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Case Report

Ipsilateral supracondylar humerus fracture and Monteggia fracture–dislocation with distal radius physeal fracture in a pediatric patient: A case report

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ABSTRACT

In pediatric patients, supracondylar humerus fractures concurrent with Monteggia fracture–dislocation and Monteggia fracture–dislocation concurrent with distal radius fracture are rare and have only been reported in case reports. We present the case of a 10-year-old girl with concurrent ipsilateral arm supracondylar humerus fracture with Monteggia fracture–dislocation and distal radius physeal fracture, which were treated with closed reduction and percutaneous pinning. The Monteggia fracture-dislocation was addressed with open reduction via a posterior approach and fixation using titanium elastic nails. The postoperative recovery was favorable. At 1-year postoperative follow-up, the Mayo Elbow Performance score was 100 points, and no limitations in joint range of motion were noted.

Introduction

Floating elbow accompanied by supracondylar humerus and forearm fractures in children is not a rare injury [1]. Most forearm fractures associated with floating elbow are distal radius fractures. Injuries of supracondylar humeral fracture accompanied by Monteggia fracture–dislocation in children are very rare, with only eight previously reported cases [2–9]. Additionally, there are only 15 reported cases of Monteggia fracture–dislocation accompanied by distal radius fracture, making it a rare injury [10–12]. In this report, we describe the treatment of a very rare injury involving a supracondylar humeral fracture, accompanied by Monteggia fracture–dislocation and distal radius physeal fracture in the ipsilateral upper extremity, which yielded excellent results.

Case report

We present the case of a 10-year-old girl whose left arm was injured by a fall from a height of approximately 1.5 m. The patient was transported to a nearby hospital on the same day and referred for treatment on the second day after the injury. X-rays revealed a modified Gartland type 2B supracondylar humerus fracture, a Bado type I Monteggia fracture–dislocation, and a Salter–Harris type II distal radius physeal fracture with volar displacement in the ipsilateral upper extremity (Fig. 1). No neurovascular symptoms or open

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wounds were noted. Surgical treatment was performed on the third day after the injury. Surgery was performed with the patient in the supine position. Reduction and fixation of the distal radius physeal fracture were performed to restore radial length prior to reduction of the humeroradial joint. The distal radius physeal fracture was reduced and fixed using steel wire-connected pins (JuNction, Arata, Japan) through closed reduction and percutaneous pinning. Next, manual reduction of the humeroradial joint was performed; however, it was difficult to achieve the reduction position. It was considered that the inability to achieve reduction was the interposition of soft tissue within the humeroradial joint. The supracondylar humerus fracture showed no progression of dislocation during the reduction maneuver; therefore, open reduction of the humeroradial joint was performed. The tourniquet was inflated to 200 mmHg and used for 60 min. An open reduction of the radial head was performed through a posterior approach [13]. With the posterior approach, triceps splitting is performed proximal to the olecranon, and as per the Boyd approach, the humeroradial joint was exposed by detaching the anconeus muscle from the radial side of the ulna distal to the olecranon. The annular ligament was incarcerated within the humeroradial joint, preventing reduction (Fig. 2A). A partial longitudinal incision was made through the annular ligament, allowing for easy reduction of the radial head (Fig. 2B). The absence of instability in the forearm during pronation and supination was confirmed following the reduction of the humeroradial joint. Reduction of the humeroradial joint resulted in an appropriate reduction position for the ulnar diaphyseal fracture. The ulnar diaphysis fracture was fixed with a titanium elastic nail (TEN) to prevent displacement. Steel wire-connected pins were used to fix a supracondylar humerus fracture. The postoperative X-rays showed a good

Fig. 1. X-ray at the time of injury. Left forearm (A: anteroposterior, B: lateral), Left elbow joint (A: anteroposterior, B: lateral).
Left wrist (A: anteroposterior, B: lateral). X-rays revealed a modified Gartland type 2B supracondylar humerus fracture, Bado type 1 Monteggia fracture–dislocation, and Salter–Harris type II distal radius physeal fracture with volar displacement.

