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# Bilateral Traumatic Proximal Humeral Physeal Fracture in an Adolescent Child – A Rare Case Report and Review of Literature

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**Learning Point of the Article:**

A lower threshold should be kept for surgical management in displaced bilateral physeal fractures, especially in adolescent age group with borderline remodeling potential.


## Abstract

**Introduction:** Proximal humerus fractures in the pediatric population are relatively uncommon accounting for <3% of all the fractures. Being the growing end of the bone, these fractures have a high threshold for conservative management. Dilemma does exist when such a fracture occurs in a borderline adolescent age group. Occurrence of bilateral physeal fractures in the same anatomical location is exceedingly rare and such a case of bilateral traumatic physeal fracture of proximal humerus has not been reported in the literature.

**Case Presentation:** A 14-year-old male child presented with post-traumatic pain and swelling of both the shoulders. Radiographs revealed displaced proximal humerus physeal fracture bilaterally. The displaced fracture was treated with closed reduction and percutaneous fixation using smooth Kirschner wires and cannulated screw.

**Conclusion:** Considering the bilateral nature of the injury and a borderline age with limited remodeling potential, a lower threshold for conservative therapy must be adopted in young active individuals. High-velocity trauma does form a major cause of such bilateral injuries, however, nutritional deficiencies and metabolic causes should be kept in mind while treating such a rare pattern of injury.


**Keywords:** Proximal humerus, physeal fracture, bilateral shoulder fracture, adolescent shoulder, bilateral physeal injury.

## Introduction

Proximal humeral fractures in the pediatric population are relatively uncommon, accounting for less than 3% of all fractures in children and include 4–7% of all epiphyseal fractures [1, 2]. They are the most common injuries of the shoulder and upper arm among children. Regarding the pediatric age groups, these injuries occur most frequently during the first decade and relatively frequently between 11 and 16 years of age due to the greater exposure to high-energy trauma through sports and accidents. Child abuse is another cause of such an injury in children under 18 months of age [3, 4].

There are a wide variety of mechanisms involved in the occurrence of proximal humerus fractures. In the newborn, it may be a result of abnormal arm position during descent along the birth canal in a compromised position [5]. In the pediatric and adolescent groups, it may be a result of direct injury on the affected shoulder or due to fall on outstretched hand with arm in abducted and externally rotated position [6].

The treatment of the fractures also vary from immobilization in sling to closed/open reduction with fixation using Kirschner wires, intramedullary flexible nails and percutaneous screws.

No mechanism and treatment protocol for the management of bilateral fracture have been described in the literature. The purpose of this study is to know the occurrence of such a rare form of bilateral fracture in adolescent age group, the treatment options, and the functional outcome.

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*Author's Photo Gallery*


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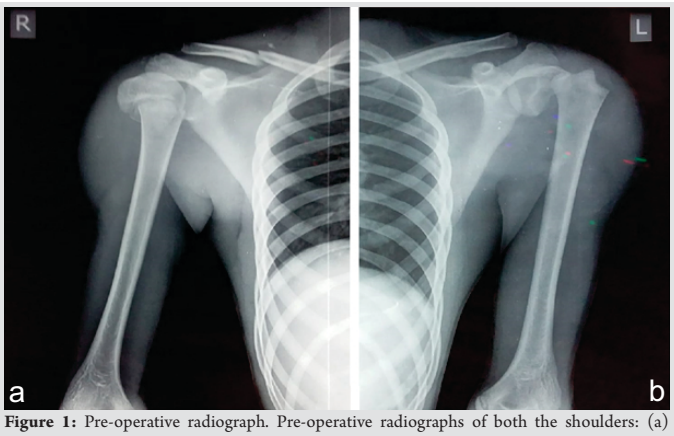


**Figure 1:** Pre-operative radiograph. Pre-operative radiographs of both the shoulders: (a) Anteroposterior radiograph of the right shoulder showing Salter-Harris type 2 proximal humerus physeal fracture with ipsilateral clavicle fracture. (b) Anteroposterior radiograph of the left shoulder showing Salter-Harris type 1 proximal humerus physeal fracture.

