E-ISSN: 3068-3726
Journal of Orthopaedic Science and Research

ATHENAEUM SCIENTIFIC PUBLISHERS

Case Report

Complications and Sequelae of Epiphyseal Separation Fractures in the Lower Limb: About 31 Cases

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Citation: Diouf JD, et al. Complications and Sequelae of Epiphyseal Separation Fractures in the Lower Limb: About 31 Cases. J Ortho Sci Res. 2025;6(3):1-7.

https://doi.org/10.46889/JOSR.2025.6319

Received Date: 28-11-2025

Accepted Date: 21-12-2025

Published Date: 28-12-2025

Abstract

Introduction: Epiphyseal separation fractures are a particular feature of pediatric traumatology and account for 15-30% of childhood trauma. The occurrence of these complications and sequelae is a reality in our developing countries. The aim of this work is to study the major consequences of these fractures and their therapeutic implications.

Material and Methods: This was a retrospective study from 2013 to 2023 and included 31 cases. It concerned all children and adolescents with major complications and sequelae related to the fracture and/or resulting from their care.

Results: During this study period, we identified 800 cases of trauma in children. The frequency of epiphyseal detachments was 9.5% with a predominance of sex male (84%). The 11-16 age group was the most represented (67.75%). In terms of lesions, the distal end of the femur was the most affected segment (78%) and Salter-Harris type II lesions were most often found (71%). Twenty-one patients presented major complications represented by cutaneous, infectious, vascular lesions and secondary displacements. Fifteen patients developed sequelae such as vicious callus, nonunion, osteonecrosis, chronic infection and stiffness.

Conclusion: Epiphyseal separation fractures give rise to various complications and sequelae that can jeopardize the normal growth of the child. A fast and optimal medical care is therefore necessary to avoid them.

Keywords: Epiphyseal Separation; Complications; Sequelae

Introduction

Epiphyseal Separation Fractures (ESF) is a specific type of pediatric trauma and accounts for 15-30% of childhood injuries [1]. Complications and sequelae are a reality in developing countries, especially given that, in our African sociocultural context, the population tends to favor traditional treatments. The complications are significant and their severity is due to the possibility of sequelae such as leg length discrepancy, axial deviations and joint stiffness. Their management is delicate, sometimes requiring repeated surgeries. The objective of our study was to describe the complications of ESF in the lower limb and to stratify the sequelae and their functional impact.

Patient and Methods

Patients

We conducted a 10-year retrospective single-center study from April 2013 to July 2023 at the General Idrissa Pouye Hospital. During this study period, we recorded 800 cases of trauma in children. The frequency of epiphyseal separations was 9.5% or 76 patients. The majority of fractures were located in the pelvic limb (53 cases). Complications and sequelae were found in 31 patients. Incomplete records, patients who consulted late at an age of complete bone maturation and those with minor complications and sequelae were excluded. Thirty-one patients met our inclusion criteria: major complications and sequelae related to the fracture and/or resulting from their treatment (in the pelvic limb) with growth cartilage still open.

Methods

Data was collected using emergency and operating room records. Statistical analysis and data tables were transcribed using Sphinx and Microsoft Excel software. The data analysis took into account: age, gender, type of accident, location of injuries, type of fracture according to the Salter and Harris classification, associated injuries, initial fracture management (orthopedic or surgical treatment), complications and documented sequelae. The patient evaluation criteria were clinical and radiographic and took into account consolidation, joint mobility, limb alignment and axis and the existence of epiphysiodesis bridges with a minimum follow-up of 8 months. The final result was evaluated and took into account joint mobility, axial deviation, ILMI and scarring disorders.

Results

The average age of patients who experienced complications or sequelae was 12.81 years, ranging from 2 to 19 years. The 11-16 age group was the most represented (67.75%). Males predominated in our series, accounting for 84% of the study population. Road traffic accidents and sports accidents were the most common causes (83%). These complications and/or sequelae mainly affected the knee, particularly the distal femur (78%), while they were less common in the ankle and hip (22%). Salter Harris type 2 epiphyseal separation fractures were the most likely to cause complications and/or sequelae (71%), followed by type 1 fractures. No Salter-Harris type 5 injuries were observed. Six patients had associated injuries, including two cases of multiple trauma, three ipsilateral injuries to the epiphyseal separation fracture (one ipsilateral tibiotalar dislocation, one equivalent bimalleolar fracture, one type 5 Duparc calcaneal fracture) and one contralateral injury (mid-diaphyseal fracture of the femur). Initial management of patients was most often surgical (osteosynthesis by pinning) in 85% of cases and orthopedic (reduction by external manipulation + cast) in 15% of cases.

