EVOLUTION OF SLIPPED CAPITAL FEMORAL EPIPHYSIS AFTER NONSURGICAL TREATMENT

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ABSTRACT
Objective: To evaluate the efficacy of conservative treatment of patients with slipped capital femoral epiphysis (SCFE) and the complications due to the progression of the disease. Methods: 18 patients (26 hips) seen consecutively from December 1996 to August 2006 at the Orthopedics Service of Santa Casa de Misericórdia de São Paulo, who had been referred from other services with a diagnosis of SCFE and were treated without surgery, were retrospectively analyzed. Results: Slip progression occurred in 19 hips (73%). Among the mild cases, eight remained mild, four became moderate and one became severe, according to the Southwick classification. Four out of the six originally moderate cases became severe and the two already severe cases worsened. Conclusion: Although today there is a consensus regarding the indication of surgical treatment for SCFE to prevent progression, some cases with confirmed diagnoses are still being treated conservatively. This is a major error, since it implies increased morbidity of the disease.
Keywords – Epiphyses, Slipped; Therapeutics; Natural history of diseases

INTRODUCTION
In cases of slippage of the capital femoral epiphysis (SCFE), gradual and progressive displacement of the epiphysis in relation to the neck occurs. This process is the result from shearing and compression forces on a diseased growth plate (1). This condition occurs mostly among overweight or even obese children at adolescent or pre-adolescent ages. There is a proportionally greater risk of being affected among patients undergoing hormone replacement or presenting endocrine diseases such as hypothyroidism or hypogonadism(2). In the clinical evaluation, claudicating gait associated with groin pain that sometimes irradiates to the internal face of the thigh and/or the knee are symptoms that are often neglected at the first attendance, thus delaying the correct diagnosis. These insidious symptoms lead to non-definitive treatment for the disease and produce the erroneous idea that the use of symptoms, removal of the load, traction of the limb followed by immobilization in a plaster cast or even simple observation(3) would be enough to halt the progressive evolution of the slippage.

Carney et al(4) demonstrated that 17% of the cases of SCFE progress with additional slippage when they are not treated surgically. Ordeberg et al(5) proved that continued presence of an open growth plate constituted a risk of progression to slippage after diagnosis.
The present study had the aim of evaluating the efficacy of conservative treatment in patients with SCFE and the complications caused by evolution of the disease.

METHODS

This was a retrospective observational study based on assessments on patients who were attended by the Pediatric Orthopedics Group of Santa Casa de Misericórdia de São Paulo, between December 1996 and August 2006, with a diagnosis of SCFE. The design for this study was submitted to and approved by the institution’s medical ethics committee (protocol 384/07).

The following were inclusion criteria:
1) Patients who had been attended previously and had been diagnosed with SCFE that was treated nonsurgically, with non-steroidal anti-inflammatory drugs (NSAIDs), physiotherapy, rest, crutches or plaster casts, and who subsequently voluntarily sought the Pediatric Orthopedics Service of Santa Casa de Misericórdia de São Paulo because they did not feel that their condition had improved.
2) Existence of radiographs produced prior to coming to our service that proved that a diagnosis of SCFE had been made, among patients who had been having regular medical follow-up.

The following were exclusion criteria:
1) Patients who had not been diagnosed with SCFE;
2) Patients who did not have radiographic documentation;
3) Patients who had been treated for hip pain with another diagnosis (for example, bruising in the thigh);
4) Patients who did not accept the surgical treatment proposed at the initial diagnosis;
5) Patients who had concomitant endocrine diseases;
6) Patients who had been diagnosed previously but who were referred for surgical treatment (and not conservative treatment) at our service.

All the medical files on the patients included in the study were analyzed, and the demographic data and data relating to clinical history and evolution of the morbid condition were registered. The lengths of time between producing radiographs and between producing radiographs and implementing treatment were also noted.

The progression of the slippage was assessed by measuring Southwick’s epiphyseal-diaphyseal angle. This angle was considered to be normal when, in lateral view, it was not more than 10° (both anteriorly and posteriorly). In Southwick’s classification, the degrees of slippage are subdivided according to the angle, and the slippage is defined as mild if the angle is up to 30°; moderate, if it is between 30° and 60°; and severe, if it is greater than 60°.

In the statistical analysis, the progression of the slippage between the initial and immediately preoperative radiographs was assessed, and these data were correlated with age, time taken for the slippage to occur and the gender affected. The level of 5% (0.05) was used in applying significance tests. In analyzing the correlations, the Mann-Whitney test, Spearman correlation analysis and Wilcoxon signed-rank test were applied. The Statistical Package for Social Sciences (SPSS) software, version 13.0, was used to obtain the results.

