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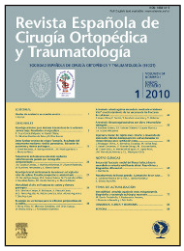

CASE REPORT

# Incarcerated humerus fracture with radial palsy in a child: open reduction and percutaneous fixation technique. A case presentation and literature review

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**KEYWORDS**
Humeral fracture;
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**Abstract** Radial nerve palsy after humeral shaft fractures can be secondary to manipulation. Incorrect diagnosis of soft tissue entrapment can lead to repetitive manipulation, putting the radial nerve at risk. We present a case of humeral shaft fracture with soft tissue entrapment and secondary nerve palsy that was successfully managed with open reduction and percutaneous fixation. We discuss the correct management in these cases.


**PALABRAS CLAVE**
Fractura húmero;
Paresia radial

**Fractura de húmero con interposición de partes blandas y paresia radial en un niño: técnica de reducción abierta y fijación percutánea. A propósito de un caso y revisión bibliográfica**

**Resumen** Una paresia del nervio radial puede ocurrir secundaria a una manipulación. Un error diagnóstico de interposición de partes blandas puede ocasionar una manipulación repetida con el consiguiente riesgo de lesión del nervio radial. Presentamos un caso de un niño con una fractura diafisaria de húmero con interposición de partes blandas y paresia radial secundaria con buen resultado tras reducción abierta y fijación percutánea. Revisamos el adecuado manejo en estos casos.


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## Introduction

With a non-reducing humeral diaphysis fracture and radial paresis, we must differentiate between unstable fracture and irreducible fracture, by the interposition of the nerve or the muscle. A careful physical examination and radiological interpretation are essential for correct diagnosis. Radial paresis associated with humeral diaphyseal fracture is a rare complication in children. If it occurs, recovery is excellent in most cases, with a recovery rate of 78-100% without surgery. Management should consequently be expectant and conservative. In radial nerve secondary palsy, occurring after manipulation or reduction, recovery takes place in 80-100% of cases without requiring surgical treatment either. If the paresis presents following a period of time, it is probably due to bone callus formation in the healing period.[4] We present the case of a patient with radial palsy after a humeral diaphysis fracture with muscle interposition, with open reduction and percutaneous fixing through Kirschner wires.

## Clinical case

A 6-year-old girl attended our emergency department 3 days after suffering a high energy traffic accident. She had been examined at another hospital and diagnosed with right humeral diaphysis fracture. Closed reduction was attempted without success. She had no prior neurological deficits and a diagnosis of unstable fracture was reached.

The patient had a deformity in her right arm, with ecchymosis on the posterior side, with clear skin retraction or wrinkle at the level of the fracture[1] (fig. 1). There was no crackling upon exploration. Vascular examination was normal, and there was complete radial nerve palsy.

**Figure 1** Cutaneous retraction of the arm.

The radiograph showed a transverse diaphyseal fracture with a third displaced fragment (fig. 2). The distal fragment was subcutaneous across the muscle plane just under the skin.

