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Pediatric Femur Fractures

Mary C. Kamienski

Trauma is the leading cause of death and disability in children. Orthopaedic trauma has led to more than 84,000 hospital admissions annually and costs nearly a billion dollars. Femoral diaphyseal fractures account for nearly 2% of all bony injuries in children and are the most common orthopaedic injury requiring hospitalization. These injuries occur at an annual rate of 19 per 100,000, with an associated cost of millions of dollars. Emergency department (ED) visits for musculoskeletal injuries account for 10%–15% of the 100 million annual visits to U.S. pediatric EDs. Treatment of femur fractures in children vary on the basis of the mechanism of injury, the patient's age, weight, the fracture pattern, family circumstances, and cost. Treatment ranges from noninvasive to invasive and includes traction, casting, internal fixation, and external fixation. Complications can include infection, delayed or malunion, leg length discrepancy, ossification, and refracture. Attention to pain control and anxiety management becomes a major focus for nursing. Pediatric femur fracture can have a devastating impact on the child and the family and requires monitoring for 12–24 months. This injury is significant and can be a life-changing event for the child and the entire family. A case study is used as an example of the extent of the problem with pediatric patients and highlights the long-term effect of this injury.

Femur Fracture

Case presentation

A.Y. was 11 years old when he was involved in a dirt bike collision. He sustained a direct hit to his left mid-shaft femur by the oncoming bike. He did not sustain any other injuries. It is estimated that both individuals were traveling approximately 30 miles per hour. He was transferred to a Level 2 trauma center because there was no pediatric unit where he was initially transported. The other victim was his brother, and there was concern that the brother had sustained a cervical spine injury, which was ultimately determined to be negative. It was important that both boys be in the same facility in order for the parents to remain with them. He was complaining of pain in his buttocks because of the hare traction splint that was used to immobilize his leg. A.Y. was medicated with intravenous morphine prior to the transfer. The morphine was effective, and the transfer occurred without incident. Upon arrival to the trauma center, additional radiographs were obtained and he was evaluated by the trauma team. No other injuries were found. A.Y. was sent directly to the operating area and the fracture was manually reduced under conscious sedation anesthesia. External fixation was applied, and he was admitted to the pediatric inpatient unit. In the morning, a pediatric orthopedist was called to consult. After reviewing the radiographs, he applied an additional fixator bar based on the nonalignment of the fracture and concern that nonunion would occur. He was then discharged home. During the next 3 months, A.Y. was in a wheelchair and progressed to using a walker. During that time, his mother provided daily pin care. He remained infection free. However, union did not occur and it was determined he would need a bone graft. A graft was obtained from his iliac crest and inserted 4 months after the initial injury. As time passed, A.Y. became difficult and angry because his activities were restricted. When he was fitted for a body brace, he became very distraught and therapy sessions were initiated. A.Y. was attending fifth grade at the time of the accident. He moved into middle school in the fall and remained in a wheelchair when in school. He refused to ride on the handicap bus and fortunately his family was able to transport him to and from school. Approximately 1 year after the incident, A.Y. was able to ambulate independently and began a short period of physical therapy. A.Y. is now 28 years old. He has permanent leg length discrepancy and his left knee is enlarged (see Figure 1). He admits to occasional pain in his knee and walks with a slight but noticeable limp. He denies any pain in his hip or back to date, which might be expected because of asymmetry of his left leg and his height (see Figure 1; also see Figures 2–4).

Incidence and Prevalence

Unintentional injuries are the leading cause of death and disability in children. Orthopaedic trauma has led

Mary C. Kamienski, PhD, APRN, FAEN, FAAN, CEN, Professor, and Specialty Director FNP in Emergency Care, Rutgers Biomedical and Health Sciences, School of Nursing, Newark, NJ.

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Correspondence: Mary C. Kamienski, PhD, APRN, FAEN, FAAN, CEN, Rutgers Biomedical and Health Sciences, School of Nursing, 65 Bergen St, Newark, NJ 07107 (Drmaryrn1@gmail.com; kamienma@sn.rutgers.edu).