RESULTS

Over the study period, 401 patients with SCFE of varying degrees were admitted. Among these, 35 patients (8.7%) with a previous diagnosis of SCFE underwent an attempt to implement conservative treatment prior to surgery. However, after applying the inclusion and exclusion criteria of this study, 18 patients (4.5%) remained in the study.

Among these 18 patients, three (16.7%) were affected in the left hip, seven (38.9%) in the right hip and eight (44.4%) bilaterally, thus making a total of 26 hips. The patients’ ages ranged from nine years and ten months to fifteen years and eight months, with a mean of twelve years and seven months. Ten of these individuals were male and eight were female.

From the retrospective analysis on the information contained in the medical files, we observed that the patients had sought our service because of persistence of the painful complaint and progression of their functional limitation, despite the conservative treatment that had been instituted. The interval between the initial and the preoperative radiograph produced in our service ranged from 26 to 402 days.

All the 18 patients included in the study had complaints of pain that was refractory to the conservative treatment instituted previously, which was the reason for seeking our service. In the initial radiograph on the 26 hips, in accordance with Southwick’s classification, it was observed that 18 (69.2%) were classified as mild slippage, six (23%) as moderate and two (7.8%) as severe. Among the 24 hips classified as mild or moderate
from the initial radiograph, the slippage worsened in nine cases (37.5%), in comparison with the preoperative radiograph according to the classification used. Among the 18 mild cases, four (16.6%) progressed to moderate and one (4.15%), to severe. Among the initially moderate cases, four (16.6%) evolved to severe. The analysis demonstrated that progression of the slippage (worsening) occurred in 19 (73%) of the 26 hips (Table 1 and Figure 1).

Table 2 demonstrates the statistical analysis on the data obtained, with evaluation according to the variables of time, age, sex and degree of slippage. Comparison between the sexes in relation to the variables of time, age and degree of slippage showed that time (p = 0.03) and age (p = 0.03) presented statistically significant differences between the sexes, such that the girls were affected at a younger mean age than the boys were, while the degree of slippage did not differ between the sexes (p = 0.890). Time (p = 0.692) and age (p = 0.814) also were not associated with the degree of slippage (Table 3).

Analysis on the angular evolution of the slippage that occurred, comparing the two times of radiographic observation (initial radiograph at another service and immediately preoperative radiograph in our service) showed that there was a statistically significant difference between these measurements (< 0.001), thus indicating that there was an increase in the slippage (Table 4).

Among the hips evaluated in this study, two of them underwent osteotomy in two planes, subsequent to in situ fixation for stabilization and growth plate fusion. One of them underwent trapezoidal osteotomy at the time of admission to our service, because of the severity of the slippage that had become established through progression of the disease. One of the patients already presented growth plate closure at the time of admission to our service, but the review of the initial radiographs demonstrated that at the time of the initial diagnosis, the growth plate was still open and, because it was not treated, the case progressed to slippage. Among the other nine hips (i.e. the contralateral hips of the unilateral cases), none of them presented growth plate abnormalities but all of them were fixed as a prophylactic measure because of the patients’ young age. Among the possible complications of the disease, we found one case of chondrolysis after osteotomy in two planes and we did not observe any avascular necrosis in any of the cases evaluated.

**DISCUSSION**

Even today, there are many situations in which the correct diagnosis of SCFE fails to be made at the initial consultation. Lack of knowledge that, in many hip conditions, pain can irradiate to the internal region of the thigh and to the knee is just one of these causes. Allied with this is the fact that, because such pain and claudication is presented in adolescents and pre-adolescents who are often overweight or obese, physicians interpret these symptoms as results from bruising or even from overloads in practicing sports. Thus, medications are administered to alleviate the symptoms, rest is recommended and, far from rarely, radiographs of the knees and spine are requested. Thus, other approaches are taken, and these end up delaying the diagnosis and implementation of adequate therapy.

Waldenström(7) described the physiopathological stages in the process of SCFE and advocated conservative treatment with traction (or rest), followed by immobilization in a plaster cast. Given the standards of that time regarding radiographic methods, the limited means for surgical fixation and the low safety levels of anesthesia, this method was accepted and greatly used in the first half of last century.

