CASE REPORT

Paediatric forearm fracture with a twist: a proximal radioulnar translocation combined with radial head fracture

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SUMMARY

A 10-year-old girl presented to the emergency department with proximal radioulnar translocation and radial head fracture, after fall onto an outstretched hand. Open reduction was used to reduce and stabilise the elbow joint after which the radial head was fixated by Kirschner wires. Three months after surgery, full range of motion was regained and union of the radial head was achieved. Proximal radioulnar translocation is a rare injury which is often missed on initial radiographs. Persistent restriction of forearm rotation with seemingly normal elbow configuration must trigger to take a closer look at the relationship between the ulna, radius and distal humerus. We show that early diagnosis and treatment of a proximal radioulnar translocation associated with a radial head fracture results in an excellent functional outcome.

BACKGROUND

Dislocation of the elbow in a paediatric patient is very rare. Only 3% of all elbow injuries in children are dislocations, with a peak incidence in the group aged 13–14 years.¹ Within this category, the proximal radioulnar translocation is an extremely rare injury; only 24 cases have been described in English literature with a high incidence of delayed diagnosis.^{2–18} Proximal radioulnar translocation is referred to as a convergent dislocation, where the radius and ulna are dislocated from the humerus, and the radial head is articulating with the trochlea and the olecranon with the capitellum.⁹ We report a case of proximal radioulnar translocation combined with a radial head fracture in a paediatric patient. The clinical importance of this case is that early diagnosis and surgical treatment, within 24 hours, results in an excellent functional outcome at 3 months follow-up, unlike most other described cases.

CASE PRESENTATION

A 10-year-old girl was presented to the emergency department after fall onto an outstretched hand after she was ejected from a swing. She immediately complained of severe pain in her left elbow. Physical examination revealed pain and slight swelling of the elbow. The vascular and neurological integrity of the arm was intact. There were no apparent signs of altered alignment, displacement or rotational deformities. The anteroposterior and lateral radiographs

showed a posterior elbow dislocation and a radial head fracture (figure 1). She was admitted to the hospital for surgical treatment later that day.

TREATMENT

The proximal radioulnar translocation with radial head fracture was treated with open reduction and internal fixation using two Kirschner wires. The operation was performed under general anaesthesia. Closed reduction was attempted, by fixating the humerus and gentle ventrocaudal traction of the lower arm, successfully reducing the humerus in the olecranon. Flexion and extension were possible; however, it was not possible to pronate or supinate the forearm, as the radial head was still dislocated (figure 2A). After the unsuccessful closed reduction, the diagnosis proximal radioulnar translocation was made after closer examination of the perioperative fluoroscopic images. Therefore, open reduction was performed using a lateral approach. The incision was made from the lateral humeral condyle towards the radial shaft. On opening the fascia, extensive muscle damage was found. The interval between the anconeus muscle and extensor carpi ulnaris muscle was identified and separated to gain access to the joint capsule for exposure of the radial head. The radial head was found tilted against the olecranon and could be mobilised and aligned with the capitellum. However, the radial shaft was not visible. It was palpated medial of the ulna, entrapped behind the coronoid. The radius shaft was levered over the coronoid, placing it back in line with the capitellum. Subsequently, the radial head was fixated with two Kirschner wires (figure 2B). After fixation of the radial head, the joint was stable. The annular ligament and fascia were closed; both Kirschner wires were left protruding the fascia to make removal less traumatic. The elbow was immobilised for 4 weeks in a long arm cast. The Kirschner wires were removed under general anaesthesia 4 weeks after initial surgery.

OUTCOME AND FOLLOW-UP

Recovery and functional outcome were evaluated at the outpatient clinic during a period of 3 months following surgery. Ten days after initial surgery, a sensory deficit of the ulnar nerve was observed without loss of motor function, which recovered spontaneously within a few weeks. It is unclear if this deficit was due to the trauma of

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Figure 1 Anteroposterior and lateral radiographs at admission to emergency department, showing a dislocated ulnohumeral joint and a radial head fracture. Close inspection shows that the radius is not in line with the capitellum, suggesting a radioulnar translocation.

the luxation or due to the trauma of the reduction. Range of motion was recorded directly after removal of the Kirschner wires and after 7 and 14 weeks (table 1). Three months after initial surgery, full range of motion was regained (figure 3) and the patient had returned to playing sports. Radiographs revealed complete fracture consolidation (figure 2C). The functional outcome at 3 months was assessed according to the Disabilities of the Arm, Shoulder and Hand score, Dutch Language Version (DASH-DLV).¹⁹ The general DASH-DLV score was 11.3. The additional DASH Sports/Performing Arts Module score to assess her ability to play field hockey was 6.3.

