

# Divergent Elbow Dislocation and Risk of Compartment Syndrome

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## ABSTRACT

**BACKGROUND:** Divergent pediatric elbow dislocations are very rare injuries.

**CASE:** An eight-year-old boy presented to the emergency department with elbow pain after a fall. On examination his elbow was swollen; skin and neurovascular function were intact. Radiographs demonstrated a divergent elbow dislocation. After successful closed reduction under sedation, the arm was casted; gentle motion was initiated at three weeks. At four months, the patient had full strength, no symptoms, and nearly full range of motion.

**INTERPRETATION:** The literature on the treatment of this injury is limited because of its rarity. We present a case of successful nonoperative management. The return of this patient for compressive symptoms should serve as a reminder that these injuries may be at high risk for compartment syndrome, possibly due to the high level of soft tissue disruption.

**KEYWORDS:** pediatric, divergent, elbow dislocation

## INTRODUCTION

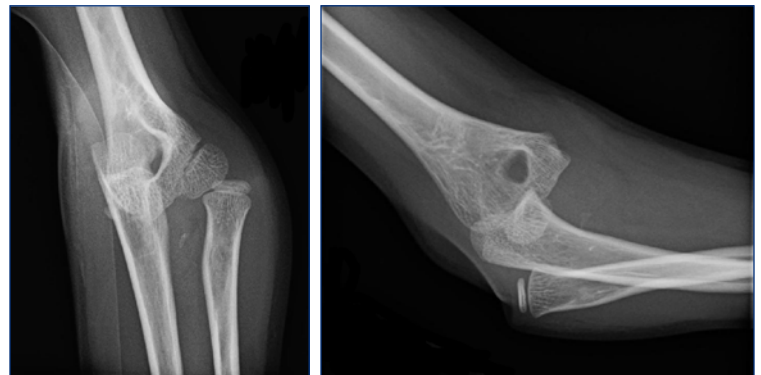
Pediatric elbow dislocations are uncommon, comprising only 3% of pediatric elbow injuries in a series of 1579 patients.<sup>1</sup> Simple dislocations involve only ligamentous injury, while complex dislocations involve concomitant fracture.<sup>2</sup> Posterior dislocations occur far more commonly than anterior dislocations, in both of which the radius and ulna move together as a unit.<sup>3</sup> In divergent dislocations, the proximal radius and ulna are wedged apart by the humerus. In a combined series of 317 elbow dislocations, only five were anterior dislocations, comprising 1.6%.<sup>4,5,6,7</sup> There were no divergent dislocations, so presumably these were even less frequent. This very rare injury was first described clinically in 1854<sup>8</sup> and radiographically in 1981.<sup>9</sup>

Although pediatric elbow dislocations peak in the second decade of life, divergent dislocations are more common in the first decade, with an average age of 8.5, thought to be secondary to increased ligamentous laxity.<sup>10,11</sup> Typically, these injuries involve disruption of both the annular ligament and interosseous membrane of the forearm.<sup>12</sup>

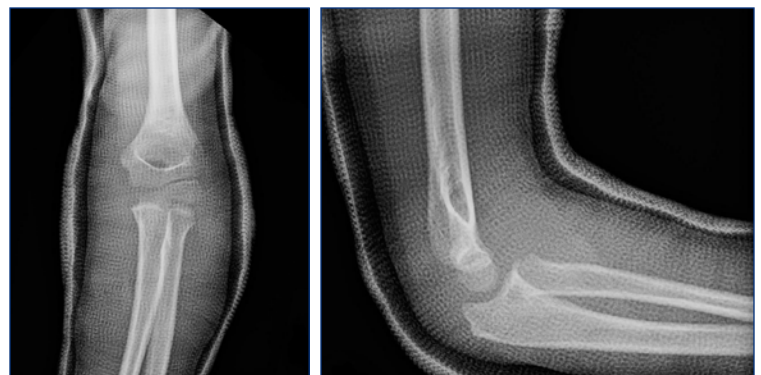
## CASE REPORT

An eight-year-old boy presented to the emergency department with left elbow pain after falling backwards off a playground slide. His skin was intact, and his elbow was swollen with limited range of motion. He was neurovascularly intact, with a palpable radial pulse. Radiographs demonstrated a posterior elbow dislocation with divergence of the proximal radius and ulna, with a small avulsion fracture of the coronoid (**Figures 1 and 2**). Under conscious sedation, the elbow was closed reduced with longitudinal traction and direct posterior pressure over the olecranon. After reduction, the joint was stable through a full arc of motion. The patient was placed in a long arm cast in ninety degrees of elbow flexion and neutral forearm rotation (**Figures 3 and 4**). The patient returned twice over the next two days with

**Figures 1–2.** Anteroposterior (AP) and lateral radiographs of left elbow obtained at time of injury.



**Figures 3–4:** AP and lateral radiographs of the elbow after closed reduction and casting.



increased pain, which resolved with the cast being split with a cast saw and widened with cast spacers. Immobilization was continued for three weeks, followed by transition to a removable splint and gentle elbow range of motion for four weeks. At four months post-injury, the patient had strength equivalent to his contralateral side, without deformity or tenderness. Final radiographs showed normal alignment of the joint (**Figures 5 and 6**). The range of motion of the injured left elbow was 0-145 degrees which lacked approximately five degrees of extension compared to the contralateral side (**Figures 7 and 8**).

