

Convergent luxation in pediatric elbow

Report of two cases

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ABSTRACT

We present two cases and a current literature review of convergent elbow dislocation (luxation). In the first case, we show how a diagnosis delay will lead the intervening doctors to open reduction and fixation with Kirschner wires, whereas an early diagnosis allows them closed reduction and conservative treatment, as described in the second case. The key to diagnosis in convergent elbow dislocation is the correct interpretation of X-rays and the blockage in pronation in physical examination. It is advisable to use indomethacin to avoid heterotopic calcifications. Final outcomes are better when diagnosis is early, independently of the reduction method.

Key words: Convergent elbow dislocation; elbow dislocation; Pediatrics; radio-ulnar translocation

Level of evidence: IV

LUXACIÓN CONVERGENTE EN CODO PEDIÁTRICO. REPORTE DE DOS CASOS

RESUMEN

Se presentan dos casos clínicos y la revisión de la literatura actual sobre luxación convergente de codo. En el primer caso, se muestra cómo un retraso en el diagnóstico conducirá a una reducción abierta y fijación con agujas de Kirschner, mientras que un diagnóstico temprano permite la reducción cerrada y el tratamiento conservador como se describe en el segundo caso.

La clave de diagnóstico para la luxación convergente de codo radica en la correcta interpretación de las radiografías y el bloque de prono-supinación en el examen físico. Se recomienda el uso de indometacina para evitar calcificaciones heterotópicas. El resultado final es mejor cuando el diagnóstico es precoz, independientemente del método de reducción.

Palabras clave: Luxación convergente; luxación de codo; pediatría; traslocación radiocubital.

Nivel de Evidencia: IV

Introduction

Elbow dislocation (luxation) accounts for the 3% of the injuries that are caused by traumatism in such joint during childhood. According to the widely accepted clas-

sification,¹ dislocation can occur with or without injury of the proximal radio-ulnar joint. If this one gets injured, dislocation can be divergent (when the ulnar and radius axes are proximally separate) or convergent (when there is translocation of olecranon process and radial head).

Conflict of interests: The authors have reported none.

This type of infrequent dislocations was described by Crawford,² for the first time in 1977 and, among the injuries they are usually associated with, we can mention fractures, vascular or nervous complications, heterotopic calcification, rigidity and recurrent dislocation.³

We present two cases treated at our Center, which can be considered paradigmatic cases due to the therapeutic differences subsequent to diagnosis timing.

Case # 1

Seven-year old boy who, upon falling from his bicycle, is assisted at the ER where he is diagnosed right elbow posterior dislocation (Figure 1A) and treated by closed reduction and immobilization in long arm splint.

Three weeks afterwards, he is subject to examination at follow-up consultation and, upon removing the splint, inflammatory signs remain and there is discrete asymmetry in the Nelaton's triangle. While checking joint balance, he is objectified forearm pronation blockage with preserved elbow flexion-extension. There is no neuro-vascular deficit.

In follow-up X-rays, the ulnar and radial bones dispositions with respect to the distal humerus in the A-P X-ray projection call the intervening doctors' attention, an abnormality that is verified in all radiographic projections. Anatomy is altered—the radius articulates with the trochlea, whereas the ulna articulates with the humeral capitellum (Figure 1B).

Upon this finding he is diagnosed proximal radio-ulnar translocation or convergent elbow dislocation.

Under general anesthesia we carry out elbow lateral approach. Once the joint has been disclosed, we confirm the translocation of both bones and verify the radius making contact with the trochlea (Figure 2). We go on to joint reduction and, in order to secure joint stability, we implant two Kirschner wires (one of them in transolecranon position and the other one through the humeral capitellum). We give immobilization with a 90°-flexion elbow splint and administer indomethacin.

Three weeks after the surgery we decide to remove both wires and splint and start rehabilitation.

Six months afterwards, we verify normal alignment in follow-up X-ray. With respect to joint balance, elbow flexion, extension and supination are complete, but there is a 30°-functional deficit in pronation as compared to the contralateral elbow, which since has remained (Figure 3).

