. This agrees with the findings of Gordon et al. [4] who reported 13 of 16 patients with unstable SCFEs had symptoms for an average of 54 days (range, 0–240 days) before developing an unstable SCFE. This suggests there is an opportunity to prevent unstable SCFEs by identifying an at-risk hip in the pre-SCFE phase and surgically stabilize it.

We recorded demographic data regarding age of onset, sex distribution, and body weight that appear to be

Fig. 1 A graph shows the sex distribution of patients sustaining stable SCFEs in large studies in the literature compared to our study of unstable SCFEs. Whereas boys and girls were equally affected by unstable SCFEs in our cohort, the other studies found patients with stable SCFEs had a greater likelihood of being male.

representative of patients with unstable SCFE. Our retrospective study design without a control cohort does not allow for clear identification of a uniquely high-risk group for unstable SCFE. While direct statistical comparison of independent variables in our study and in those in the literature is inappropriate due to heterogeneity of data and differences in study design, we present the raw data without any attempt to draw any conclusions regarding its importance. Boys and girls were equally affected in this cohort, whereas the literature reports a greater likelihood of being male (range of ratios, 1.4:1–2.4:1) [1, 2, 10, 12, 17] (Fig. 1). Additionally, for children with stable SCFEs, the average BMI has been above the 95th percentile in more than 18% to 51% of affected children [1, 2, 10, 16, 17]. Loder et al. [14] reported 18 of 30 patients (60%) with unstable SCFEs had an average BMI greater than the 95th percentile. Bhatia et al. [1] showed 16 of 54 patients (31%) with stable SCFEs had a BMI of less than 25. In our study, 54% of boys and 46% of girls with unstable SCFEs were under the 90th percentile for weight, a threshold for obesity on the BMI chart (Fig. 2).

The age at which all SCFEs occur, including unstable SCFEs, has declined according to recent epidemiologic studies. In a large multicenter epidemiologic study published in 1996 but focusing on children born in the 1960s and 1970s, Loder [12] determined the mean age of occurrence to be 13.5 years in boys and 12 years for girls. Lehmann et al. [11] reviewed a large national US database for pediatric admissions for SCFE in 1997 and 2000 (children presumably born in the 1980s) and discovered the average age of onset was 12.7 years for boys and 11.2 years for girls. We found the average age of onset of unstable SCFEs to be 13.2 years (95% CI, 12.6–13.8 years) in boys and 11.8 years (95% CI, 11.4–12.2 years) in girls. While direct statistical comparison to a historic cohort is difficult for continuous variables, the 95% CI for our cohort contains the mean ages reported for boys and girls in the two largest epidemiologic studies available for stable SCFEs (Table 2). We conclude there is no difference in age of onset for children with unstable SCFE.

Fig. 2 A graph compares the percentage of obese (>95%), overweight (90%–95%), and normal-weight (<90%) patients in several studies to our patient cohort. No statistical comparison can be made due to heterogeneity of data.

Table 2. Comparison of mean age of onset of unstable SCFE in our studies and in large studies of stable SCFE from the literature

Study	Number of patients	Mean age (years)	
		Male	Female
Loder [12]	1630	13.5	12
Lehmann et al. [11]	Not reported (national database)	12.7	11.2
Castro et al. [2]	14,341 (pooled data)	13.7	11.9
Bhatia et al. [1]	54	13	11.4
Current study	82	13.2 ± 0.6*	11.8 ± 0.4*

* Values are expressed as mean ± 95% CI; as our study group CI is inclusive of the mean age of onset for these large studies on stable SCFE in the literature, we conclude there is no difference in age of onset; SCFE = slipped capital femoral epiphysis.

In summary, we found children with SCFEs are likely to limp or to report pain in the hip, thigh, or knee before onset of their SCFE for up to 6 weeks on average. The notion that unstable SCFE is often an acute-on-chronic event is not antiquated, and children with signs, symptoms, and radiographic evidence of stable SCFE or at-risk physes should

be treated urgently to avoid unstable SCFE. The diagnosis of SCFE should be considered in any preadolescent or adolescent child who presents with a new onset of limp or pain in the hip, thigh, or knee, or restricted hip ROM. Identifying a stable SCFE or at-risk physis and treating it promptly can avoid the potential morbidity associated with an unstable SCFE.

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