

# Bilateral Humerus and Corner Fractures in an 18-Month-Old Infant

## A Case Report and Review of Child Abuse from the Resident Perspective

Kevin M. Kaplan, M.D., Konrad I. Gruson, M.D., and Nadir Paksima, D.O., M.P.H.

### Abstract

*Child abuse continues to be a serious problem that is likely to be encountered in all medical specialties, with orthopaedic surgeons commonly evaluating children having sustained musculoskeletal injuries. In busy emergency departments and clinics, junior residents shoulder much of the responsibility in identifying cases of abuse. We report the case of an otherwise healthy 18-month-old child, who presented to the emergency room with bilateral humeral shaft and corner fractures. These injuries were originally presented to the orthopaedic resident as having occurred from an accidental fall from a crib. The appropriate evaluation for a patient suspected of sustaining an injury from child abuse is reviewed.*

Child abuse, as defined in the Child Abuse Prevention and Treatment act, is “at a minimum, any act or failure to act resulting in imminent risk of serious physical or emotional harm, death, sexual abuse, or exploitation of a child by a parent or caretaker who is responsible for the child’s welfare.” With continued increases in cases of abuse and neglect, physicians will likely encounter a number of cases during their careers.<sup>1</sup>

After soft-tissue bruises and burns, fractures are the second most common presentation of physical abuse.<sup>2</sup> The literature estimates that orthopaedic surgeons will see one

third to one half of physically abused children.<sup>3</sup> Given that approximately 35% of these children will be abused again and that between 5% to 10% of children may die from such abuse, it is paramount for physicians to recognize and address these situations.<sup>3</sup> Retrospective chart reviews have indicated that between 12% to 41% of cases do not clearly identify a cause of fracture in children younger than 3 years of age.<sup>4</sup>

Physicians working in the emergency room are faced with the constant challenge of managing large numbers of patients with varying diagnoses. Thus, secondary to abbreviated history and physical exams, physicians may fail to identify the true mechanism of injury, while also failing to identify concurrent pathology. In teaching institutions, fractures in children necessitate orthopaedic consults; these are usually done by the junior resident on call. These residents must alert to signs of maltreatment and perform a thorough history and physical exam in order to correctly diagnose and treat patients who may have been subject to physical abuse.

We report the case of an otherwise healthy 18-month-old child who presented to the emergency room with bilateral humeral shaft and corner fractures. The injuries were originally presented to the resident as having occurred from an accidental fall from a crib.

### Case Report

An 18-month-old female presented to the emergency room, with both parents claiming that the patient fell from her bed several hours prior to admission and was inconsolable. The parents reported that the patient was unwilling to move either upper extremity and was sensitive to touch and movement of both extremities as well. Children’s Tylenol taken at home did not alleviate the symptoms.

The patient was evaluated in the pediatric emergency room, where radiographs demonstrated bilateral diaphyseal humerus fractures (Fig. 1). At this point, an orthopaedic consult was

Kevin M. Kaplan, M.D., and Konrad I. Gruson, M.D., were Resident and Administrative Chief Resident, respectively, within the Department of Orthopaedic Surgery at time of submission. Nadir Paksima, D.O., M.P.H., is Clinical Assistant Professor of Orthopaedic Surgery, New York University School of Medicine, and Attending in the Division of Hand and Wrist Surgery, Department of Orthopaedic Surgery, NYU Hospital for Joint Diseases, NYU Medical Center, New York, New York.

Correspondence: Nadir Paksima, D.O., Suite 8U, 530 First Avenue, New York, New York, 10016; npaksima@gmail.com.



**Figure 1** Bilateral humeral shaft fractures.

sought. The junior resident on call repeated a thorough history and physical examination. The parents again stated that the child had fallen from her crib onto both arms. Physical examination revealed a well-nourished 18-month-old female, with arms held limp at her side. The patient was alert and responsive when prompted to gaze in different directions. No lesions were noted on the patient's head, body, or genital regions. All extremities were warm and well perfused with symmetric pulses. On further observation of the child, it was noted that she refused to move either arm and would not weightbear on either lower extremity. Swelling was noted in bilateral upper extremities. The patient was exquisitely tender to palpation

in bilateral humeri and bilateral ankles. The remainder of the physical exam was unremarkable. Radiographic examination of bilateral lower extremities was subsequently ordered, revealing bilateral corner fractures (Fig. 2). At this point, per recommendation by the orthopaedic resident, the patient was admitted for observation and for appropriate consultations with pediatrics, ophthalmology, and child services.