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FIGURE 1. A.Y. 28 years of age. Note the enlarged knee. The color version of this figure is available in the online issue at https://journals.lww.com/orthopaedicnursing.

FIGURE 2. AY 28 years of age. Note leg length discrepancy. The color version of this figure is available in the online issue at https://journals.lww.com/orthopaedicnursing.

to more than 84,000 hospital admissions annually and costs nearly a billion dollars (Sarraff & Haines, 2010). The National Center for Health Statistics reports that mortality among teenagers aged 12–19 years is an average of 16,375 teenagers from 1999 to 2006, with accidents as the leading cause of death in this age group (Minino, 2010). Pediatric femur fractures account for 2% of traumatic injuries among children aged 1–4 years and teens up to 14 years of age. Males are more commonly affected at a rate of 2.6.1 (Edgington, Shirley, & Sink, 2018; Karadsheh & Taylor, 2019).

Emergency department (ED) visits for musculoskeletal injuries accounted for 10%–15% of the 10 million annual visits to U.S. pediatric EDs (Sarraff & Haines, 2010). Fractures may vary with age, gender, and maturation; however, the peak occurs in early puberty. In a study of 382 subjects (2–14 years of age), males were at a higher risk for injury after low-energy trauma (Valerio et al., 2010).

Femur fractures are the most common major pediatric orthopaedic injury and occur at an annual rate of 19 per 100,000 (American Academy of Orthopaedic Surgeons, 2015). Management of these fractures is guided by many factors, which include associated injuries in patients with multiple trauma, age, patient weight, fracture pattern, family circumstances, and cost. A young child who has sustained a femoral shaft fracture should always be evaluated for child abuse or neglect. High-energy trauma injuries are generally treated surgically, whereas nonsurgical management is preferred in younger children (Edgington et al., 2018). The mechanism of injury will usually determine the severity of the injury. The age of the child and the type of fracture sustained are other important factors that affect the severity of the injury. Femoral fractures are the most common reason children are hospitalized for orthopaedic injuries. A child who sustains multiple trauma will need hospitalization in a trauma facility, whereas the child with a single injury may be cared for in a local community hospital with a pediatric unit. Conditions such as osteopenia and benign or malignant bone tumors should be considered.

Femur fracture in a child before walking age is suspicious for nonaccidental trauma. Treatment options are

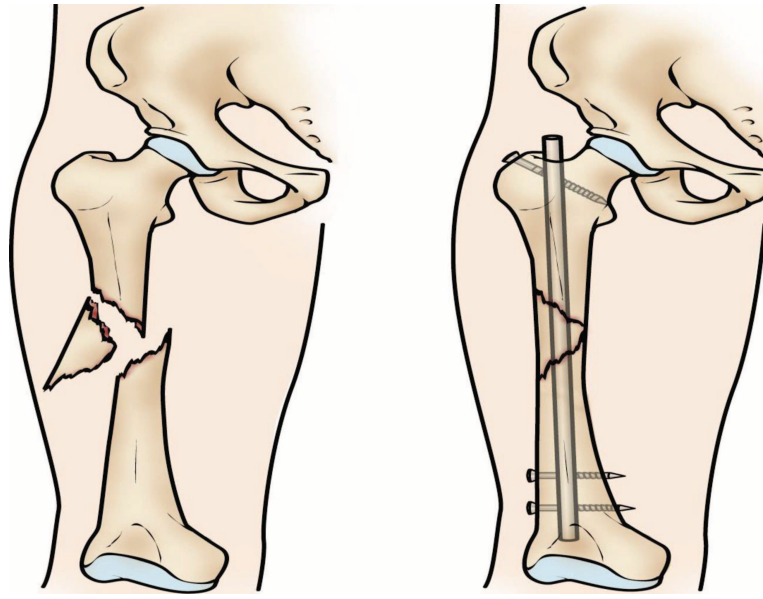

Figure 3. Intramedullary nailing provides strong, stable, full-length fixation. Reproduced with permission from OrthoInfo.@ American Academy of Orthopaedic Surgeons. Retrieved from http://orthoinfo.aaos.org. The color version of this figure is available in the online issue at https://journals.lww.com/orthopaedicnursing.

based on patient age and fracture characteristics. An infant younger than 6 months may be placed in a Pavlik harness, a spica cast, or traction with subsequent casting. Infants and children aged 6 months to 5 years will usually be placed in a spica cast even if they are unstable. Some unstable fractures may be treated with a spica cast or flexible nails, although this is controversial (Edgington et al., 2018).

