

Management of Femoral Neck Fractures in Children: Experience of a Short Series in a Developing Country

Jean Baptiste Yaokreh, Thierry-Herve Odehouri-Koudou, Gaudens Atafy Dieth, Samba Tembely, Yapo Guy-Serge Kouame, Bertin Dibi Kouame, Ossenou Ouattara

Department of Mother and Children, University of Félix Houphouët Boigny Pediatric Surgery Unit, CHU Yopougon, Abidjan Côte d'Ivoire, Abidjan

Abstract

Background: Fractures of the femoral neck are rare injuries in children but can have many devastating complications. Their treatment is not standardized, but the objectives are early anatomic reduction to minimize the risk for complications. The aim of this study was to assess outcomes of a short series of femoral neck fractures managed in a resource-limited setting. **Materials and Methods:** The medical charts of 11 children who were managed in our institution for femoral neck fractures between January 2000 and December 2015 were assessed retrospectively. There were two cases ($n = 2$) of Delbet type I, 5 ($n = 5$) type II, and 4 ($n = 4$) type III fractures. Patients were treated either surgically by open reduction and internal fixation ($n = 4$) or conservatively by traction followed by spica cast ($n = 7$). Outcomes were assessed using Ratliff system. **Results:** Femoral neck fracture incidence was one case per year. Of the 11 patients, there were 7 boys and 4 girls, with a mean age 9.4 ± 3.28 years. At the mean follow-up of 3.64 ± 1.97 years (range, 2–8.8 years), outcome was fair to good in 8 (72.7%) and poor in 3 (27.3%) cases. Average union time was 13.5 ± 1.77 weeks. Complication rate was 72.7%. Avascular necrosis occurred in three cases (27.3%). Six patients (54.5%) developed coxa vara, with a mean neck-shaft angle of $102.16^\circ \pm 12.07^\circ$ (range, 90° – 118°). Five patients (45.5%) had leg length discrepancy with a mean 18 mm (range, 7–35 mm). **Discussion:** Local conditions negatively influenced the management of femoral neck fractures. Conservative treatment led to many complications which increase the cost of management.

Keywords: Avascular necrosis, children, conservative treatment, coxa vara, developing country, femoral neck fracture

INTRODUCTION

Femoral neck fractures are rare injuries and account for less than 1% of all pediatric fractures.^[1-7] These fractures result mainly from high energy trauma as in motor vehicle accident or fall from height.^[6] Their treatment by closed or open reduction and internal fixation as soon as possible within 24 h is recommended by most authors to decrease the risk of avascular necrosis (AVN).^[2,6-8] In the developing world, delayed treatment is more common.^[7] We hypothesized that the working conditions affect the prognosis. The aim of this study was to assess the outcomes of a short series managed in a developing country.

MATERIALS AND METHODS

We retrospectively reviewed the data from 16 children (10 boys and 6 girls) under 16 years of age who were managed for femoral neck fractures at the pediatric surgery unit from January 2000 to December 2015. Patients with open fractures

and pathological fractures and patients who were lost to latest follow-up were excluded from this study. Eleven ($n = 11$) patients were enrolled. The mechanisms of injury were pedestrian-automobile collision ($n = 4$; 36.4%) and a fall from height ($n = 7$; 63.6%). According to Delbet's system,^[9] there were 2 ($n = 2$) type 1, 5 ($n = 5$) type 2, and 4 ($n = 4$) type 3 fractures. We did not have any type 4. Six patients ($n = 6$; 54.5%) had fractured their left hip, and the other 5 ($n = 5$; 45.5%) had sustained an injury on the right side. There were no bilateral femoral neck fractures. Two patients were considered polytraumatized. One amplifier was dedicated for three departments (pediatric surgery, neurosurgery, and traumatology) in our operating room. Four patients (Group A)

Address for correspondence: Pr. Jean Baptiste Yaokreh, Department of General Pediatric Surgery, CHU Yopougon, University of Félix Houphouët Boigny, Abidjan Cote d'Ivoire, 21 BP 2954, Abidjan. E-mail: enanblaodette@yahoo.fr