DISCUSSION

To our knowledge, there are 24 reported cases of proximal radioulnar translocations in the English literature (table 2); 22 of these cases involve paediatric patients, and two have been reported in adults.^{3 4} The mechanism of the injury is thought to be a fall onto an hyperpronated outstretched hand, which causes an axial load on the proximal part of the radius. The hyperpronation of the radius disrupts soft tissue and ligaments, especially the annular ligament.⁵ Moreover, there must be injury to the brachial anterior tendon to have medial transposition of the radial head.⁵ Due to incomplete ossification of the coronoid process, an avulsion of the brachialis anterior tendon is often missed on radiographs.⁵ In addition, a different trauma mechanism has been suggested; a fall on an outstretched arm

Table 1 Range of motion in week after initial surgery

Follow-up	4 weeks after surgery	7 weeks after surgery	14 weeks after surgery
Pronation/supination	45-0-45	90-0-60	90-0-90
Flexion/extension	110-40-0	130-40-0	160-0-0

in supination and elbow in flexion, which causes axial loading and a valgus strain. This results in rupture of medial collateral structures and a fracture of the radial neck followed by posterolaterally dislocation of the ulna and medial crossing of the radius over the ulna.⁶

Proximal radioulnar translocation is often overlooked on initial radiographs; among the 24 cases only seven described a diagnosis based on the initial radiographs before closed reduction was attempted.^{5 6 10 12 17} In eight cases, there was delay in recognising the translocation varying from 1 day to 5 weeks.^{2 3 5 7 8 13 14 17} It was defined as delay when the patient was discharged without the diagnosis of translocation and returned to the hospital with persistent symptoms. Different explanations are given in literature as to why this diagnosis is often overlooked: (1) the very low incidence of this type of injury causing physician to misdiagnose the translocation⁷ and (2) during closed reduction a characteristic 'clunk' is felt, which might unfairly suggest successful reduction of the elbow joint. The lateral radiograph afterwards may give the idea of a well-reduced elbow. A closer look at the anteroposterior radiograph is needed to find that the radius is still articulating with the trochlea while the ulna articulates with the capitellum. In addition, after 'reduction' of the dislocation, there is an improved flexion-extension arc of the forearm; however, the forearm is locked in almost complete pronation, which has been referred to as 'pseudoreduction'.^{8 9} Therefore, it is important to inspect the lateral and anteroposterior radiographs with extra vigilance, especially if the patient continues to complain of pain and has restricted rotation of the forearm.

Figure 2 (A) Perioperative radiograph after attempt at closed reduction. The ulnohumeral joint was reduced, while the radial shaft was still dislocated behind the ulna. (B) Postoperative radiograph after fixating radial head with two Kirschner wires and placing long arm splint. (C) Radiograph after 14 weeks follow-up.

Figure 3 Functional outcome at 3-month follow-up. (A) Extension; (B) flexion; (C) pronation and (D) supination.