Treatment

The treatment of fractures in the age group 5–16 years is controversial, with multiple options available and no clear consensus on the preferred modality of management. Surgical options are external fixation, plating (conventional and submuscular bridge plating), and intramedullary nails, which can be flexible nails

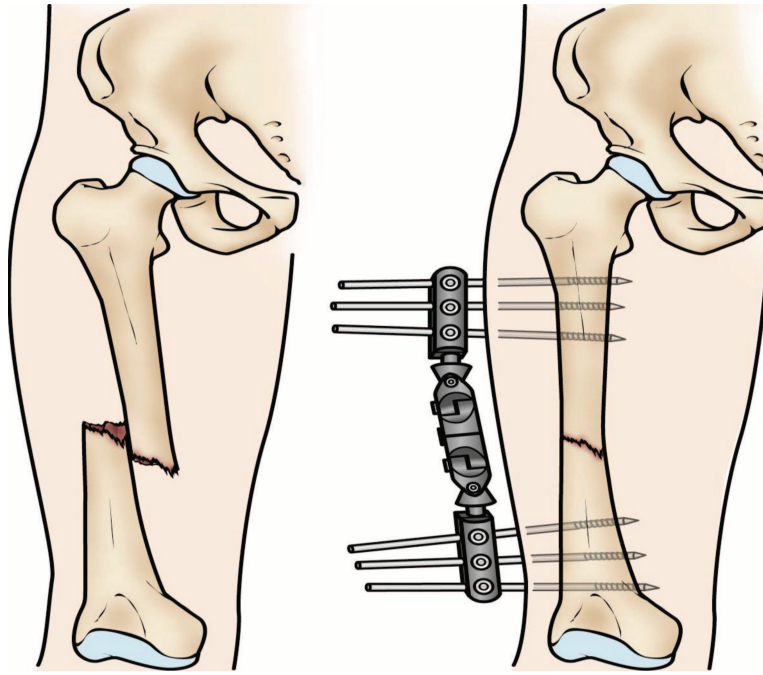

Figure 4. External fixation is often used to hold the bones together temporarily when the skin and muscles have been injured. Reproduced with permission from OrthoInfo.@American Academy of Orthopaedic Surgeons. Retrieved from http://orthoinfo.aaos.org. The color version of this figure is available in the online issue at https://journals.lww.com/orthopaedicnursing.

(titanium nail, Ender's nail) or rigid nails (Edgington et al., 2018).

External fixation is used to align and stabilize diaphyseal femoral fractures. This allows for early weight-bearing and range of motion. Common complications from external fixation include pin track infections and loosening, delayed union or malunion, leg length discrepancy, ossification, and refracture. A major consideration when applying external fixation is to avoid injury to the growth plate. Postapplication concerns are primarily pin care. In the case presentation, pin care was done by the patient's mother and there was no evidence of infection throughout the course of his healing.

Elastic, flexible intramedullary nailing (FIN) requires the insertion of two flexible titanium rods through the femur. This procedure is done under general anesthesia. The treatment goals are to achieve bone realignment, rapid healing, and a timely return to normal activities for the child. The child will not be able to bear weight for about 6 weeks after the surgery. The rods are removed 6–12 months postsurgery, which is a quick outpatient procedure. A cast or brace is not usually needed postsurgery.

Rigid intramedullary nailing is performed under general anesthesia. A rod is inserted near the hip and fixed by screws at both ends. A cast or brace is not required postsurgery. The child will be able to walk on the affected leg in most cases. The joints remain flexible and muscle strength is maintained (Wani et al., 2016).