In 1990, in a lone paper going against recent trends towards in situ fixation after diagnosis, Betz et al(3) revisited conservative treatment and recommended traction and plaster-cast immobilization of the affected limb. Despite observation of increased chondrolysis rates and inefficiency with regard to achieving growth plate fusion in many cases, and despite the long duration of immobilization required, this method gained followers.

Shortly before this, Ordeberg et al(5) had warned of the risk of progression of the slippage and consequent worsening of the prognosis in cases treated conservatively when the growth plate was found to be open. Carney et al(4) evaluated the evolution of SCFE with conservative treatment and found that the degree of slippage worsened in 17% of the patients. They also observed that 8% of the mild cases, 18% of the moderate cases and 28% of the severe cases evolved to chondrolysis. In relation to necrosis, the results were equally disastrous, with a 2% occurrence rate in the mild cases but 20% in the moderate and severe cases. Ingram et al(8) found that chondrolysis was present in 28.9% of the 329 cases evaluated, and observed that this complication was greater in female patients with acute slippage and in patients with greater degrees of slippage.
On the other hand, high complication rates in surgical treatment(9,10) have occurred at times when the surgical techniques used and the synthesis materials used did not help surgeons, thus compromising the results

Table 1 – Distribution of the hips according to sex, initial degree of slippage, preoperative degree of slippage, number of days that elapsed until treatment and the patients’ ages (December 1996 to August 2006).

| Patient | Sex | Age (months) | Initial degree of slippage | Preoperative degree of slippage | Slippage during observation period | Time elapsed (days) |
|---------|-----|--------------|-----------------------------|-------------------------------|-----------------------------------|---------------------|
| 1       | F   | 145          | 20°                         | 30°                           | 10°                               | 26                  |
| 2       | M   | 143          | 51°                         | 75°                           | 24°                               | 28                  |
| 3       | M   | 143          | 52°                         | 71°                           | 19°                               | 28                  |
| 4       | M   | 157          | 18°                         | 20°                           | 2°                                | 33                  |
| 5       | F   | 152          | 15°                         | 21°                           | 6°                                | 33                  |
| 6       | M   | 134          | 28°                         | 31°                           | 3°                                | 36                  |
| 7       | M   | 118          | 16°                         | 16°                           | 0°                                | 36                  |
| 8       | M   | 118          | 21°                         | 30°                           | 9°                                | 36                  |
| 9       | M   | 177          | 36°                         | 36°                           | 0°                                | 37                  |
| 10      | M   | 177          | 30°                         | 30°                           | 0°                                | 37                  |
| 11      | M   | 163          | 77°                         | 84°                           | 7°                                | 41                  |
| 12      | M   | 188          | 30°                         | 70°                           | 40°                               | 47                  |
| 13      | M   | 188          | 20°                         | 29°                           | 9°                                | 47                  |
| 14      | F   | 143          | 21°                         | 35°                           | 10°                               | 48                  |
| 15      | F   | 143          | 25°                         | 35°                           | 10°                               | 48                  |
| 16      | M   | 176          | 79°                         | 90°                           | 11°                               | 48                  |
| 17      | F   | 155          | 20°                         | 20°                           | 0°                                | 57                  |
| 18      | F   | 155          | 30°                         | 30°                           | 0°                                | 57                  |
| 19      | M   | 163          | 49°                         | 52°                           | 3°                                | 64                  |
| 20      | M   | 163          | 10°                         | 10°                           | 0°                                | 64                  |
| 21      | F   | 133          | 42°                         | 70°                           | 28°                               | 76                  |
| 22      | M   | 175          | 38°                         | 41°                           | 3°                                | 87                  |
| 23      | F   | 131          | 22°                         | 29°                           | 7°                                | 100                 |
| 24      | F   | 131          | 11°                         | 11°                           | 0°                                | 100                 |
| 25      | F   | 136          | 28°                         | 35°                           | 7°                                | 128                 |
| 26      | F   | 153          | 6°                          | 39°                           | 33°                               | 402                 |

Table 2 – Relationship between the patients’ sex and the variables of degree of slippage, time elapsed and age, according to application of the Mann-Whitney test.

| Variable | Sex | n  | Mean | Standard deviation | p  |
|----------|-----|----|------|-------------------|----|
| Slippage | F   | 11 | 9.27 | 11.23             | 0.896 |
|          | M   | 15 | 8.67 | 11.25             |     |
| Time elapsed | F   | 11 | 97.73 | 105.63          | 0.033 |
|            | M   | 15 | 44.60 | 16.06            |     |
| Age       | F   | 11 | 143.36 | 9.53            | 0.035 |
|          | M   | 15 | 158.87 | 23.03           |     |

