



Simultaneous Bilateral Femur Fractures in Children: A Case Series from a Pediatric Level I Trauma Center and Review of the Literature

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Introduction

Bilateral femur fractures are rare injuries with an unknown incidence. In the pediatric population, these fractures occur in a bimodal distribution with most occurring at 2-3 years of age as well as 17-18 years of age.¹ Most femur fractures in children are typically caused by high energy trauma such as car accidents or falls, while low energy fractures are rare and usually due to genetic, metabolic, or endocrine disorders.² Complications following femur fractures have been well described before and include wound infection, re-fracture, nonunion/malunion, avascular necrosis, growth arrest, and limb-length discrepancy.³⁻⁶

The current literature on pediatric bilateral femur fractures is limited to sparse case reports. The purpose of this study was to review our institutional experience with a case series of simultaneous bilateral femur fractures and highlight the presentation, treatment, and outcomes of these rare injuries as well as perform a comparison to similar unilateral femur fractures in order to identify any clinically relevant differences that may guide future management. We hypothesized that simultaneous bilateral femur fractures would have initially greater

severity at time of presentation due to higher energy trauma and also have worse outcomes and/or a higher incidence of complications.

Methods

A retrospective review of a prospectively collected institutional femur fracture database was conducted for patients aged 0-18 years who presented with bilateral femur fractures sustained between 2007 and 2017. All patients had a minimum of 1 year follow up. Data was collected which included demographics, mechanism of injury, fracture location, pattern, treatment modality, length of stay, physical therapy usage, return to activity, and short/long-term complications. Further analysis was conducted to compare unilateral and bilateral femur fractures in a 2:1 fashion. Unilateral femur fractures that met case matched criteria (identical age, gender, and fracture location) were identified from the same femur fracture database.

Results

We identified eight children with simultaneous bilateral femur fractures (Figure 1). The mean age at the time of injury was 11 ± 2.7

Age	Gender	Mortality	Mechanism	Left Fracture	Left Fracture Treatment	Right Fracture	Right Fracture Treatment	Associated Injuries	Length of Stay	Complications
12	Male	N	Peds struck vs MVA	Oblique Midshaft	Rigid IMN	Physal SHQ Distal	CRPP	TBI	27	Acute Psychosis
8	Male	N	Peds struck vs MVA	Oblique Midshaft	Flexible IMN	Physal SHQ Distal	CRPP	TBI, Facial Fracture, Hearing Loss	11	Central bar involving 20% of R distal physis
15	Male	N	Ground level Fall	Transverse Distal 1/3	CRPP	Delbet IV Proximal	ORIF-Plate/Screw	None	6	None
9	Male	N	Jet Ski Injury	Transverse Midshaft	Flexible IMN	Transverse Midshaft	Flexible IMN	Liver Laceration	7	None
11	Female	N	MVA	Transverse Proximal	Rigid IMN	Comminuted Midshaft	Rigid IMN	Mesenteric vein laceration, Renal artery avulsion, Multiple spine fractures, Tibia and ulnar shaft fracture, Pulmonary contusion	19	None
7	Male	N	Peds struck vs MVA	Comminuted Midshaft	Flexible IMN	Transverse Proximal 1/3	Flexible IMN	None	4	R Genu Valgum
11	Male	N	Peds struck vs MVA	Transverse Midshaft	Flexible IMN	Transverse Midshaft	Flexible IMN	TBI, Splenic laceration, Renal contusion, Cervical fracture, Rib fracture, Concussion	12	None
13	Male	N	Peds struck vs MVA	Transverse Midshaft	Rigid IMN	Physal SHQ Distal	ORIF- Screws	TBI, Tongue laceration, Concussion, Hemorrhagic shock, Pneumothorax	10	None

Figure 1. Case Series of Bilateral Femur Fractures.

years (range: 7-15 years). Seven of eight patients were male. The mechanism of injury was high energy trauma in seven of eight patients, including five instances of pedestrians struck by a motor vehicle. One patient sustained bilateral femur fractures after a ground level fall in the setting of Duchenne Muscular Dystrophy and osteoporosis. Six patients had at least one significant associated injury, including four patients with traumatic brain injury (TBI), four patients with intra-abdominal injuries, and two patients with spinal fractures.