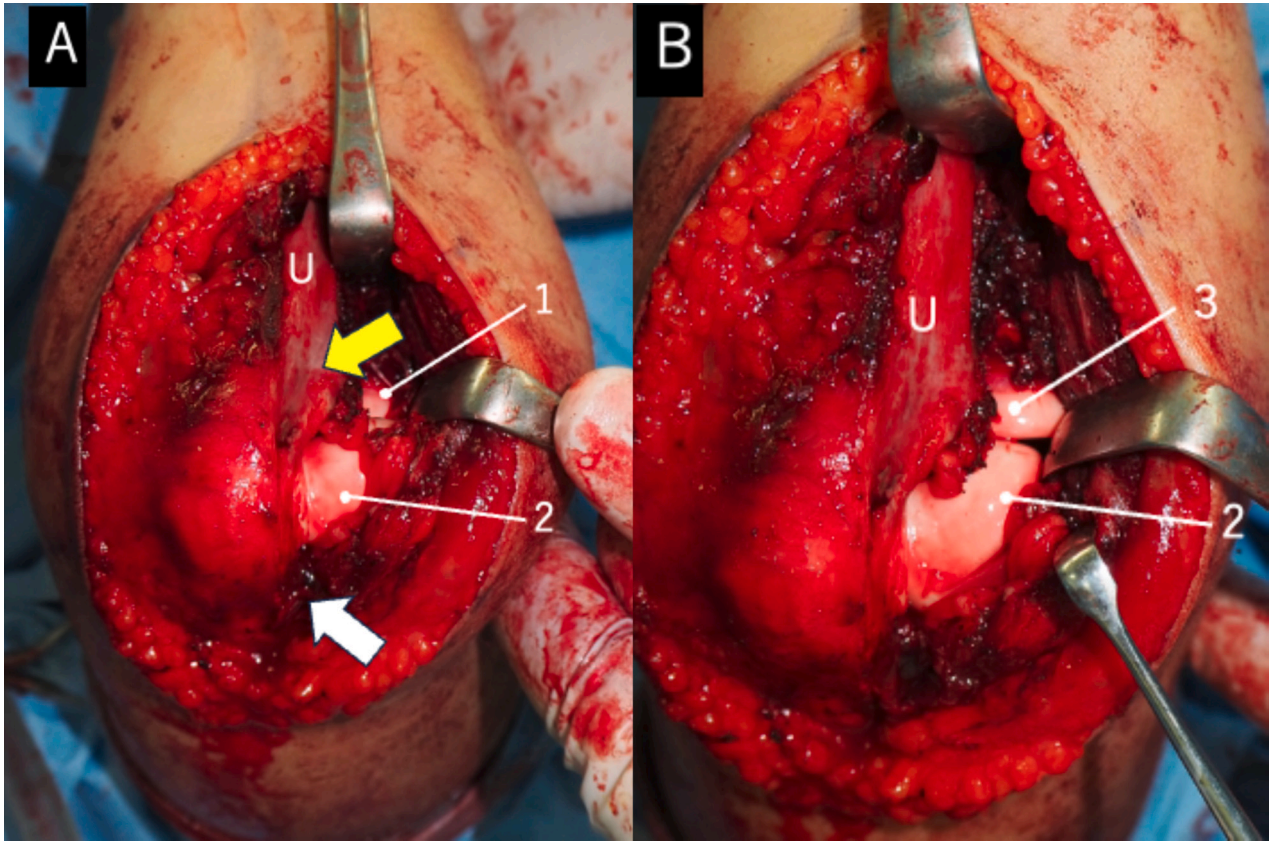

Fig. 2. A: Posterior approach. Triceps splitting approach (white arrow). The anconeus muscle is detached from the ulna (U) (yellow arrow). The annular ligament (1) was interposed at the humeroradial joint (2: humeral capitellum, 3: radial head) as an inhibitory factor of reduction. B: A partial longitudinal incision of the annular ligament (1) was made, and the humeroradial joint was reduced. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

reduction position (Fig. 3). Postoperatively, a long arm splint was applied to the forearm in a supinated position, and no postoperative drainage was performed. At 5 weeks postoperatively, as callus formation was favorable, the steel wire-connected pins for the supracondylar humerus and distal radius physeal fractures, along with the splint fixation, was removed, and range of motion training for the elbow and wrist joints was initiated. At approximately 3 months postoperatively, bone union was confirmed on X-rays. Approximately 6 months postoperatively, the ulnar TEN was removed. Intraoperatively, Fluoroscopic imaging under general anesthesia was used to evaluate the instability of the humeroradial joint. No instability was noted in the humeroradial joint during forearm pronation (Fig. 4).

Approximately 1 year after surgery, the elbow joint range of motion was 10° extension, 150° flexion, 90° pronation, and 90° supination, with no range of motion limitation (Fig. 5). X-rays showed that bone union had been achieved at each fracture site with good alignment (Fig. 6). The patient was unaware of any symptoms in her daily life, and her Mayo Elbow Performance score was 100.