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underwent surgery with image intensifier under general anesthesia. Of them, one had closed reduction and internal fixation with two screws [Figure 1] and the other three had open reduction through an anterolateral approach and internal fixation with two screws ($n = 1$) or two k-wires ($n = 2$). Wound was closed under suction drainage which was removed 3 days later. Patients with k-wires fixation underwent spica cast. The remaining seven patients (Group B) were managed conservatively. They were kept on skin traction, and the traction force was approximately 1/7 of the body weight. When signs of consolidation were confirmed by the absence of tenderness at the site, a hip spica cast was applied without anesthesia. All the patients with spica cast were watched for 24 h in the hospital for any discomfort; then, they were discharged after care of spica. There were followed up at 6, 10, and 14 weeks in the outpatient unit with radiographs at each review to assess the progress of fracture healing. Taking into consideration the union at fracture, a spica cast was removed, and nonweight bearing with crutches or wheelchair for 6 weeks was allowed. Patients were then reviewed and partial weight bearing with crutches was allowed for another 6 weeks. All the patients were contacted by phone, and their parents gave informed consent before being included in the study. In the latest follow-up, clinical examination was performed to evaluate gait abnormalities, leg length discrepancy (LLD), and rotational malalignment. Any functional limitation was also documented. Outcomes of the hips were assessed using Ratliff system [Table 1].^[10]

RESULTS

Femoral neck fractures' incidence in this study was one case per year. Of the 11 patients who had follow-up evaluation, there are 7 boys (63.6%) and 4 girls (36.4%), with a mean age 9.4 ± 3.28 years (range, 3.5–14 years) at the time of injury.

Clinical and outcome details of patients were summarized in Table 2.

The average time to surgery and mean duration to hospital stay in Group A was 19.5 ± 9.46 days (range, 8–31 days) and 21 ± 7.25 days (range, 14–37 days), respectively. Mean duration for traction in Group B was 28.3 ± 5.12 days (range, 21–37 days). Fractures healed in all cases. Average union time was 13.5 ± 1.77 weeks (range, 11–16 weeks).

	Good	Fair	Poor
Pain	None or ignores	Occasional	Disabling
Movement	Full or terminal restriction	>50%	<50%
Activity	Normal or avoids games	Normal or avoids games	Restricted
Radiographic indications	Normal or some deformity of the femoral neck	Severe deformity of the femoral neck Mild AVN	Severe AVN Degenerative arthritis Arthrodesis

AVN: Avascular necrosis

Outcome was assessed at a mean of 3.64 ± 1.97 years' follow-up (range, 2–8.8 years), and results were good in 4 cases (36.4%), fair in 4 (36.4%), and poor in 3 (27.2%). In Group A, outcome was good in 2 ($n = 2$) cases, fair in 1 ($n = 1$) case, and poor in 1 ($n = 1$) case. In Group B, outcome was good in 2 ($n = 2$) cases, fair in 3 ($n = 3$), and poor in 2 ($n = 2$) cases.

Complications developed in eight patients (72.7%), four of whom had more than one. AVN occurred in three patients (27.2%) (Group A: $n = 1$, Group B: $n = 2$). Six patients (54.5%) developed coxa vara (neck shaft angle $<120^\circ$), with a mean angle of $102.16^\circ \pm 12.07^\circ$ (range, $90\text{--}118^\circ$) [Figure 2]. Five patients presented LLD with a mean length 18 ± 10.65 mm (range, 7–35 mm). None of the patients treated surgically developed coxa vara. Two patients with coxa vara were treated secondarily by subtrochanteric valgus osteotomy. There was no instance of nonunion and infection.