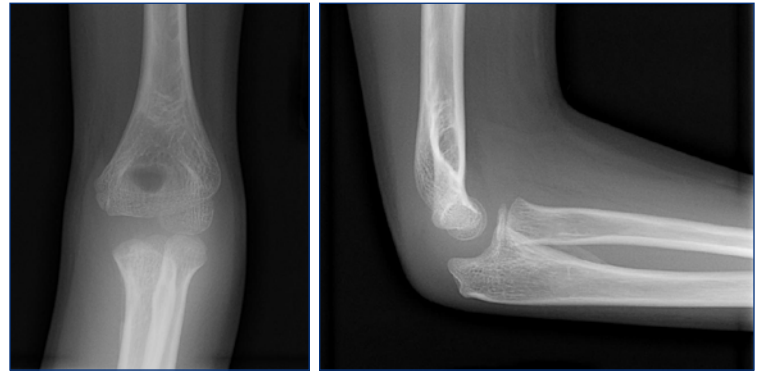
## DISCUSSION

The proposed mechanism of divergent dislocations involves a combination of axial compressive with rotational forces on an outstretched, pronated arm. The injury begins with displacement of the trochlea anteriorly with resultant disruption of the annular ligament from its ulnar attachment. In a complex dislocation, the coronoid process may then fracture. Pronation of the forearm results in lateral translation of the radial head on the capitellum with eventual dislocation. The humerus acts as a wedge driven between the proximal radius and ulna with disruption of the interosseous ligament. Concomitantly, the patient may sustain rupture or avulsion fracture of the medial collateral ligament or medial epicondyle.<sup>2</sup>

When the humerus wedges between the proximal radius and ulna, they can diverge either anteroposteriorly or mediolaterally.<sup>13</sup> A cadaveric study was unable to recreate a stable transverse divergent dislocation with adult cadaveric elbows, though a stable anteroposterior dislocation was obtained by releasing all the ligamentous stabilizers of the elbow. Because the authors could not reproduce dislocations in directions other than posterior, they argued that only posterior divergent elbow dislocations truly exist, and poor quality, oblique injury radiographs likely contribute to the appearance of multiple directions of dislocation.<sup>10</sup>

The majority of reported cases describe conservative, closed reduction with cast immobilization.<sup>10</sup> Conscious sedation or general anesthesia are required for muscle relaxation, analgesia, and anxiolysis. In this case, traction was applied with a posterior force applied to the olecranon resulting in closed reduction of the dislocation. Other authors have described traction with a medial-lateral compressive force applied to the proximal radius and ulna to assist in reduction.<sup>10</sup> Stability throughout the entire elbow range of motion including pronation and supination must be assessed by the provider and documented along with neurovascular status following reduction. Casting is preferred, especially in young children, due to the necessity for immobilization and the difficulty of removing the cast by the patient. A splint, either plaster or fiberglass, can also be used for immobilization provided it is reinforced with extra cotton cast padding and applied to a reliable patient who will not remove it prior to follow-up. Instability, especially in the setting of a large coronoid

**Figures 5–6.** AP and lateral radiographs of the elbow at four-month followup, showing normal alignment.



**Figures 7–8.** Clinical photographs at final follow-up visit four months post-injury demonstrating a five-degree loss of extension of the injured left elbow compared to the contralateral elbow.



fracture, may be an indication for surgical intervention.<sup>2</sup>

Regardless of the method of treatment, the family and child should be instructed to scrupulously ice and elevate the extremity. There are no documented cases of compartment syndrome following a pediatric divergent elbow dislocation in the literature; however, considerable injury to soft tissues including the interosseous membrane during the injury could result in the development of this serious condition.<sup>10</sup> In this case, the patient's soft tissue injury caused increasing swelling even after closed reduction, which resulted in increased pain due to a constrictive cast on the expanding soft tissues. Fortunately, the increasing symptoms prompted an expeditious return to the emergency department, where splitting of the cast resolved the symptoms prior to development of compartment syndrome. Following cast splitting, the patient should be observed until full resolution of symptoms, which often occurs instantaneously with release of a constrictive cast. The most reliable indicator of acute compartment syndrome in pediatric patients is an increasing analgesia requirement.<sup>14</sup> Other potential complications of divergent elbow dislocations include persistent elbow instability and entrapment of the median nerve during reduction.<sup>13</sup>

## CONCLUSION

The literature on the treatment of divergent elbow dislocations is limited to case reports and reviews because of the extreme rarity of these injuries. As such, we present a case of successful conservative management of this injury with closed reduction and a period of immobilization. The return of this patient for compressive symptoms due to the cast should serve as a reminder that these injuries may be at high risk for compartment syndrome, and that casts should likely be split at the time of application. One must be vigilant and have a high index of suspicion to detect compartment syndrome after reduction of these injuries, and proper counseling of the patient and family in the signs and symptoms of impending compartment syndrome is paramount in the treatment of this injury.

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