Case # 2

Seven-year old girl who consults the ER upon falling from swing; she shows pain, deformity and functional impairment in right elbow. She does not show sensitive-motor abnormalities.

Initial X-rays show posterior elbow dislocation and Salter-Harris type II epiphysiolysis in proximal radius (Figure 4).



▲ **Figure 1.** Altered anatomic relationship between radius and ulna.

Figure 2. Radius (1) articulating with humeral trochlea (2).

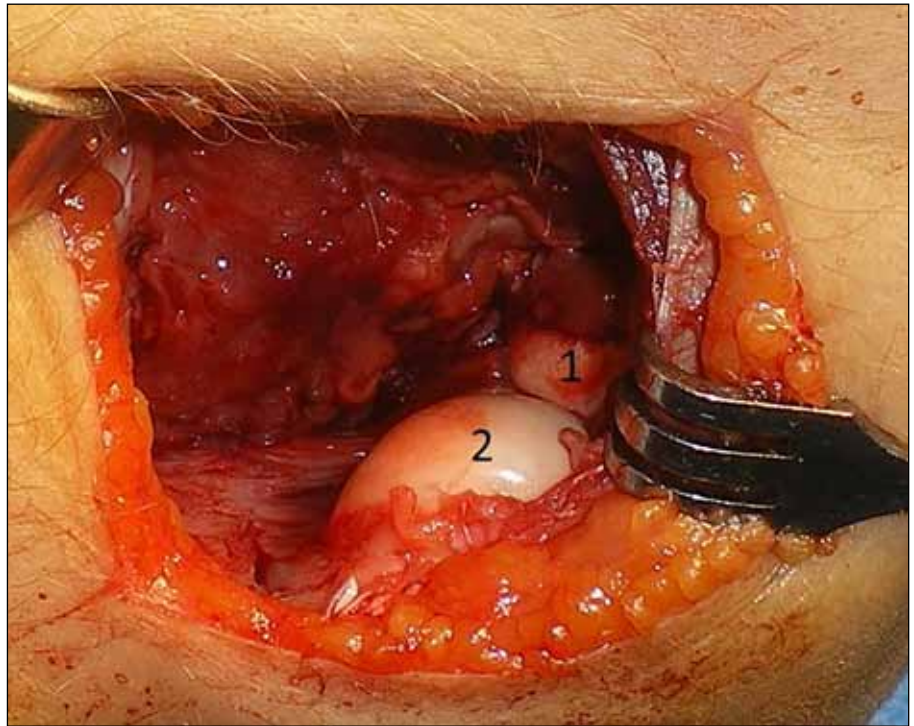


Figure 3. Six-month post-operative X-rays. There is normal alignment.



Figure 4. Posterior elbow dislocation and Salter-Harris type II proximal radius fracture.



At the ER she is subject to closed reduction of posterior elbow dislocation and is noticed to suffer proximal radioulnar translocation, which is confirmed with CT scan.

After general sedation-analgesia, closed reduction is successfully carried out and the patient is put in cylindrical long arm cast, which is kept 5 weeks (Figure 5).

Fourteen months later, both elbow flexion-extension mobility and pronosupination mobility are complete. In follow-up X-ray we verify the correct alignment of all bone components, but there is rarefaction in radial head (Figure 6), as well as heterotopic calcification in brachialis muscle, which is verified by MRI.



▲ **Figure 5.** X-rays upon reduction.



▲ **Figure 6.** Radial head rarefaction with heterotopic calcification in brachialis muscle.

Discussion

In this review, we include two paradigmatic cases of this type of injuries, which add to the 26 that have already been described in the specialized literature (Table). Age at the time of the presentation of this type of injuries ranges

from 6 to 13 years old;^{4,5} they affect boys and girls indistinctly. Fourteen cases, along with the two cases we present here, also suffered an associated fracture—the most frequent ones being proximal radius epiphysiolysis and radial neck fracture (13 cases and our Case # 2), followed by coronoid process fracture (2 cases).