Discussion

It has been reported that the floating elbow occurs in 3.5 %–5.3 % of supracondylar humerus fractures in children [1]. Most forearm

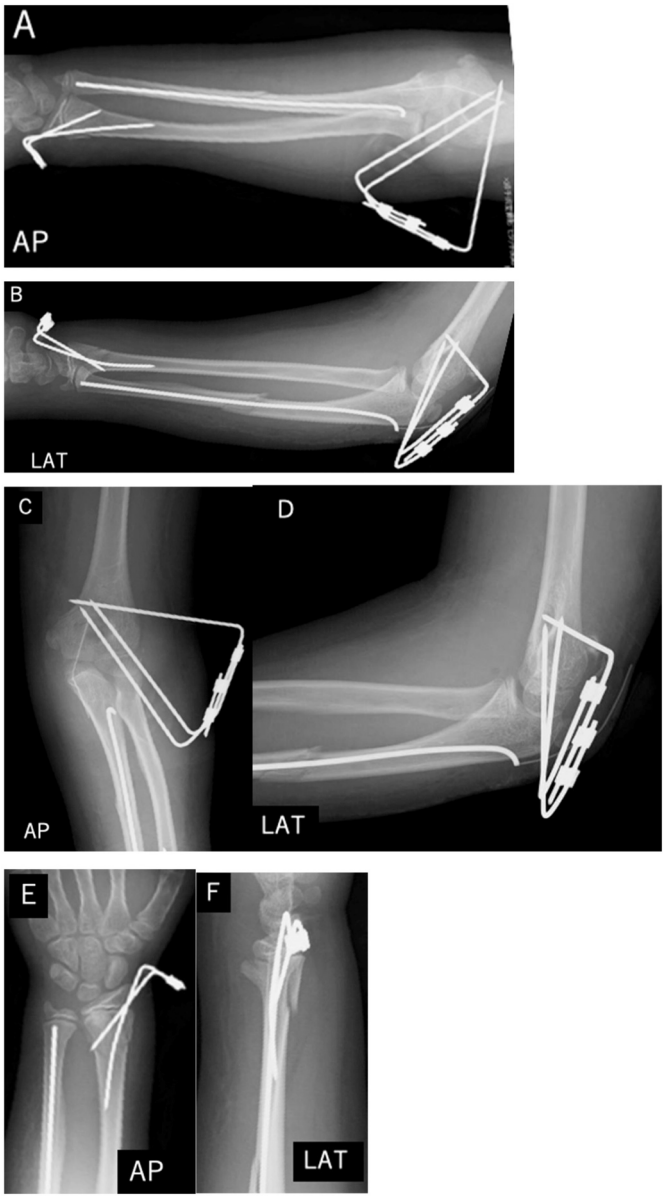

Fig. 3. Postoperative X-rays. Left forearm (A: frontal image, B: lateral image), left elbow joint (C: frontal image, D: lateral image), left wrist joint (E: frontal image, F: lateral image). The reduction position of the humeroradial joint and each fracture site is good.

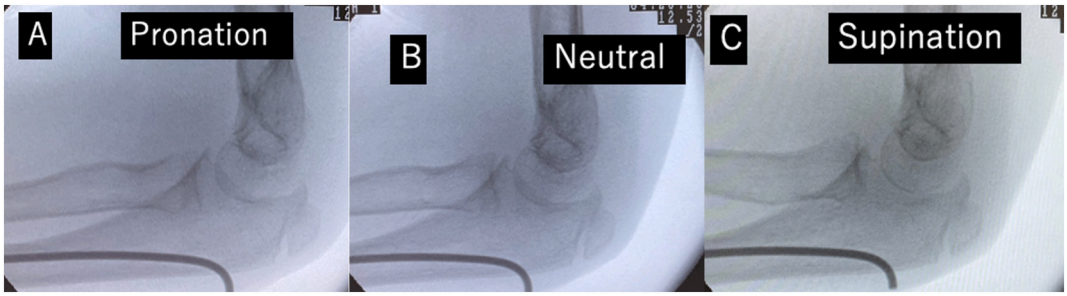

Fig. 4. Intraoperative fluoroscopic lateral view of the elbow joint at 6 months postoperatively (A: forearm prnation position B: forearm neutral posotion C: forearm supination position). Humeroradial joint congruence is good.