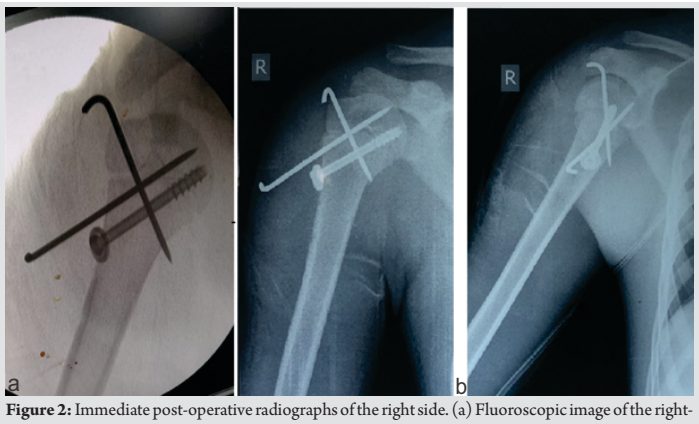


**Figure 2:** Immediate post-operative radiographs of the right side. (a) Fluoroscopic image of the right-sided proximal humerus fracture after closed reduction and percutaneous fixation. (b) Immediate post-operative anteroposterior and axillary view radiographs showing well-reduced fracture of the right side.

## Case Presentation

A 14-year-old male child presented to the orthopedic casualty of a tertiary care center with pain in both the shoulders and unable to move both the upper limbs following fall from a moving train. The patient was referred from level one and level two care centers after primary stabilization. He was conscious and oriented with bilateral shoulder swelling and inability to move both the shoulders. There was an associated degloving injury to the face with intact vision. There were no head, chest, or abdominal injuries.

Local examination revealed swelling, bruising, and tenderness on both shoulders with arms held by the side of the body. The range of movement was painful and severely restricted. A 4x6 cm degloving injury near the lateral aspect of the face was noted with intact vision. No neurological or vascular deficits noted in both the upper extremities.

Anteroposterior and axillary radiographs of both shoulders revealed displaced proximal humeral physeal injury in both the upper extremities with a right-sided clavicle fracture. The left side had a Salter-Harris type 1 (physeal separation) Neer-Horwitz Grade 4 injury with >2/3rd shaft diameter displacement, with 85.6 varus angulation (Fig. 1a). The right side had Salter-Harris type 2 physeal injury of proximal humerus with Neer-Horwitz Grade 2 injury with 16.5° of valgus angulation (Fig. 1b).

Considering the poor remodeling potential at a borderline adolescent age and the amount of displacement, a decision for closed/open anatomical reduction and fixation was taken. The patient was induced under general anesthesia and a beach chair position was given to ensure adequate fluoroscopic visualization. For the right side, closed reduction by traction, abduction, and rotational maneuver was performed and the fracture reduction was confirmed under orthogonal fluoroscopic imaging. Skin marking was done for the course of the axillary nerve 6 cm distal to the acromion. Two smooth Kirschner wires were inserted percutaneously crossing the physis in a cross pattern. To provide further stability, a 4 mm cannulated cancellous screw was passed with washer across the physis. Stability of the construct was confirmed under fluoroscopy and the pins were bent and placed subcutaneously (Fig. 2a, b).

Similar maneuver was performed on the left side and three smooth Kirschner wires were inserted percutaneously and placed subcutaneously (Fig. 3a, b). Both the arms were placed in a shoulder immobilizer for 3 weeks. Gradual passive range of motion exercises were started and the pins were removed at 6 weeks (Fig. 4a, b). Full range of motion was achieved at 3 months

**Figure 4:** Radiograph at 6-week follow-up. Follow-up radiograph after 6 weeks of surgery showing periosteal callus formation.

