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Case Report

Proximal Humerus Open Fracture in Pediatrics: A Case Report and Literature Review

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Abstract

Background: Proximal humerus fracture (PHF) in pediatrics is managed with different options: nonoperative or operative. However, proximal humerus open fractures are sparse in the literature.
Case Report: We present a 9-year-old boy who presented to our institution with proximal humerus open fracture (type IIIA of Gustilo classification). After irrigation and debridement, reduction was satisfactory. We preferred to immobilize the fracture using sling-and-swathe and U-slab splint.
Conclusion: Satisfactory union, angulation, and range of motion (ROM) were achieved.

Keywords: Pediatrics; Fractures; Open Fractures; Humerus Fractures; Treatment Outcome

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Background

Fractures of the proximal humerus in children account for about 2% of all fractures in the pediatric population (1). Proximal humerus fractures (PHFs) happen with a male predominance of at least 3:1, with an estimated incidence ranging from 31.4 to 680 fractures per 100000 children annually (2, 3). Although this type of fracture is rare, it is particularly valuable for orthopedic surgeons. PHFs that occur before skeletal maturity rarely lead to functional or cosmetic deficits, which is why they have traditionally been treated nonoperatively (4, 5). However, the management of grade III and grade IV fractures remains a contentious issue, particularly in the case of inadequately rehabilitated adolescents (4, 5). It is imperative to note that the outcomes of fractures tend to deteriorate with an increase in displacement and age of the children (6, 7). In the present study, we have reported a young boy with a completely displaced open fracture of the proximal humerus, which was treated with one surgical step after reduction without the use of any fixation devices such as pin or plate.

Case Report

The patient was a 9-year-old boy with no past medical history who presented to our institution after direct trauma to his upper arm that got stuck in the bakery dough machine four hours ago. Physical examination revealed a crushed soft tissue injury (type IIIA of Gustilo classification) about 30 cm on his left upper arm which was associated with obvious deformity and gross instability (Figures 1 and 2). Neurological examination was normal. Additionally, his distal pulses were palpable and similar to his other upper limb. Necessary emergency measures including fluid therapy, washing the wound and dressing it, applied relative immobility with the help of arm sling, and received stat doses of antibiotics (cephazolin and gentamicin) and tetanus immunoglobulin were taken. After ensuring the stability of clinical symptoms, shoulder, arm, and elbow radiographs were obtained which demonstrated a totally displaced PHF [grade IV in Neer-Horwitz classification (5)]. He had neither shoulder dislocation nor physeal fracture (Figure 3).

Figure 1. Laceration over the left upper arm measuring approximately 20 cm

Differential Diagnosis, Investigation, and Treatment: The patient was taken to the operating room for urgent irrigation and debridement with 9 liters of saline.

Figure 2. Alternative view showing soft tissue damage consistent with Gustilo type IIIA

Exploration showed no significant neurovascular injury or exposed bone.

The upper arm was then reduced by applying longitudinal traction to the distal brachium, followed by abduction, flexion, and external rotation. Satisfactory stability and soft-tissue tension were obtained. It was checked then by fluoroscopy (C-arm) and was found that about 50% displacement and less than 20% angulation remained. The wound was closed primarily under appropriate tension.

The upper limb was immobilized with postoperative neurovascular examination was normal.

Figure 3. Preoperative anteroposterior (AP) X-ray demonstrating a totally displaced proximal humerus fracture (PHF)

Standard shoulder radiographs were obtained immediately after the operation that showed about 50% translation and less than 15 degrees of angulation in his fracture (Figure 4).

Outcome and Follow-up: Antibiotic therapy (cephazolin and gentamicin) continued in the ward. Due to the dry wound, he was discharged after 3 days with oral antibiotics (chephalexin every 6 hours for 2 weeks). While the upper limb was immobilized in the sling-and-swathe, weekly X-rays were performed to ensure that the fracture site did not displace for up to six weeks.

Figure 4. Immediate postoperative X-ray showing about 50% translation and < 15° angulation

After seeing evidence of union, range of motion (ROM) began. At three and then six months postoperatively, the patient returned for a follow-up visit, and radiographs were obtained to check the state of fracture union and remodeling (Figure 5).

Figure 5. 12-week follow-up anteroposterior (AP) radiograph showing complete fracture union

He had no complaints, and the abduction, forward flection, external rotation, and internal rotation were full (Figure 6). The wound was completely healed with no discharge or dehiscence.

Figure 6. Patient regained full range of motion (ROM) after 12 weeks

Discussion

The glenohumeral joint's wide ROM and the remodeling potential of the proximal humeral physis enable many pediatric fractures to heal with nonoperative treatment (8-10). Moreover, owing to the proximal humeral growth physis responsibility for 80% of overall humeral longitudinal growth, proximal humeral growth physis possess a remarkable ability to remodel (10-12). The periosteum is metabolically active in the immature humerus, which causes faster stabilization of fractures and their recovery (3, 13).

Despite significant variation in suggested surgical thresholds, there is a lack of universally accepted evidence-based guidelines (4, 14).

Non-surgical treatment is effective for younger patients or those with fractures that are not significantly displaced, while surgical treatment is usually considered in older children with minimal growth remaining, significantly displaced fractures, open fractures, ipsilateral elbow or forearm injury, associated neurovascular injury, and poly-trauma patients (1, 15). Nonoperative treatment produces outstanding results even with significant displacement, generally up to the age of ten, though the precise age cut-off varies across the literature (5, 16).

The percutaneous Kirschner wire (K-wire) pinning method is commonly employed for fixation in children, frequently in conjunction with close reduction. Plate and screw fixation are seldom deemed necessary; nevertheless, numerous surgeons advocate for the employment of the elastic stable intramedullary nailing (ESIN) technique due to its stability and safety in relation to the nearby soft tissues (17).

Dobbs et al. conducted a retrospective analysis of 28 patients with Neer-Horwitz classification grade-III and grade-IV PHFs. Three of them were treated just with closed reduction and immobilization, twenty patients were treated with closed reduction and pin fixation, open reduction and screw fixation was done for three patients, and two patients underwent open reduction and pin fixation. Postoperatively, all of them had Neer grade I or II displacement, until fracture union. Following the follow-up period, which was approximately four years, all patients exhibited almost normal glenohumeral movement and exceptional strength (14).

One meta-analysis demonstrated a non-significant difference in radiological outcomes in ESIN (96%), followed by nonoperative management (93%) and K-wires (88%) (18).

As per the study conducted by Hannonen et al. that included 300 children aged < 16 years, the majority (92%) were treated nonoperatively. It was found that just 3.3% of cases, which were initially treated nonoperatively, required surgical intervention later due to redisplacement (3).

The present case, the PHF with 100% displacement improved to grade III Neer-Horwitz classification (about 50% translation) after reduction. Although we can use a device, high infection risk and high remodeling potential in growing children ensure us to not use any device.

The clinical and radiological results at three and six months after the occurrence of the fracture showed satisfactory angulation in anteroposterior (AP) radiography, complete union, and excellent shoulder ROM without joint stiffness or pain. Further, other complications such as wound infection or nerve defects did not occur.

Conclusion

According to the mentioned studies as well as the patient of this study, it seems that in children with PHF with high severe displacement especially in the case of a wide contaminated wound, considering the possibility of surgical site infection in case of using a device for internal fixation, non-surgical treatment including reduction and immobilization can be started as initial treatment. The advantage of this method is that after the healing of the patient's wound and before complete union, if the fracture is displaced again, this time we can perform internal fixation without concern for infection risk.

Conflict of Interest

The authors declare no conflict of interest in this study.

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