Table 2 Review of literature

Author	Sex	Age	Side	Diagnosis	Associated fracture	Treatment	Full immobilisation in splint/cast	End follow-up	Functional outcome at end follow-up	Complications
Agashe <i>et al</i> ⁸	M	12	L	Delay (7 days)	Salter Harris II	ORIF (two screws) after two CR attempts	4 weeks	2 year	F/E 120–5, P/S FROM	–
Antonios <i>et al</i> ¹⁶	F	10	L	Early (after CR attempt)	None	CR after two CR attempts	4 weeks	5 months	FROM	Light paraesthesia ulnar nerve after trauma (resolved within 4 weeks)
Carey <i>et al</i> ⁹	M	12	L	Early (after CR attempt)	Avulsion coronoid	OR after CR attempt	3 weeks	6 months	FROM	Paraesthesia ulnar nerve after trauma (resolved within 3 days)
Carl <i>et al</i> ¹⁸	F	10	R	Early	Radial neck	OR after two CR attempts	Unknown	2 year	F/E FROM, P/S 90–75	Unknown
Combourieu <i>et al</i> ⁵	F	6	R	Early (initial radiographs)	None	CR	2 months	1 year	FROM	Transient ulnar nerve palsy during follow-up (resolved within 6 months)
	M	12	L	Delay (2 months)	None	OR after CR attempts	Unknown	1 year	F/E 150–0, P/S 70–145	Partial ulnar nerve palsy with paraesthesia (resolved within 1 year). At 1 year slight growth disturbance radial head
	M	9	L	Early (initial radiographs)	None	CR	3 weeks	5 months	FROM	Incomplete motor and sensory ulnar nerve palsy (resolved within 5 months). Growth disturbance of radial head and anterior calcification
Eklöf <i>et al</i> ¹⁷	F	8	R	Delay (5 weeks)	Avulsion coronoid	OR of translocation after ORIF for avulsion	Unknown	2–5 year	Restricted elbow motility	–
	F	8	R	Early (initial radiographs)	Radial neck	ORIF after CR attempts	Unknown	4 months	FROM	–
	M	10	–	Early	Radial neck	ORIF after CR attempt	Unknown	3 months	FROM	–
Galea <i>et al</i> ¹³	F	6	R	Delay (5 days)	None	OR after CR attempt	5 weeks	5 months	FROM (at 10 weeks)	Postoperative median nerve palsy
Gillingham <i>et al</i> ¹⁴	F	6	L	Delay (15 days)	None	ORIF (K-wire) after two CR attempts	3 weeks	2 year	F/E FROM, P/S 70–30	–
Harvey <i>et al</i> ²	F	7	R	Delay (5 weeks delay)	None	OR with osteotomy proximal ulna after CR attempt	Unknown	3 months	F/E 100–30, P/S 30–10	Complete ulnar nerve paralysis after surgery (resolved within 2 months). At 3 months AVN radial head
Isbister <i>et al</i> ⁶	M	11	L	Early (initial radiograph)	Salter Harris II	ORIF (K-wire) after CR attempt	3 weeks	2 year	F/E 140–0, P/S 55–45	–
	M	13	R	Early (initial radiograph)	Salter Harris II	ORIF (K-wire) after CR attempt	Unknown	2 year	F/E 145–0, P/S 50–50	Paraesthesia ulnar nerve after trauma (resolved within 3 weeks). Heterotopic ossification, marked callus formation and slight deformity.
Lee <i>et al</i> ¹⁵	F	10	L	Early (after CR attempt)	None	CR at second CR attempt	4 weeks	2 year	FROM (at 3 months)	Motor and sensory ulnar nerve palsy after trauma (resolved within 5 weeks).
Lippe <i>et al</i> ⁴	F	34	L	Early (after CR attempt)	None	OR after two CR attempts	3 weeks	2 year	F/E 130–10, P/S FROM	–
MacSween <i>et al</i> ¹¹	M	6	L	Early (after CR attempt)	Radial neck	CR at second CR attempt	3 weeks	1 year	FROM (at 5 months)	–

Continued

Table 2 Continued

Author	Sex	Age	Side	Diagnosis	Associated fracture	Treatment	Full immobilisation in splint/cast	End follow-up	Functional outcome at end follow-up	Complications
Parikh <i>et al</i> ¹²	M	16	L	Early (initial radiographs)	Radial neck	ORIF (three K-wires and removal intra-articular coronoid osteochondral fragment) after CR attempt	Unknown	4 year	FROM	Paraesthesia ulnar nerve after trauma (resolved within 1 month). At 4 years heterotrophic ossification and possible non-union radial neck fracture.
Robert <i>et al</i> ³	F	27	L	Delay (2 weeks)	Radial head	OR with osteotomy radial head after two CR attempts	4 weeks	3 year	F/E 135–25°, P/S 80–60° (at 6 months)	Occasional wrist discomfort
	M	15	L	Early (after CR attempt)	Radial head	ORIF (three K-wires) after CR attempt	5.5 weeks	2 year	FROM	Little sign of radiographic union at 2 years.
	M	12	–	Early (during OR)	Radial head	ORIF (two K-wires) after CR attempt	5 weeks	6 months	F/E FROM, P/S 50–30	Delayed union of radial head.
Saied <i>et al</i> ¹⁰	M	10	R	Early (initial radiographs)	Radial neck	ORIF (two K-wires) after CR attempt	3 weeks	7 year	F/E 130–0°, P/S 50–90	Mild heterotopic ossification and stigmata old radial neck fracture.
Yoon <i>et al</i> ⁷	M	5	L	Delay (1 day)	Radial head	OR after two CR attempts	4 weeks	1 year	FROM (at 6 months)	Heterotopic ossification.