Twenty-one patients presented with skin, vascular, infectious or mechanical complications. These complications resulted from the fracture and/or its treatment. The following were noted:

- 1 case of open fracture with epiphyseal separation of the distal femur: Irrigation - debridment + osteosynthesis by X-shaped pinning
- Vascular wound due to partial tear of the popliteal vein following a Salter Harris 1 distal femoral epiphyseal fracture (Fig. 1): Osteosynthesis + vascular repair by saphenous vein graft
- 1 complication under plaster cast, namely bedsores occurring on day 28
- 3 secondary displacements, including 2 following initial orthopedic treatment and 1 following X-shaped pin osteosynthesis (Fig. 2)
- 13 cases of severe knee stiffness with presence of osteosynthesis material. These occurred on average 2 months after surgery. First-line physical therapy resulted in an average gain of 22.5 degrees in flexion range of motion
- 3 cases of surgical site infections, including 2 cases of early suppuration on osteosynthesis material and 1 case of septic arthritis of the knee
- Mixed gangrene leading to transfemoral amputation (Fig. 3)

Fifteen patients developed sequelae. These included:

- 3 cases of malunion secondary to traditional treatment, including 2 cases of valgus and varus malunion in the knee and 1 case of valgus malunion in the ankle. Treatment was performed using DCS screws and plates on the knees (Fig. 4) and partial epiphysiodesis with staples at the ankle (Fig. 5)
- Two cases of axial deviation due to partial epiphysiodesis: 6-degree knee valgus and varus deviation of the ankle
- 7 cases of persistent knee stiffness on osteosynthesis hardware. The average range of motion was 33.75 degrees. Removal of the hardware combined with mobilization under general anesthesia resulted in an average gain of 70 degrees of range of motion (4 cases). Arthrolysis was performed in 3 patients, resulting in a 45-degree increase in range of motion
- 02 cases of medial malleolus pseudarthrosis after type 3 and type 4 Salter-Harris epiphyseal separation fractures of the ankle
- 02 cases of osteonecrosis of the femoral head following type 1 epiphyseal separation fracture of the proximal end of the femur (Fig. 6)
- 01 case of chronic osteoarthritis of the knee

The results were evaluated with an average follow-up period of 50 months. Regarding knee joint range of motion, five patients regained full range of motion (Fig. 7). Mobility was good (greater than 100 degrees) in 9 patients, average (90 degrees) in 3

patients and severe (less than 90 degrees) in 3 patients (Fig. 8). Lower Limb Length Discrepancy (LLLD) was observed in two patients. This was due to osteonecrosis of the femoral head following epiphyseal separation fracture (well compensated by heel lifts) and epiphysiodesis of the distal ankle. Axial deviations were found in four patients: one 17-degree knee valgus, one 7-degree knee varus, one well-tolerated 3-degree knee valgus and one equinus varus ankle (Fig. 9). One patient had a chronic productive fistula in the distal femur (Fig. 10). Residual pain was found in only three patients.

Figure 1: Salter-Harris type 1 epiphyseal separation fracture of the distal femur with major displacement and impact on popliteal blood flow.

2A 2B

Figure 2: a: Secondary displacement type 2 epiphyseal separation fracture of the distal femur (left) after orthopedic treatment; b: Secondary displacement after surgical treatment with inappropriate pin size (right).

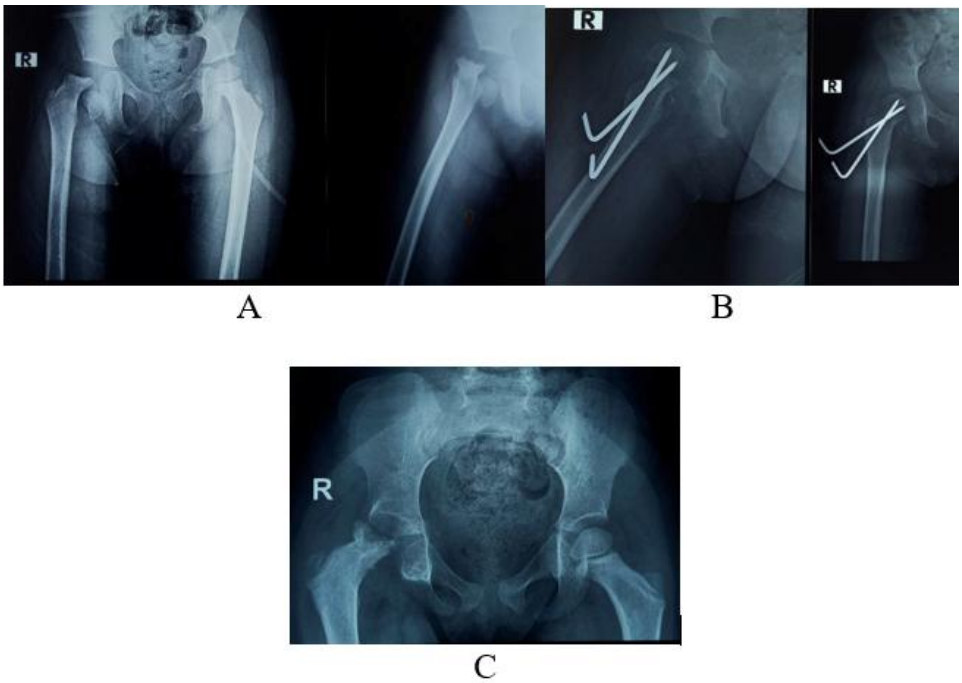
Figure 3: Open epiphyseal separation fracture with hydro-aerial images.