Table 3 – Application of Spearman correlation analysis, in relation to time elapsed, age and slippage.

| Variable      | Statistic | Time elapsed | Age |
|---------------|-----------|--------------|-----|
| Slippage      | Correlation coefficient | -0.082 | -0.048 |
| Significance (p) | 0.692 | 0.814 |

Table 4 – Application of the Wilcoxon signed-rank test between the initial and preoperative degrees of slippage.

| Pair of variables | Mean | n  | Standard deviation | p   |
|------------------|------|----|-------------------|-----|
| Initial degree   | 30.58 | 26 | 18.54             | < 0.001 |
| Preoperative degree | 39.50 | 26 | 22.94             |     |
from this type of treatment. With the advent of the current fluoroscopic equipment and devices for positioning patients, and better tactical and technical knowledge among surgeons, the ability to achieve fixation with a single well-positioned screw has meant that the high complication rate has dropped from reported levels of up to 36% to 4.6% or less (9,13).

This in situ fixation can be achieved percutaneously in mild and moderate cases, using a single screw, without prejudicing the final result. Not only is the surgical scar small, but also there is minimal bleeding. According to Loder et al (14), the advantages of fixation using a single screw include low levels of soft-tissue injury, avoidance of progression of the slippage and low incidence of necrosis and chondrolysis. Excellent results have also been demonstrated by Aronson and Carlson (11) and Blanco et al (13), from using the technique of fixation with a single screw in cases of mild and moderate slippage, with success rates of 91% to 95%.

The epidemiological results from this study demonstrated that the age at which slippage occurred was lower among the girls than among the boys, and that this was a statistically significant result (Table 2). This reinforces what was already known, given that this disease is related to bone maturity, which occurs earlier among girls than among boys. On the other hand, the age at onset and the time elapsed did not explain the subsequent behavior of the slippage that took place. It is known that chronological age does not always correspond to bone age. Moreover, not all the patients will have followed the advice to rest that forms part of conservative treatment, and such behavior will have altered the speed and severity of the slippage. The progressive nature of slippage that was subjected to conservative treatment was clearly demonstrated in the present study by the angle values found on the preoperative radiographs, which were higher than on the initial radiographs, thereby proving the inefficiency of the “conservative” treatment that had been instituted.

Although the number of hips subjected to conservative treatment that was identified in this ten-year study seems small (n = 26), it needs to be emphasized that in reality, the number of patients with this condition can be expected to be much greater. Among the inclusion criteria for this study, we deemed it necessary that radiographs had already been produced before the case

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**Figure 1** – Case 21: 11-year-old female patient. Radiographs at the time of the initial diagnosis (A and B), Progression of slippage after 76 days (C and D).
reached our service, thereby proving the existence of the disease and allowing the attending physician to advise that one of the types of palliative treatment should be instituted (such as the use of anti-inflammatory drugs, analgesics, immobilization, load withdrawal, rest or even physiotherapy). Many of the cases of SCFE admitted to our service did not have previous radiographs, despite reports in many medical files stating that the patients had been seen previously and that radiographs had been produced. Thus, the patients did not always bring their previous examinations, which made it difficult to conduct the study.

In addition to these patients who did not bring their previous radiographs, there were also some lamentable cases that had not even been examined in other services, let alone radiographed, despite the presence of typical SCFE conditions, and also some cases in which only the knees had been radiographed, or even the pelvis without making the diagnosis. If these cases were to be included in the study, at least another 35 patients would be added, thus resulting in a percentage of 8.7% of all the medical files examined.

It needs to be added to this discussion that, recently, acetabular impact and its consequences such as labral lesions and osteoarthrotic evolution has been correlated with all degrees of SCFE, according to reports by Leunig et al (15) and Ganz et al (16). These authors described a direct relationship between SCFE and acetabular impact that resulted from a process of insufficient remodeling of the femoral neck. In this manner, expectant management after SCFE has been correctly diagnoses cannot be justified today. For us, as specialists, this is a matter of concern, given that cases often come to us when the severity of slippage has already reached a stage at which complication-free therapy may be difficult to achieve.

CONCLUSION

Conservative treatment is not effective for avoiding the worsening of slippage in SCFE cases. The complications coming from an observational therapeutic approach are the factors associated with the natural evolution of progressive diseases, i.e., different degrees of biomechanical abnormality of the hip and the likely medium to long-term repercussions from this.

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