Delay: when patient is discharged from ER without diagnosis of translocation and returns to hospital with persistent symptoms. Early: diagnosis made based on initial radiographs, after CR attempt or during OR. CR, closed reduction; F, female; FROM, full range of motion; F/E, flexion–extension arc; K-wire, Kirschner wire; L, left; M, male; OR, open reduction; ORIF, open reduction and internal fixation; P/S, pronation–supination arc; R, right.

Proximal radioulnar translocation is often accompanied by other fractures, 15 out of the 24 cases reported a concomitant fracture including radial neck fractures,^{10–12 17 18} radial head fractures^{3 6–8} and coronoid avulsions.^{9 17} These fractures often determine the therapeutic options. In only five cases, closed reduction was successful,^{5 11 15 16} of which only one was accompanied with a translocation associated fracture.¹¹ It has been stated that, when the diagnosis takes place early, closed reduction with hypersupination could effectively reduce the translocation.¹¹ Most translocations were treated with open reduction (9 out of 24) or with open reduction and internal fixation (10 out of 24) due to an associated fracture. Open reduction and internal fixation were mostly done with one or two Kirschner wires. Alternatives, as two screws have been described to fixated the radial head.⁹ In two cases, an osteotomy of the ulna or radial head was necessary to achieve reduction of the translocation.^{2 3} A method not previously used for fixation of radial neck fractures associated with proximal radioulnar translocation is the radial retrograde flexible intramedullary nail. This technique has shown good results with isolated radial neck fractures and could be contemplated for future cases, given the good functional outcome and minimal invasiveness of this approach.^{20 21}

Functional outcomes differ in literature; 12 cases report full range of motion at the end of follow-up, varying between regaining full range of motion at 3 months and up to 3 years after the sustained injury.^{3 5 7 9 11 13 15–17} Eight cases report restricted elbow motion in the flexion–extension and/or pronation–supination arc after 2 years of follow-up.^{4 6 8 10 14 17 18} Of these cases, only three had an delay in diagnosis.^{8 14 17} All the patients with a restricted motion at 2-year follow-up were surgically treated; five with open reduction and internal fixation^{6 8 10 14} and three with only open reduction.^{4 17 18}

A common complication of the proximal radioulnar translocation is incomplete ulnar nerve palsy; nine patients presented with an ulnar nerve palsy either after the trauma or after (surgical) treatment, all recovered simultaneously within 1 year.^{2 5 6 9 12 15 16} Other complications described in the literature are heterotopic ossifications,^{6 7 10 12} delayed or non-unions of the proximal radius,^{3 12} median nerve palsy after surgery,¹³ growth disturbance of radial head⁵ and avascular necrosis of the radial head.²

In our case, an early diagnosis was followed-up by surgery within 24 hours, which in our eyes greatly contributed to the fast and full functional recovery.

Learning points

- ▶ Proximal radioulnar translocation is an extremely rare injury with a high rate of delayed diagnoses, concomitant fractures and complications.
- ▶ When assessing a radiograph after elbow trauma, take a close look at the relationship between the ulna, radius and the distal humerus; since proximal radioulnar translocation is often missed on initial radiographs.
- ▶ If a patient has persistent pain and restricted rotation of the forearm after a trauma onto outstretched hand even though the elbow configuration seems normal on radiographs, be extra mindful of a possible translocation.
- ▶ Open reduction and internal fixation with two Kirschner wires is an effective and safe treatment option for stabilisation of the elbow joint after proximal radioulnar translocation associated with radial head fracture.

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