A B

Figure 4: a: Malunion of the distal femur in varus; b: Treatment with Dynamic Condylar Screws (DCS).

A B

Figure 5: a: Malunion of the distal ankle in valgus; b: Osteotomy correction + partial epiphysiodesis.



A B C

Figure 6: a: Epiphyseal separation fracture of the proximal end of the right femur; b: Reduction + fixation by pinning; c: Osteonecrosis of the femoral head at M6.

Figure 7: Full knee mobility after AMOS and knee mobilization.

Figure 8: Severe knee stiffness after X-shaped pinning.

Figure 9: Ankle varus due to distal tibial epiphysiodesis.

Figure 10: Chronic sequestrating osteomyelitis with knee stiffness (history of knee osteosynthesis).

Discussion

The growth plates in the pelvic limb play an important role in the synchronous growth of bone segments (40% in the distal tibia and 80% in the distal femur). Lesions that are considered benign can sometimes cause growth arrest due to the formation of an epiphysiodesis bridge, with major clinical repercussions in children. This can result in axial deviations and/or unequal leg lengths. The incidence of growth plate injuries during this study period was relatively low (9.5%) but not without complications. This low rate was also found by Sagara (4.5%) in Bamako [2]. The average age of patients with ESF was 12.81 years, similar to the series by Mieret, et al., and Dendane [3,4]. Road traffic accidents were the most common cause in our series, all types combined, with a percentage of 48%. The high velocity of the trauma caused by these road traffic accidents may explain the occurrence of certain complications, particularly open fractures and their future sequelae. Indeed, the role of trauma intensity in the genesis of epiphysiodesis is a frequently reported concept [5,6].

The initial management of epiphyseal separations varies in the literature. In some authors treatment was mainly orthopedic (reduction + immobilization) [7-10]. However, Ba, Razamanahefa, and Diallo, et al., observed a predominance of surgical treatment (reduction + osteosynthesis) [11-13]. Our study falls into this second category. Eighty-five percent (85%) of patients in our series received surgical treatment. Our complications and sequelae were diverse and varied, resulting from the fracture but also from the initial therapeutic management. Skin lesions are relatively rare in the literature [7,8,11]. Toure IA, in his series of 84 cases found a rate of 6% skin opening (05 cases), Ba S, observed 04 cases of skin opening in his series of 45 cases [7,8]. In our series, we observed only 2 cases of skin opening. Our early transfers were explained by irreductibility due to probable periosteal interposition (orthopedically treated patients). Mechanical failure due to inappropriate pin size was the cause for those treated surgically.

Knee stiffness on osteosynthesis hardware was common (69%) and could only be corrected after removal of the hardware despite early physical therapy. However, in cases of associated ipsilateral injury, this stiffness persisted despite removal and even after arthrolysis. Several authors have reported this occurrence of joint stiffness in their studies [2,8,10,11,15]. The axial deviations noted were the result of incomplete epiphysiodesis and/or malunion due to insufficient reduction. Several authors have found cases of epiphysiodesis in their series [2,4,7,11,15].

They are not unique to Salter-Harris type 5 epiphyseal separations. Toupin and Lechevallier, found that axial deviations after SH II always follow high-energy fractures with significant displacement [16]. Epiphysiodesis can also occur after infection or complicate inappropriate treatment (difficult pinning, screws passing through the growth plate) [17,18].

Conclusion

Epiphyseal separation fractures are a specific anatomical and clinical condition in children and adolescents. The resulting complications and sequelae are serious, as they can compromise the child's normal growth. In all cases, it is essential to monitor these children regularly until skeletal maturity to detect any misalignment or inequality in length in a timely manner.

Conflict of Interests

The authors declare that there is no conflict of interest related to this study.

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