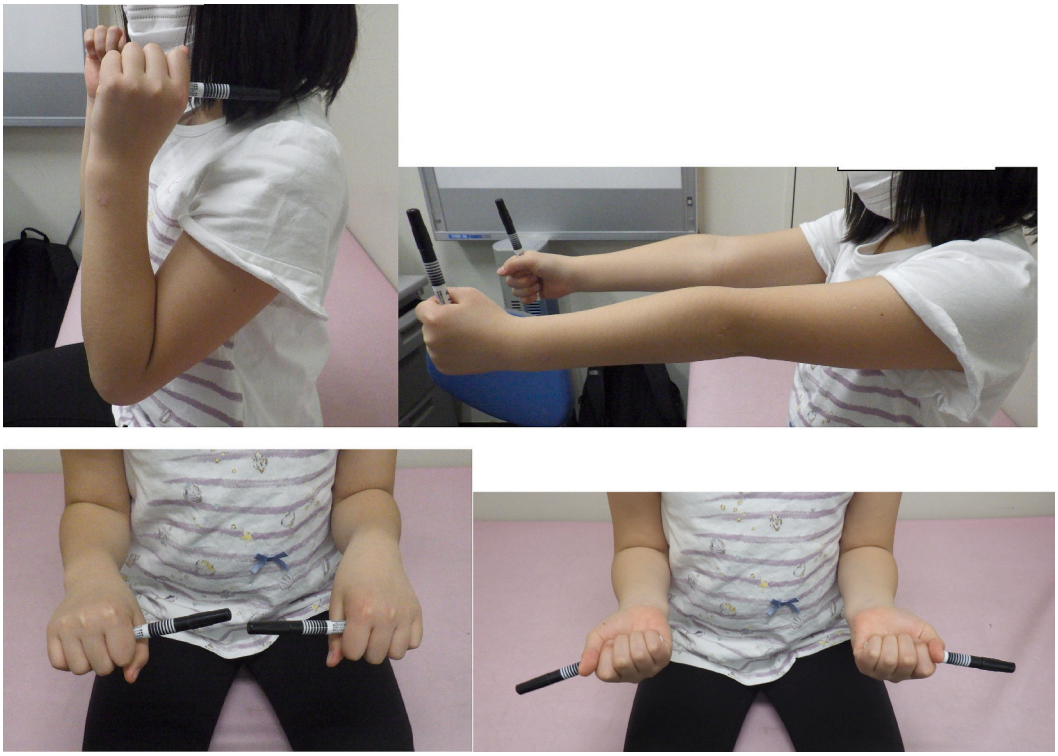

Fig. 5. The range of motion is good at 1-year postoperative follow-up.

fractures associated with floating elbow are distal radius fractures. Injuries of supracondylar humerus fracture accompanied by Monteggia fracture-dislocations in children are very rare, with only eight cases reported previously [2–9]. A distal radius buckle fracture was observed in three of the eight reported cases [2–4]. In addition, there have only been 15 reported cases of Monteggia fracture–dislocation associated with distal radius fractures, making it a rare injury [10–12]. This is the first report of an injury involving a displaced Salter–Harris type II distal radius physeal fracture, Bado type I Monteggia fracture–dislocation, and a modified Gartland classification type 2B supracondylar humerus fracture, each of which required surgical treatment.

The nine cases, including the present case of pediatric supracondylar humerus fracture accompanied by Monteggia fracture–dislocation, consist of seven Bado type I cases, one type III case, and one type I equivalent case. The case with type I equivalent was reported by Ismaili et al. [5] as Bado type III. However, it is categorized as type I equivalent because the injury was accompanied by an ulnar diaphysis fracture and an epiphyseal line of the proximal radius [5].

There have been 15 previous reports of cases of Monteggia fracture–dislocation accompanied by distal radius fractures, which were reviewed by Tsuji et al. and Gao et al. [10,11]. In the present case, there are four cases of Bado type I, one case of Bado Type II, eight cases of Bado type III, and three cases of Bado type I equivalent. Furthermore, when focusing solely on the distal radius fractures, volar dislocation-type injuries include only our case and Tsuji et al. [10].

In the treatment of supracondylar humerus fractures with a distal radius fracture, the question of which injury should be fixed first remains controversial [1]. In injuries accompanied by supracondylar humerus fracture combined with Monteggia fracture–dislocation

Fig. 6. X-rays at 1-year postoperative follow-up. Left forearm (A: frontal image, B: lateral image), left elbow joint (C: frontal image, D: lateral image).
Bone fusion is obtained, and good alignment is achieved.

or Monteggia fracture–dislocation and distal radius fracture, previous reports have only included case reports, and no established treatment guidelines have been reported. Among the eight reported cases of pediatric supracondylar humerus fractures accompanied by Monteggia fracture–dislocation, three cases were treated with conservative therapy. Surgical treatment was performed on the remaining five cases. In all five case reports, pinning for the supracondylar humerus fracture was performed first rather than reducing Monteggia fracture–dislocation.