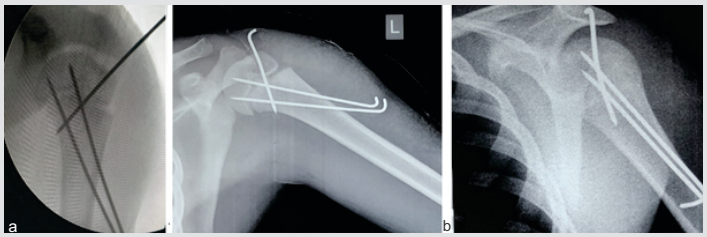


**Figure 3:** Immediate post-operative radiographs of the left side. (a) Fluoroscopic image of the left-sided proximal humerus fracture after closed reduction and percutaneous fixation. (b) Immediate post-operative anteroposterior and axillary view radiographs showing well-reduced fracture of the left side.

**Figure 5:** Functional outcome at 18 months postoperatively with painless full range of motion in both the shoulders.

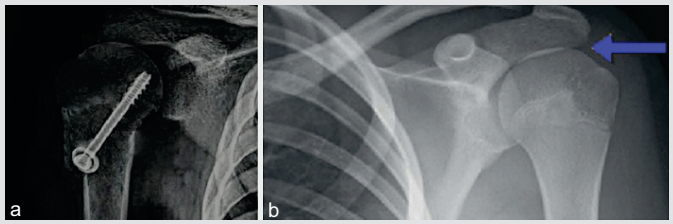


**Figure 6:** Radiograph at 18 months follow-up. (a) Follow-up anteroposterior radiographs of the right shoulder showing partial obliteration of the physis with no sign of avascular necrosis. (b) Follow-up anteroposterior radiographs of the left shoulder showing healed fracture with restoration of anatomy. Arrow pointing to healed fracture anatomy.

postoperatively. The screw removal was scheduled at 6 months, however, the patient was lost to follow-up.

The patient presented at 18 months with full restoration of the function and full range of motion with no pain and the disabilities of the arm, shoulder, and hand (DASH) score of 1.7/100 (Fig. 5). The right side shows partial obliteration of the physis with no signs of avascular necrosis. The left side healed fracture and restoration of the anatomy (Fig. 6).

## Discussion

Proximal humeral physeal injuries form 0.45% of pediatric fractures. Etiology varies from birth injury, sports injury to high-velocity injuries. Child abuse is a common mode of injury in children presenting before 18 months of age. Proximal humerus is also a common site for unicameral bone cyst, fibrous dysplasia making it more prone to pathological fractures following trivial trauma. Physeal separations in developing countries are common in scurvy [7], but such a bilateral form of injury in the region of proximal humerus has not been previously described. About 80% of the longitudinal growth of the humerus occurs at the proximal humeral physis. This high activity level explains the tremendous remodeling of proximal humerus fractures in the pediatric population. Younger the patient, higher is the remodeling potential.

**Table 1: Review of literature -Guideline for conservative management in paediatric proximal humeral physeal injuries.**

| Year | Study | Age | Accepted angulation for non-surgical management |
|---|---|---|---|
| 1969 | Dameron and Reibel [15] | 11+ | <20 of angulation and 50%displacement |
| 1992 | Beaty [16] | 10–12 | Up to 40–70 angulation |
| | | 12+ | <40 angulation and 50% displacement |
| 1993 | Burgos-Flores*et al*. [17] | >13 | Angulation <30% in one plane or < 50% displacement |
| 2003 | Dobbs [8] | ≤7 | Up to 75 angulation |
| | | 8–11 | Up to 60 angulation |
| | | ≥12 | Up to 45 angulation |
| 2008 | Fernandez*et al*. [18] | >10 years | 20–30 angulation, valgus deformity 10° |
| 2009 | Bahrs*et al*. [12] | <10 | <60angulatio and <10° valgus deformity |
| | | ≥10 | <30 angulation and<10 valgus deformity |
| 2010 | Pahlavan [11] | >13 | Minimally displaced fractures can be treated conservatively |
| | | 10–13 | Decision on case-to-case basis |
| | | <10 | Majority can be treated by non-operative means |
| 2011 | Binder*et al*. [4] | <12 | <30 of angulation |
| | | ≥12 | Anatomical reduction |
| 2011 | Hutchinson*et al*. [19] | ≥12 | <40 angulation, recommend surgery on all Grade IV fractures |
| 2017 | Hohloch [20] | ≥12 | Displacement of <1/3rd shaft width and <20 angulation |
| | | 10–12 | Displacement of <1/3rd shaft width and <20 angulation, conservative measures preferred |