DISCUSSION

Femoral neck fractures are rare injuries in childhood and are associated with a high rate of complications.^[5,11–13] These fractures result from a high energy trauma during traffic accident and falls from height.^[6,12] The most common type of femoral neck fracture in our series was Delbet type 2 followed by type 3 fractures. Similar fracture type was reported in previous studies.^[3,6,7,11,12,14] The low incidence in this report confirms the rarity of this condition,^[13,15] which was attributed to the thick and strong periosteum cover and to the tough, strong bone of children.^[6]

The objective of treatment was to achieve accurate anatomical reduction with stable internal fixation to avoid fracture healing complications such as AVN, but the best treatment strategy remains always a matter of debate. Treatment options were varied and included cast immobilization only, closed reduction with cast immobilization, closed reduction and internal fixation, and open reduction and internal fixation.^[1] Nowadays, there is consensus on the early treatment of femoral neck fractures with internal fixation within 24 h.^[1,2,4,7,8] Closed reduction and internal fixation under fluoroscopy are the most common method of treatment.^[8,16] The role of early hip decompression which was advocated by Bukva *et al.*^[1] to decrease complication rate has not been clearly established.^[5,17]

In developing country, delayed management of pediatric fractures is common because of ignorance, illiteracy, tendency to go to bone setters, financial constraints, and late referral by hospital and local conditions such as inadequate equipment.^[7,17,18] In case of early admission in our context, delay to surgical intervention was explained by the fact that operating room entrance fee, implants, and pharmaceutical product were bought by the parents who have no health insurance in the majority of cases. Besides, some parents refused surgical intervention. For the reasons above, we frequently applied conservative treatment. Our approach is debatable; hence, our result needs to be interpreted with caution. Good outcome after treatment of femoral neck

Table 2: Clinical details and outcome of patients

Case	Sex/age (year)	Mechanism	Delbet type/side	Treatment	Hospital stay (day)	Follow-up (year)	Results	Complications
1	Female/9	FFH	2/left	CRIF, 2 screws	18	8.8	Good	HO, coxa breva
2	Male/14	PAC	3/left	ORIF, 2 screws	31	2.5	Poor	AVN LLD 35 mm
3	Male/9	FFH	3/right	ORIF, 2k-wires	21	2	Good	-
4	Male/9	FFH	3/right	ORIF, 3 k-wires	14	3.2	Fair	-
5	Male/13	PAC	2/right	TSC	29	4	Fair	Coxa vara 90° LLD 26 mm
6	Female/5	PAC	3/left	TSC	24	2.6	Fair	Coxa vara 115°
7	Male/13	FFH	2/left	TSC	37	4.5	Poor	AVN, LLD 10 mm
8	Female/10	PAC	1/right	TSC	29	3.1	Poor	AVN, LLD 15 mm Coxa vara 90°
9	Female/11	FFH	1/left	TSC	27	2.2	Fair	Coxa vara 102°
10	Male/7	FFH	2/right	TSC	31	2.1	Good	LLD 7mm
11	Male/3.7	FFH	2/left	TSC	21	4.7	Good	Coxa vara 118°

PAC: Pedestrian-automobile collision, FFH: Fall from height, CRIF: Closed reduction internal fixation, ORIF: Open reduction internal fixation, TSC: Traction followed spica cast, HO: Heterotopic ossification, Coxa breva: Short neck, LLD: Leg length discrepancy

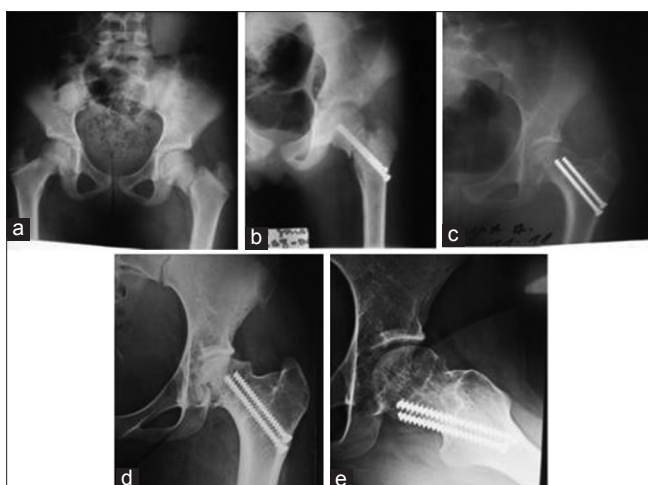


Figure 1: (a) A 9-year-old girl sustained a type II fracture after a sports injury. (b) Immediate postoperative radiographs after closed reduction and internal fixation. (c) Two years after surgery, radiographs show complete union and short neck. (d and e) Eight-year-follow up radiographs shows heterotopic ossification with the presence of screws