The following day, the parents were questioned again as to the patient's history, with the help of child services and the attending pediatrician. During these interviews, the parents revealed that the patient sustained the injuries after the father struck her several times because of continued crying. Appropriate legal measures were followed as per the Child Protection and Treatment Act.

The remainder of the skeletal survey and an evaluation by ophthalmology was unremarkable. Treatment for the humerus fractures included a circumferential ace wrap to keep the arms immobilized, in addition to soft dressings for the bilateral lower extremities. The patient remained in the hospital for more than two weeks, secondary to ongoing legal issues, after which the bandage was removed. At the time of removal, the patient moved both arms simultaneously, without evidence of irritability. There was significant callous formation with minimal angulation of both fracture sites. Serial radiographs demonstrated healing of bilateral corner fractures (Fig. 3) and bilateral humerus fractures (Fig. 4).

## Discussion

Kempe and colleagues' 1962 study aided in establishing the essential role of physicians in recognizing and treating



**Figure 2** A, Left tibia corner fracture. B, Right tibia corner fracture.



**Figure 3** A, Healing bilateral tibial corner fractures with callous formation. B, Healed bilateral tibial corner fractures.

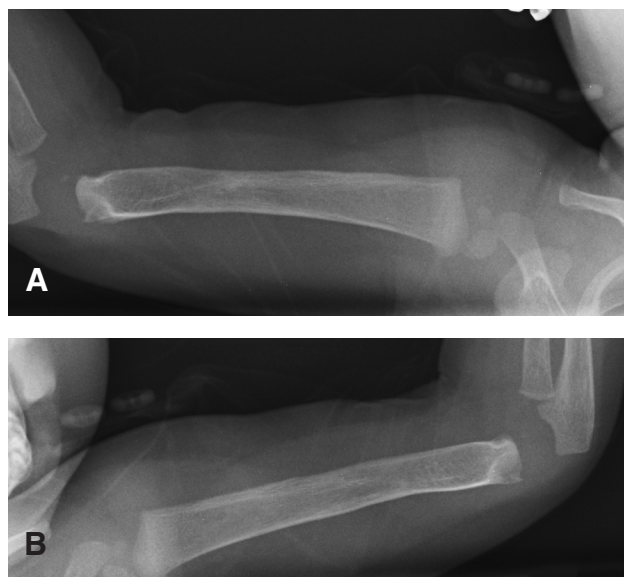
the manifestations of child abuse.<sup>5</sup> In 2003, child protective service agencies accepted approximately 3 million referrals for investigation or assessment. Of these referrals, 906,000 were positively identified as having been victims. Sixty percent of abuse victims experienced neglect, 20% were physically abused, 10% were sexually abused, and 5% were emotionally abused. Additionally, in 2003, over 1500 children died secondary to child abuse.<sup>1</sup> Alarming, Loder and Bookout reported that close to 50% of abused children had been evaluated previously by a physician for an injury.<sup>6</sup> Galleno and Oppenheim indicated that, with appropriate intervention, rates of recurrence could be reduced to less than 10%.<sup>7</sup>

All gender and age groups are subject to child abuse. Historically, there has been an inverse relationship between demographic status and rates of maltreatment. In addition, first born, unplanned, premature, and handicapped children are subject to higher rates of abuse. Drug use, unemployment, and previous family history are also significant contributing factors.<sup>8</sup>

The literature documents that skeletal trauma is present in 10% to 70% of physically abused children.<sup>3,7,9-11</sup> Thus, an orthopaedic resident must be able to appropriately evaluate children presenting to the emergency room with injuries that are consistent with abuse as a contributing cause. In

addition, evaluation of a suspected case of child abuse should be handled through a team approach that involves the pediatricians and indicated subspecialists.

The orthopaedic consult has the responsibility to obtain



**Figure 4** A, Healed right humerus fracture. B, Healed left humerus fracture.

a detailed account of a child's injury from the parents. Appropriate questions include the following: What caused the injury? How, when, and where did the injury occur? Did anyone witness the event? Did they notice any concurrent injuries? Is there a history of injury in the child?<sup>4</sup> In addition, when possible, the child can be appropriately questioned as to the circumstances of the injury. The consult also has the responsibility to evaluate whether the injury is consistent with the age of the child. For example, tibial shaft fractures in nonambulatory children are uncommon.