In past case totaling 15 cases of Monteggia fracture-dislocation with concurrent radius fracture, 4 were treated with conservative therapy, while 11 underwent surgical treatment. In three cases, the distal radius fracture was fixed first, while in the other eight reported cases, the Monteggia fracture–dislocation was reduced and fixed first. According to past reports, good outcomes have been achieved, and there is no clear evidence on which one should be reduced and fixed first. In the present case, to achieve the reduction position of the radial head, it was necessary to first reposition and fix the long radius; therefore, we performed reduction and fixation of the distal radius physeal fracture. In addition, the progression of dislocation of the supracondylar humerus fracture was not evident during manual reduction of the radial head; therefore, reduction and fixation of the Monteggia fracture–dislocation was performed first. As treatment for the Monteggia fracture–dislocation, we planned to perform an open reduction, suspecting the presence of soft tissue in the humeroradial joint during manual reduction. There are four reports of open reduction of the humeroradial joint in patients with Monteggia fracture–dislocation accompanied by distal radius fracture. In one case, the approach is unknown; however, two cases underwent open reduction via the Kocher approach, and one case was treated using the dorsolateral approach [12]. Sood et al. reported good results with treatment using the dorsolateral approach for injuries involving proximal ulna and radius physeal fractures [12]. Generally, approaches to the humeroradial joint are performed using the Kocher approach or the Boyd approach [14].The Boyd approach provides better exposure and is useful for releasing incarcerated soft tissue within the humeroradial joint and reducing and reconstructing the annular ligament [14]. We performed the exposure of the humeroradial joint using the posterior approach. The difference in this approach is that in the Boyd approach, the lateral triceps is exposed, while in the posterior approach, triceps splitting is performed (Fig. 2A) [13]. Distal to the olecranon, the humeroradial joint is accessed by detaching the anconeus muscle from the radial side of the ulna. The posterior approach provides a good field of view for exposing the humeroradial joint. Therefore, it is considered a useful technique for removing soft tissue within the humeroradial joint and performing open reduction of proximal ulna fractures [13].

In this case, no signs of neurovascular injury or acute compartment syndrome were observed throughout the perioperative period, starting from the time of injury. In cases of floating elbow, the incidence of pulseless extremities is reported to be comparable to that of isolated supracondylar fractures, whereas nerve injuries are reported to occur at a higher rate in floating elbow cases [1,15]. In past case reports, totaling 8 cases of pediatric supracondylar humeral fracture accompanied by Monteggia fracture-dislocation, neither pulseless extremities nor nerve injuries were reported. In past case reports, totaling 15 cases of Monteggia fracture-dislocation with concurrent distal radius fracture, no pulseless extremities have been reported. However, nerve injuries have been documented, including one cases of median nerve numbness, two cases of posterior interosseous nerve injury, and one case of combined median, ulnar, radial nerve palsy without vascular injury. Nerve injury associated with Monteggia fracture-dislocation has been reported in 11 % of cases [16]. In Cases of combined Monteggia fracture-dislocation and distal radius fractures, nerve injury was observed in 4 out of 15cases, accounting for approximately 27 %, indicating a higher incidence. In cases of floating elbow, the incidence of acute compartment syndrome is reported to be 2 %, which is higher compared to the 0.2–0.4 % incidence observed in isolated supracondylar humeral fractures [1]. In injuries of supracondylar humeral fractures accompanied by Monteggia fracture-dislocations, as well as in injuries of Monteggia fracture-dislocations accompanied by distal radius fractures, no cases of compartment syndrome have been reported in the literature. However, in cases of combined injuries, the injury mechanism is often associated with higher energy impacts and greater deformity compared to isolated injuries. Therefore, careful attention should be given to neurovascular complications and the potential development of compartment syndrome during treatment.

Conclusion

This case involves a pediatric patient with a supracondylar humerus fracture and Monteggia fracture–dislocation with distal radius physeal fracture in the ipsilateral upper extremity. Reduction and fixation were performed from the distal radius, as it was a distal injury. Open reduction of the humeroradial joint was then carried out using the posterior approach. The patient progressed without the onset of complications, achieving good alignment and resulting in favorable outcomes.

Abbreviations

TEN titanium elastic nail

CRediT authorship contribution statement

Ryu Igaki: Writing – original draft. **Tomohiro Yasuda:** Writing – review & editing. **Yuki Samejima:** Writing – review & editing. **Yuuto Murakami:** Writing – review & editing. **Shinsuke Takagi:** Writing – review & editing. **Keikichi Kawasaki:** Writing – review & editing.

Declaration of competing interest

The level of evidence is a Level IV case report.
The authors declare that there are no conflicts of interest regarding the publication of this paper.

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