fractures in children is diversely related in the literature: Inan 72%,^[3] Bali 75%,^[6] Togrul 67.2%,^[12] and Varshney 85.7%.^[17]

Results are very unpredictable in spite of very judicious handling in very experienced hands. No one claims to be experienced enough to predict the outcome of this fracture which was characterized by a high incidence of complication with an occurrence of 6% to 70%.^[1,3,12,17]

The most frequent and disabling complication are AVN.^[5] The risk of AVN depends on several factors including age, degree of initial displacement, type of fracture, time of surgery, and method of fixation.^[3,5,7,11]

For Bali *et al.*,^[6] the most important factor is likely the severity of vascular compromise sustained at the time of initial trauma.

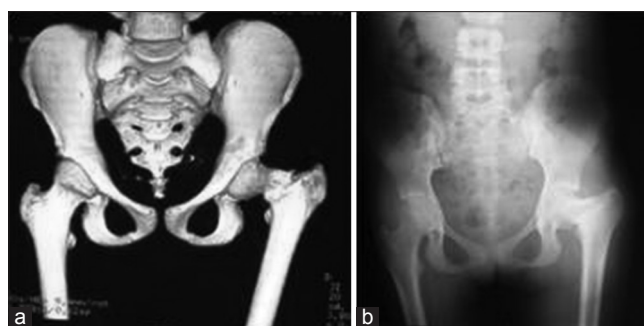


Figure 2: (a) A 10-year-old girl sustained a Type III fracture (computed tomography scan) after a sports injury. (b) Two years after conservative treatment, radiograph shows 90° coxa vara malunion

Moon *et al.* in a meta-analysis of 360 cases concluded that the fracture type and age are the two statistically significant predictors.^[16]

In a recent study, Spence *et al.* noted that the location of the fracture based on the Delbet classification was the strong predictor of AVN.^[4]

In another series of Azam *et al.*,^[18] AVN developed despite excellent reduction in five patients, of whom two were operated in the 2nd week and three in the 3rd week. They attributed delayed fixation as a contributing factor after considering other variables. Delayed fixation favored bony callus formation and required more soft-tissue dissection, which adversely affects the outcome.

Inversely, Stone *et al.*^[5] and Ju *et al.*^[7] in their series of delayed treatment concluded that open reduction and internal fixation can significantly reduce the incidence of AVN.

Previous reports have suggested that AVN become evident within 12 months of injury.^[4,10] AVN should be screened with repeat clinical examination and radiographs. We emphasized that follow-up was difficult in our context such as the case 1 who was lost during 6 years.

The most common complication in this series was coxa vara (54%). Its prevalence has been reported to be approximately 20%–30% by previously published series.^[7,18,19] Coxa vara was related to the quality of the fracture reduction.^[7] It may develop secondary to AVN, malunion and premature physal closure, or a combination of all above.^[12] All the cases of coxa vara in this series were seen in the group treated conservatively. Similar findings are noted in the series of Togrul *et al.*^[12] Severe coxa vara such as in this study shortens the limb and needs second intervention which increases the cost of management.

An heterotopic ossification was seen in this study. It was certainly due to the femoroacetabular impingement.

We did not have the other complications such as infection, non-union, pressure sores, or nerve palsies which were related in previous studies.^[3,12,19]

We are aware that there are several limitations to this current study such as the retrospective nature with various methods of treatment and the small sample size.

CONCLUSION

Femoral neck fractures are rare, and their treatment was a high challenge in developing world or a developing country. Conservative treatment due to local economic and social conditions increases the risk of coxa vara.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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