Although external fixation and FIN have been extensively used in the management of pediatric femur fractures, there are very few studies that have compared the results. The purpose of this study was to compare the results of external fixation and FIN in pediatric femur fractures. Two groups of patients were treated by external fixator (EF) and FIN over two different but successive time periods, and results were compared. The first group (EF) consisted of 45 patients, and the second group had 50 patients. Age in the EF group ranged from 6 to 14 years (average = 9.93 years), and age in the FIN group ranged from 6 to 11 years (average = 7.66 years). In the EF group, the fixator was removed at an average of 12.23 weeks. In the FIN group, radiographic union was evident at an average time of 10.06 weeks. Pin-site infection was common in the EF group. One patient had a refracture in the EF group, and one patient had to be reoperated in the FIN group after he developed anterior angulation of more than 30° (Wani et al., 2016).

The total incidence of closed femoral shaft fractures between 2009 and 2012 was explored in a comparison of children aged 6–10 years treated in a community hospital versus those treated in a children's hospital. Patients treated at a general hospital received open reduction with internal fixation or external fixation more frequently when compared with those treated at children's hospitals (Sigrist et al., 2019).

Overall, there is a general trend toward operative stabilization of femoral shaft fractures in children. In the adolescent age group, the trend is toward intramedullary nailing using lateral trochanteric entry while there remains no consensus regarding treating the age group between 6 and 14 years (Christie, 2015).

Nursing Implications

Attention to pain control in these patients is critical in the preoperative and postoperative periods. Self-reporting is the most reliable indicator of pain; however, this is only possible with children who are cognitively mature or clinically alert enough to localize the pain. In the case of multiple trauma, an assumption may have to be made that the injury is painful. Children who are not able to localize the pain may exhibit other behaviors that indicate they are in pain such as crying, restlessness, tachycardia, increase in blood pressure, respiratory rate, and muscle tone, diaphoresis flushing, pallor, thrashing back arching, poor feeding, sleep disturbance, and head banging (Krauss, Calligaris, Green, & Barbi, 2016).

Common medications used to treat children with a femur fracture include nonsteroidal anti-inflammatory drugs such as ibuprofen and naproxen for mild pain; oxycodone, hydromorphone, ketorolac, tramadol, and fentanyl for moderate pain; and morphine, fentanyl, and hydromorphone for severe pain. Nurse-driven protocols for pain assessment and management allow quick initiation of pain relief. Early and aggressive pain assessment and management are crucial. Equally important is the need to administer the appropriate dose. Analgesia continues to be used less frequently in children and is associated with inadequate dosing (Kraus et al., 2016). Side effects from the use of these medications can include nausea, vomiting, respiratory depression, and sedation (Lee & Jo, 2014).

Anxiety is often more distressing than pain in children and their families. Identification and management of anxiety are also a nurse-driven function (Christie, 2015). Nonpharmacological approaches include providing physical comfort measures for the patient and the family. Distraction activities should be implemented stratified by age and developmental stage of the patient. Neonates and infants respond positively to oral stimulation and physical contact or touch. Children of all ages benefit from touch and other distracting activities that can include bubble blowing, sound and music, controlled deep breathing, imitation play, interactive games, and books (Kraus et al., 2016).

Reducing the anxiety levels of family members can help reduce anxiety levels in the patient. Providing information has been determined to have the greatest impact on parental anxiety. Information should include a discussion of what is happening now, what is planned, and who the providers will be. In the inpatient setting, many individuals come in and out of the patient area. They should be identified by name and the role they will play in the care of the patient. The possible side effects from analgesics should be explained. All information should be repeated frequently, as anxiety often interferes with memory. Parents may also have many questions about the impact this injury will have on the child's life. Although these discussions should always be tentative, nurses should answer with explanations that care plans may vary and encourage them to seek answers from the provider if possible.

Conclusion

Femur fractures remain a significant injury in children. These fractures can be a life-changing event for the child and the entire family. Pediatric injuries can create

interruptions in school and sporting activities. Parents will need to manage the care of the child, which can have an impact on their work life and the life of siblings. Nurses can assist the family and the child to adjust to these changes. Recommendations for counseling should be considered if the child or parents are having difficulty adapting to the changes.

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