All injuries were closed. Twelve out of sixteen fractures involved the femoral shaft, three involved the distal femur physis, and one was intertrochanteric. All patients underwent operative fixation bilaterally. Method of fracture fixation varied according to patient age as well as fracture location and pattern. Treatment options included rigid/flexible Intramedullary Nail (IMN), Plate/Screw constructs, and Closed Reduction with Percutaneous Pinning (CRPP). Average length of stay was 12 days (range 4-27 days). Four patients required admission to inpatient rehab facility.

There were no mortalities in the perioperative period or at long term follow up. All fractures went on to union. There were no instances of infection or re-fracture. One patient experienced unilateral genu valgum deformity treated successfully with medial hemi-epiphysiodesis and plating. Another patient experienced a unilateral bony bar of approximately 20% of the physis which did not result in angular deformity or limb length discrepancy. There was one case of acute psychosis. Patients returned to full activity at an average of 5.8 months respectively (range 3-9 months).

The bilateral femur fracture case involving a patient with Duchenne's muscular dystrophy was excluded from the following comparisons. Subsequent analysis was conducted comparing seven bilateral femur fracture cases to sixteen unilateral femur fracture cases that were matched based on age, gender, and fracture location. There were no statistically significant differences found between the bilateral and unilateral groups when comparing age and gender. The number of associated injuries at time of presentation was different, with the bilateral fractures cohort having a significantly greater number of associated injuries ($p < 0.05$) (Table 1). Two patients required blood transfusion in the bilateral cohort, one of whom had sustained multiple abdominal injuries. No patients required blood transfusion in the unilateral cohort. Average length of stay in the bilateral group was 12.9 days compared to 4.5 days in the unilateral group, which was found to be statistically significant ($p < 0.05$). The mean number of complications in the unilateral patient cohort was 0.5, compared to 0.7 in the bilateral cohort. The difference in

complications between the two groups was not found to be significant ($p > 0.05$). Average number of months required to return to activity was also not significantly different between the bilateral and unilateral groups ($p > 0.05$).

Discussion

Patients with bilateral femur fractures had a statistically significant greater number of associated injuries at time of presentation. These associated injuries included traumatic brain injuries, multiple fractures, and cardiothoracic/abdominal injuries. This is most likely attributed to the greater trauma/force sustained in order to produce bilateral fractures in comparison to the force needed to produce a unilateral fracture. High impact pedestrian-motor vehicle accidents were the cause of injury for six out of eight patients in our series.

Few cases of bilateral femur fractures have been reported in the literature. Most are related to high speed trauma. Scott *et al* reported bilateral proximal femur fractures in a four year old following an ATV injury.⁷ The patient underwent bilateral open reduction and internal fixation which was complicated by left hip avascular necrosis. Smith reported a case of a four-year old who presented with bilateral femoral shaft fractures after a high speed MVA while restrained with a standard factory fitted lap belt instead of a car seat.⁸ The patient was treated with flexible intramedullary nailing and had an uneventful recovery.⁸ Dhar reported a case of a nine-year old girl who presented with bilateral femoral neck fractures following a motor vehicle accident. The patient was managed with early open reduction and internal fixation with a successful outcome.⁹ These reports are consistent with the results of our series.

There are numerous limitations to this study. Despite being the largest series of patients with bilateral pediatric femur fractures, the sample size remains relatively small and is retrospective in nature. As a result, comparisons to the unilateral group would benefit from a larger cohort. Longer-term follow-up is also necessary to accurately assess complications.

Conclusion

This report of eight patients demonstrates that bilateral femur fractures in the pediatric population are commonly a result of high energy trauma and highlights the importance of careful preoperative evaluation. Although bilateral femur fractures may have worse initial presentation, greater length of stay, and more complicated multi-specialty management, once appropriately treated, their short-term outcomes and

Table 1. Clinical Characteristics of Unilateral vs. Bilateral Femur Fractures

	Unilateral Cohort	Bilateral Cohort
Mean Number of Associated Injuries	0.4	2.9
Mean Length of Stay	4.5 days	12.9 days
Mean Number of Complications	0.5	0.7

complications are similar to their unilateral counterparts. We believe that with coordinated pediatric trauma care, successful management is possible as with the majority of patients in this series.

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