Table. Published cases

Article	Age	Sex	Associated fractures	Neuro-vascular status	Treatment	Diagnosis timing	Extension/ Flexion	Pronation/ Supination	Complications
Crawford	12	F	PR	No	ORIF	-	30/80	20/20	
MacSween	6	M	PR	No	CR	Early	-10/Complete		
Harvey	7	F	No	Post. ulnar	OR	5 weeks	30/100	10/30	PR avascular necrosis
Schullion	11	M	PR	No	ORIF	Early	Remarkable loss		HC
Carey	12	M	Coronoid process	Ulnar	OR	Early	Complete		
Eklof	8	F	Coronoid process	No	ORIF	5 weeks	Remarkable loss		
	8	F	PR	No	ORIF	Early	Complete		
	10	M	PR	No	ORIF	Early	Complete		
Ibister	11	M	PR	No	ORIF	Early	0/140	45/55	
	13	M	PR	Ulnar	ORIF	Early	0/145	50/50	HC + PR rarefaction
Carl	10	F	PR	No	OR	Early	Complete	Complete/15	
Gillingham	6	F	No	Normal	ORIF	2 weeks	Complete	-20/-50	PR rarefaction
Leconte	15	F	PR	Median	ORIF	Early	Complete		
Rodrigo	10	M	PR	No	CR + pKW	Early	Complete	-10/Complete	PR rarefaction
Galea	6	F	No	Post median	RA	5 days	Complete		
Bon-Jin Lee	10	F	No	Ulnar	RC	Early	Complete		
Gascó	9	M	No	No	OR	3 weeks	Complete	Pérdida 30°	HC
Saied	10	F	PR	No	ORIF	Early	Complete/130	50/Complete	HC + PR rarefaction
Wodecki	6	F	No	Ulnar	OR	Early	Complete		
Roberts	12	M	No	No	ORIF	Early	0/145	30/50	PR rarefaction
	15	M	PR	No	ORIF	Early	Complete		PR non-union
Combourieu	6	F	No	Ulnar	CR	Early	Complete		
	12	M	No	Ulnar	CR	2 months	0/150	70/145	HC + PR rarefaction
	9	M	No	Ulnar	CR	Early	Complete		HC + PR rarefaction
Antonis	10	F	No	Ulnar	CR	Early	Complete		
Parikh	16	M	PR	Ulnar	ORIF	Early	Complete		

F = female, M = male, RP = proximal radius, post = post-operative, ORIF = open reduction and internal fixation, CR = closed reduction, OR = open reduction, pKW = percutaneous Kirschner wires; HC = heterotopic calcification.

They are caused by indirect traumatism in the context of accidental fall, which generates valgus-axial compression^{4,6-10} which, with extended elbow and forcefully pronated forearm,^{11,12} causes the rupture of the joint capsule and the proximal radio-ulnar joint (annular ligament and external lateral ligament), as well as the rupture of the proximal portion of the interosseous membrane.^{3,6,8,10,12-15} This makes the radius cross the front of the ulna and this one displace laterally and articulate with the humeral capitellum.

The axial load in elbow extension can cause the fracture of the coronoid process—if the elbow is in hyperextension, or that of the radial head, which is more likely to fracture as the elbow gains flexion degrees.

The avulsion of the brachialis muscle tendon is necessary for the radial head to carry out medial translocation.³ This is an underdiagnosed injury due to the incomplete ossification of the coronoid process, but it becomes visible with subsequent heterotopic ossification on the front aspect of the ulna.⁸

Moreover, Harvey suggests the possibility of iatrogenic translocation, upon carrying out closed reduction in posterior-lateral or lateral dislocation of the elbow with pronated forearm when the proximal radio-ulnar joint is injured.^{3,6,8,13,16,17}

Findings do not differ substantially from those in usual dislocation, but it is very important to check joint mobility, especially upon reduction,^{4,9,11,17-19} because if elbow flexion-extension is preserved with blockage in forearm pronation, it is highly likely that the proximal radio-ulnar relationship is inadequate.^{8,14}

This type of dislocations can cause the stretch of the neuro-vascular bundle and generate neuropraxia,¹⁵ the most frequent one being that of the ulnar nerve (9 cases), with complete spontaneous resolution.^{8,10}

