A Distal Humerus Fracture with a Proximal Medial Forearm Wound- Open or Closed?

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Introduction

Open fractures are associated with a higher risk of infection and if not identified and treated appropriately, can lead to limb- and life-altering consequences.[1] Prompt administration of intravenous antibiotics and tetanus treatment (if indicated) can help to significantly lower the rates of infection.[2] Because of the time sensitivity of treatment, a high level of clinical suspicion should be maintained when evaluating trauma patients to ensure that an open fracture is not missed. Traditional teaching is that any wound near a fracture site should be considered a potential conduit for communication of the fracture site with the environment. However, the distance between the fracture and the open wound raising the suspicion for an open fracture is not well studied. Conventionally, wounds associated with an open fracture are thought to at least be on the same limb segment as the fractured bone. Humeral shaft fractures are much less common than distal humerus fractures in the pediatric population and in many patients these fractures can be treated non-operatively.[3] Very few of these fractures are open on presentation, with only about 1% of pediatric supracondylar humerus fractures being open injuries.[4]

In this report, we present a case of a poly-trauma pediatric patient with a distal humeral shaft fracture with a traumatic wound in a different limb segment, the proximal forearm, that was eventually identified as being an open injury.

Case Presentation

The patient is a 12-year-old male who was involved in an automobile versus pedestrian accident. In the trauma bay, the patient was alert and oriented with no notable head, neck, or trunk trauma. He had gross deformities of his left upper arm and right lower leg. All his limbs were well perfused. He had a mixed neurological exam of his left upper extremity with weakness of thumb and wrist extension as well as finger abduction and flexion. He also endorsed global paresthesias of his left hand and right foot. On his left forearm roughly four centimeters distal to the medial epicondyle, there was a one-centimeter medial forearm wound that probed roughly six centimeters deep (Figure 1). On his right lower leg there was a two-centimeter stellate skin defect over the lateral portion of his mid-shin with consistent bloody drainage and visible bone. He also reported left ankle pain but there were no wounds or deformity noted. Preliminary imaging showed a transverse fracture of the left distal humerus shaft which was significantly displaced and angulated with a small butterfly fragment but no apparent fracture of the forearm (Figure 2). Air was also noted around the

Figure 1. One centimeter wound over the proximal medial forearm. Cotton tip able to probe roughly six centimeters deep into the wound.

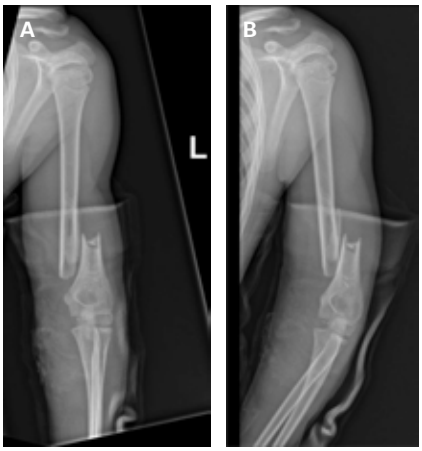

Figure 2. **(A)** AP and **(B)** oblique radiographs of the left humerus showing a displaced, comminuted transverse humeral shaft fracture.

distal humerus fracture site on CT (Figure 3). A right distal third transverse tibia and fibula fracture which was also significantly angulated and displaced was also identified (Figure 4). The patient was given a tetanus immunization booster and intravenous antibiotics (cefazolin and gentamicin) were administered for the open right tibia/fibula fracture. The open wounds of his left forearm and right shin were washed with betadine-diluted normal saline and dressed with soft dressings. The patient was administered conscious sedation and underwent closed reduction of his right tibia/fibula shaft fracture. The patient was temporarily stabilized in a right lower extremity short leg splint, a left upper extremity long arm splint, and a left lower extremity short leg splint. Secondary survey and additional imaging revealed additional injuries including a mandible fracture, a rib fracture, a left minimally displaced distal third clavicle fracture, and a left minimally displaced Salter Harris 2 fracture of the distal tibia.

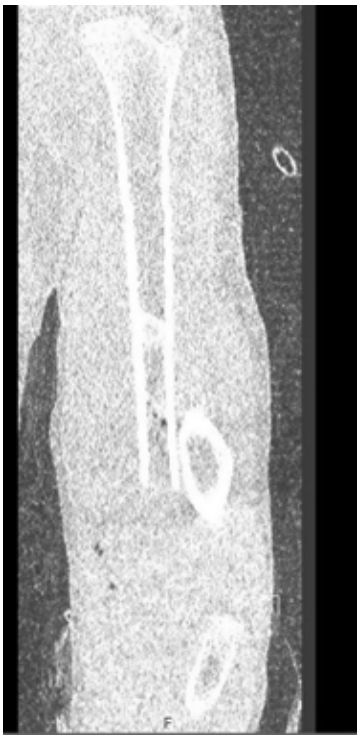

Figure 3. Coronal slice of CT of the left upper extremity showing distal humerus fracture with air around the fracture site.