Most fractures involving the proximal humerus in children aged 5–11 years are metaphyseal, and Salter-Harris type II fractures are predominantly seen in children older than 11 years [8]. Salter-Harris type III and IV injuries are rarely seen and are usually associated with high-energy trauma [9].

Traditional studies showed good to excellent functional results in all age groups of children with pediatric proximal humerus fractures. According to von Laer [10], the patient's age has a major influence on the treatment of such injuries. Dobbs et al. concluded that Neer-Horwitz Grade I and II proximal humerus fractures in children and older adolescents also should be treated non-surgically. Non-surgical care is not recommended for patients with open Neer-Horwitz Grade I and II fractures, vascular injury, or polytrauma [8].

Controversy exists in the treatment of Neer-Horwitz Grade 3 and Grade 4 injuries, where two factors are considered: (1) Chronological age and (2) amount of displacement and angulation. Table 1 depicts the acceptable alignments for non-surgical management.

A systematic review by Pahlavan et al. divided patients based on age groups of <10 years, 10–13 years, and >13 years. Non-surgical management is advocated <10 years because of the good remodeling potential to minimize risk of shortening and malunion. In the age group of >13 years, surgical management is advocated due to the minimal remodeling potential. For children between 10 and 13 years, treatment is to be decided from case to case basis considering remodeling potential [11].

It is in the adolescent age group, that periosteum, long head of biceps tendon, and other structures form a potential impediment to anatomical or near anatomical reduction [12]. Furthermore, as these patients approach skeletal maturity the results of non-operative treatment tend to be potentially worse due to the dismal remodeling potential, especially in non-anatomically reduced fractures. This can lead to long-term restriction in movement and pain [8, 13]. In addition, it remains unclear that even slight malreduction in the proximal humerus may lead to abnormal shoulder biomechanics and bring difficulty to active adolescents involved in high-level sports-related activities [14].

Contemporary literature does not depict clear guidelines for the management of bilateral proximal humeral fracture. A bilateral displaced shoulder fracture, if malunited may add to a significant morbidity in an active adolescent. The treatment was thus undertaken keeping a low threshold for conservative management. Furthermore, the fracture being significantly displaced, surgical management was considered better for an optimal outcome.

The patient was advised an implant removal of the cannulated screw at 6 months, however. the relatives did not consent to the same. Considering the age of the child, dismal growing potential, and presence of a multiaxial ball-socket joint proximally, the potential for limb length discrepancy or any future deformity due to partial fusion of the physis was judged to be minimal. At the borderline or late adolescent age, thus the stability of the fracture should be a priority

## Conclusion

Open/closed reduction with percutaneous internal fixation can provide excellent outcome in adolescent children with displaced bilateral proximal humerus fractures. The threshold for conservative treatment in severely displaced fractures should be kept low, especially if the injury is bilateral.

### Clinical Message

Considering the association of this pattern of injury with a high-velocity trauma, detailed evaluation should be performed to rule out other systemic injuries. Other causes such as child abuse, rickets, and scurvy should be investigated and ruled out. A lower threshold should be kept for surgical management in displaced bilateral physeal fractures, especially in adolescent age group with borderline remodeling potential.

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