All authors agree that the key to the early diagnosis of this condition is the correct interpretation of (A-P and lateral) X-rays, looking for the correct relationship between the radius and the humeral capitellum. It is possible to guide oneself with a radio-capitellum line that goes through the axis of the proximal radius and coincides with the humeral capitellum.^{14,20} The initial diagnosis at the ER can be hampered by dubious X-rays because of improper arm position secondary to pain and deformity in small children; therefore, CT scan can be most helpful,⁹ especially for surgical planning and to communicate likely open reduction to the child's family.⁵

In most cases this condition was diagnosed early or upon failed reduction (19 cases and our Case # 2). Only in 5 cases and in our Case #1, it took more than two weeks to make diagnosis, what caused contraction of soft tissues and made reduction difficult,^{10, 19} and gave place to the for-

mation of a scar between the proximal radius and ulna.⁸

With respect to treatment, 25% underwent closed reduction, half the cases required additional stability with Kirschner wires, and 75% demanded open reduction due to impossible closed reduction (probably due to the blockage of the radial epiphysis in its abnormal location)^{17,21} due to late diagnosis or due to the necessary reduction of the fracture of the radial head.^{8,19}

Closed reduction should be carried out applying direct pressure on the ulna and radius (especially on the medial aspect of the radius) and giving longitudinal traction to the forearm in supination.^{7-9,18,20}

If closed reduction is not possible, it is necessary to opt for the surgical approach of the injury under general anesthesia. The type of surgical approach is controversial (with lateral approach described in 5 cases and our Case # 1^{7,14,15,17,21}, medial approach in 3 cases,^{11,15} and both approaches in 2 cases).^{8,9}

Upon performing the surgical approach, it is necessary to go on to the translocation of the radial head by finger pressure⁵ with the arm in supination¹⁴ and continue with the reconstruction of the avulsion of the brachialis muscle tendon¹¹ and the annular ligament (with the Speed and Boyd's technique,¹⁷ with triceps tendon in the Bell Tawse's technique¹⁴ or with scar remains dissected while releasing soft tissues).⁸

If upon reconstruction of the annular ligament the elbow remains unstable, it is necessary to consider the need for securing the radio-capitellum relationship with Kirschner wires, which will be removed three weeks afterwards.^{6,7,13,14,19}

In two of the cases of open reduction, there were transitory nerve injuries in the ulnar³ or median²⁰ nerves.

Upon reduction it is advisable to give the patient immobilization with long arm cast with 90° flexion elbow and neutral forearm during 3 to 4 weeks due to the important involvement of the soft tissues.^{5,6,8,9,16,21}

A diagnosis that takes more than two weeks to be made results in poor outcomes in terms of ROM (especially pronosupination),^{14,19} which is the most important prognosis factor in early diagnosis. There can also be valgus-ulnar instability and nervous injury.²⁰

Apart from these limitations, in Robert's cases¹⁹ patients experience late wrist pain that can be associated with the injury of the interosseous membrane.

Among the late complications in this type of injuries it is worth mentioning the infrequent rarefactions in radial head (40% of the cases), possibly due to the partial interruption of the epiphyseal vessels subsequent to the great translocation that the proximal radius suffers at the time of the injury,^{8,13} along with the aforementioned heterotopic calcifications, in 25% of the cases.

Conclusions

Undoubtedly, the key to the diagnosis of convergent elbow dislocations is the correct interpretation of X-rays (especially the A-P elbow X-ray), along with the blockage in prono-supination in physical examination, especially upon reduction of posterior elbow dislocations.

When reduction of lateral or posterior-lateral elbow dislocation is carried out, it is necessary to avoid forceful pronation of the forearm so as to avoid the iatrogenic

translocation of both forearm bones. The injury of the ulnar nerve is frequent in this type of injuries, but the patients have always recovered in few months.

In the definite treatment of this injury it is necessary to include indomethacin to avoid heterotopic calcifications.

Finally, it is worth highlighting that not infrequently this injury can be overlooked and outcomes were good when there was early diagnosis, independently of the reduction method.

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