Figure 4. AP x-ray of the right distal tibia/fibula showing a displaced, transverse distal third tibia/fibula fracture.

Surgical Intervention

A few hours later, once medically cleared for surgery, the patient was taken to the operating room with the orthopedic surgery team to address his injuries. Initial attention was turned to the open right tibia/fibula fracture. The wound on his right lower leg was extended and an extensive sharp debridement with extensive irrigation procedure performed. Black gravel/stone-like material was encountered and removed from the wound. Devitalized soft tissue was sharply removed and the fracture edges were debrided. Once visibly clean, the area was extensively irrigated. His right tibia was then fixed with two flexible intramedullary nails. The open wound was closed loosely and the lower leg splinted.

Attention was then turned to his left upper extremity. The one-centimeter wound in the proximal medial forearm, about four centimeters distal to the medial epicondyle, was evaluated. This wound was extended proximally and distally by about one centimeter in each direction. Gently milking at the distal humerus then expressed a significant amount of dark sanguineous fluid from the wound. Gentle blunt finger dissection was performed through the zone of soft tissue injury which led across the antecubital fossa to the distal aspect of the proximal aspect of the humerus fracture. This finding was consistent with the distal humerus shaft fracture having created a large soft tissue zone of injury that extended from the distal third of the humerus all the way down to the proximal third of the forearm. Given the degree of contamination of the tibial wound, the decision was made to extend the humeral incision to explore this entire tract. The incision was extended proximally across the medial elbow to the fracture site and blunt dissection commenced. As expected, significant trauma was noted to the soft tissue and musculature about the antecubital fossa. The median nerve was explored through the zone of injury and was found to be intact. The proximal fragment of the humerus was found to be stripped of its periosteum and was contaminated with the similar black stone/gravel-like substance encountered in the right lower extremity. The soft tissues and bone were similarly debrided and irrigated. The fracture was fixed with flexible intramedullary nails. The wound was loosely closed and a posterior slab splint was placed.

His facial fracture was managed nonoperatively by the oral maxillofacial surgery team. Postoperatively, the patient was neurovascularly intact to all four limbs with resolution of all preoperative left hand/right foot paresthesias as well as left hand weakness. His humerus fracture went on to heal uneventfully with full return of arm/elbow function (Figures 5 and 6).

Figure 5. 1-week postoperative x-rays. **(A)** AP proximal humerus, **(B)** AP of distal humerus, and **(C)** lateral of distal humerus showing evidence of fracture reduction and placement of two flexible nails.

Discussion

A high index of clinical suspicion needs to be maintained by healthcare providers to ensure that open fractures are not missed. This includes a thorough inspection of the skin of an affected extremity to ensure the presence or lack of skin defects near the fracture site. To our knowledge, there has not been a report describing an open fracture where the open wound was found to only be present on a different limb segment than the fracture. In this case, we definitively found that a distal third humeral shaft fracture exited the skin through a laceration in the proximal forearm, leading to gross contamination of the bony segment and extensive soft tissue trauma through the zone of injury. This injury likely occurred as axial compression on the somewhat extended limb caused the proximal humeral segment to piston through the anterior medial soft tissues of the antecubital fossa and out of the proximal medial forearm prior to returning to its position in the upper arm.

Upon original primary survey evaluation of this patient, there was some question as to whether the left distal humerus fracture was open because the medial proximal forearm wound appeared to be far away from the fracture site. In this case, not initially declaring this an open injury did not seriously impact the management of this patient because treatment of his concomitant obviously open right distal tibia/fibula fracture necessitated prompt administration of intravenous antibiotics.[1,5] However, if this patient had not had the contralateral open tibia fracture, a clinical dilemma would have arisen as to whether to utilize the open fracture protocol for the left distal humerus fracture. In this case free air at the distal humeral shaft fracture site noted on the CT scan alerted the team of the strong possibility of the open injury, but had this study not been performed or had the wound not been thoroughly explored, this patient's clinical outcome may have been significantly different. Irrespective of the outcome, this case highlights that strong consideration should be given to administration of antibiotics in the setting of any open wound on the same extremity with a noted fracture or clinical deformity, even if it initially seems to be very distant or even on a different segment of the limb. In these cases,

Figure 6. 10-month postoperative x-rays. **(A)** AP and **(B)** lateral humerus x-rays showing healing of the prior fracture site with evidence of callous formation. The 2 flexible nails are still in place.

the risks of missed treatment for an open fracture would seem to outweigh the risks of erroneously administering antibiotics if the wound turns out to only be superficial in nature.

Conclusion

Open fractures of long bones after a traumatic event can have significant ramifications if not identified and treated expeditiously. To mitigate the consequences of a missed open fracture, health care providers performing the original evaluation should be on high alert when skin defects are noted in the same extremity as a known or even suspected fracture, even if the site of the skin laceration does not appear close to the fracture site. As this case highlights, it is even possible for the fracture to create a zone of soft tissue injury that causes a skin defect in another portion of the limb.

References

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