Physical examination should be systematic and comprehensive. Evaluation should begin with an examination of the skin and documentation of the presence, size, shape, and location of any abrasions, lacerations, or other traumatic abnormalities.<sup>12</sup> Although children commonly have bruises from everyday activity, areas that should alert the consult to abuse include the buttocks, perineum, genitalia, and back of the head and legs.<sup>2</sup> Following the visual examination, the child should be observed for spontaneous movement in all extremities. The examination continues with a complete physical, beginning with a neurovascular assessment. Palpation should be done in such a way that suspected areas of injury are avoided until the end of the examination. The axial skeleton, including the head, neck, spine, clavicles, ribs, and pelvis should be evaluated in addition to a comprehensive exam of the extremities. Swelling, deformity, crepitus, and range of motion should be assessed during the examination.<sup>8</sup> A rarely reported complication of the lower extremity, compartment syndrome associated with child abuse, was described in two children. Thus, continued monitoring of these patients is paramount to avoid this potentially devastating complication.<sup>13</sup>

In cases of suspected abuse, a skeletal survey should be conducted to identify concurrent injuries. The survey consists of anteroposterior (AP) radiographs of bilateral arms, forearms, hands, thighs, lower legs, and feet, as well as AP and lateral radiographs of the axial skeleton and skull.<sup>14</sup> Franken and Smith stressed the importance of obtaining radiographs of the joint above and below a suspected area of injury.<sup>15</sup> In addition, the literature recommends avoiding the "babygram," instead, favoring site-specific biplanar radiographs, and obliques, if necessary, for the identification of pathology.<sup>14</sup> Bone scans can be used to better identify lesions in the axial skeleton and cartilaginous areas. However, the study is limited in that a radiologist skilled in evaluation of the test is needed, in addition to the fact that symmetric fractures and epiphyseal-metaphyseal fractures may be missed, as these are areas of normal uptake.<sup>16</sup> Ultrasonography also has been used to evaluate trauma to areas that have not yet ossified.<sup>17</sup>

A young child's skeleton, unlike the adult skeleton, has biochemical and physiologic properties that diminish the tissue's overall mechanical strength, making children more susceptible to injury.<sup>18</sup> In fact, repeatedly abused children may present with multiple fractures at various stages of

healing. Thus, the orthopaedic consult should be knowledgeable on differentiating the stages of fracture healing. As outlined by Cramer, soft tissue swelling diminishes several days after injury. Subsequently, in 1 to 2 weeks, periosteal new bone forms, followed by radiographic loss of the fracture line at week 2 to 3. Soft callus will be present at this point, with hard callus forming in weeks 3 to 6. Finally, remodeling will occur, with children demonstrating excellent potential to correct any initial angular malalignment.<sup>12</sup>

In this case, the child presented with bilateral humerus and corner fractures, which to our knowledge is an abuse-related event that has not been reported. Approximately 50% of abused children have a single fracture, 33% have two to three fractures, and the remaining 17% have more than three fractures.<sup>19</sup> No fracture is pathognomonic for physical abuse, as reported in multiple studies.<sup>3,17,20</sup> However, the orthopaedic consult should be aware of fractures that are common to abused children. Metaphyseal and epiphyseal fractures (commonly referred to as corner fractures), skull fractures crossing suture lines, fractures to the axial skeleton (including posterior rib fractures), and fractures in multiple locations should immediately alert the consult to the possibility of abuse.<sup>3</sup> Despite studies indicating that abused children most commonly have transverse fractures to long bones, such as to the humerus, femur, and tibia, these injuries are found just as commonly in accidental trauma settings.<sup>8</sup>

Other conditions should also be considered when evaluating a child with multiple fractures. Examples of these diagnoses include osteogenesis imperfecta, Caffey disease, rickets, congenital syphilis, hematologic abnormalities, and normal radiographic variants. Despite the possibility of numerous etiologies for fractures in children, the consult must maintain a high level of suspicion for abuse when indicated.

## Conclusion

With a high number of charts demonstrating inadequate documentation for the evaluation of potentially abused children, it is evident that the junior orthopaedic resident must learn the proper procedure for evaluating a suspected case.<sup>8</sup> Many times, as demonstrated in the present case, the emergency room physician will default to the orthopaedic consult in the presence of a fracture or may send the patient with immobilization for follow-up in the clinic. Thus, it becomes the responsibility of the resident to be able to appropriately identify children at risk and be familiar with common patterns of presentation. Increased education may decrease the rate of repeated abuse and may potentially decrease mortality in abused children.

## Disclosure Statement

None of the authors have a financial or proprietary interest in the subject matter or materials discussed in the manuscript,



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