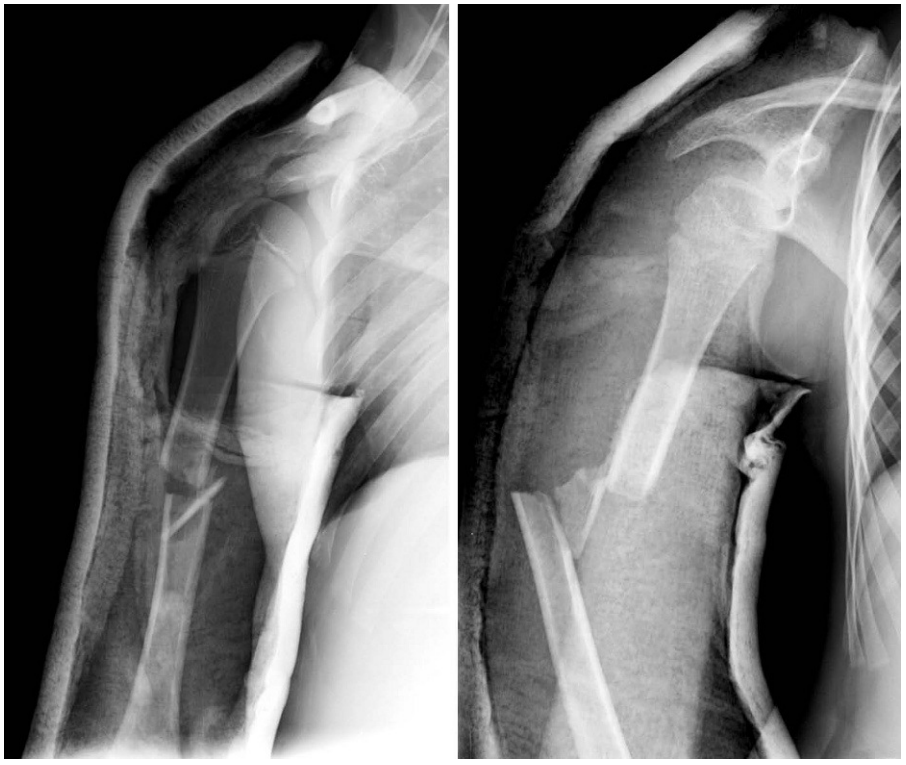

**Figure 2** Humeral diaphysis fracture with radiographic evidence of interposition.

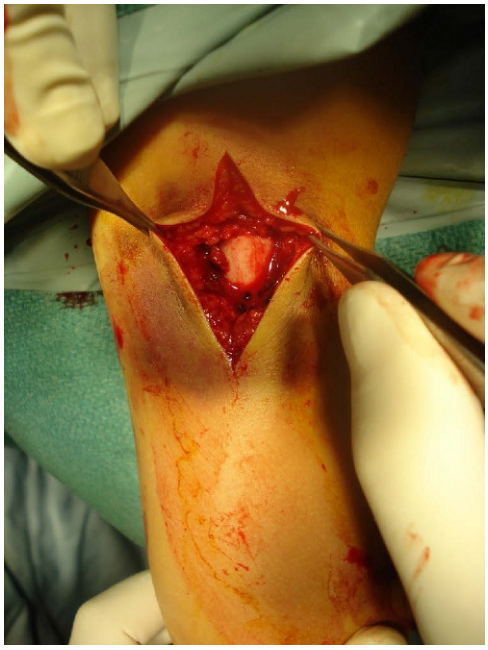

**Figure 3** Distal fragment of humerus through the muscle plane.

**Figure 4** Radial nerve.

This radiological image, along with the skin retraction and lack of crepitus with motion, led us to suspect the existence of tissue interposition. The decision was taken to confirm this under direct fluoroscopy and not to perform closed reduction because muscular interposition, due to manipulation, despite having achieved a reduction, could have exacerbated the neurological damage. We then carried out open reduction and fixation with radial nerve exploration.

## Surgical technique

Under general anaesthesia, the patient lay prone with a radiolucent support under the right arm. Radiation protection was put in place and i.v. antibiotic prophylaxis was administered. The interposition in the fracture was confirmed by continuous fluoroscopy.

A posterior longitudinal incision was made on the arm at the level of the fracture. The fascia was opened and the distal fragment protruding through the triceps was identified immediately (fig. 3). The radial nerve was explored with no signs of laceration, transection or elongation (fig. 4). The periosteum was removed from the fracture and then it was reduced at all levels, with a visual control of the radial nerve.

Retrograde percutaneous pinning was performed with a K needle associated with a small medial incision for the control of the ulnar nerve at the elbow. Pre-moulded tip needles (1.8 mm) were advanced from medial and lateral positions through the medullary canal to the area near the proximal physis. A divergent assembly was obtained, to achieve rotational stability of the fracture (fig. 5). A U splint was put in place for 3 postoperative weeks.

After 2 weeks follow up, the patient had regained full function of the radial nerve. The needles were removed at 6 weeks. No pain and no mobility at the fracture site were reported. The patient presented full mobility of the shoulder and elbow and radiographs showed correct fracture union (fig. 6).

**Figure 5** Reduction and synthesis of the fracture.

## Discussion

Humeral diaphysis fractures represent 3% of fractures in patients younger than 16 years old, usually following minor

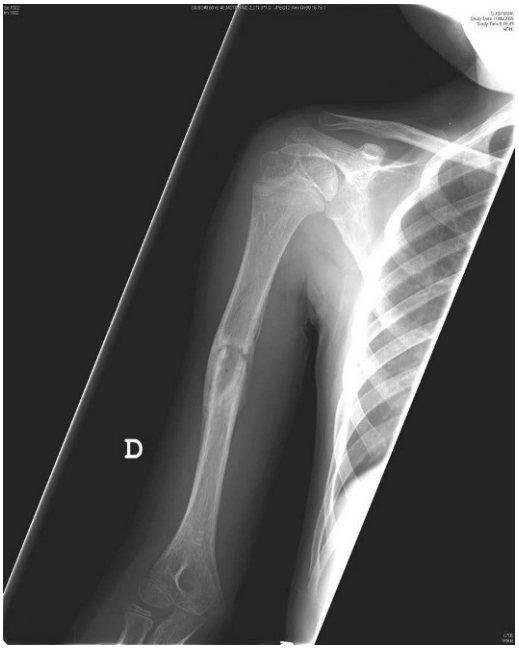


**Figure 6** Postoperative image.

trauma. High-energy fractures usually associate comminution.[2] The most frequent neurological complication is radial paresis, which represents between 2% and 17%,[3-5] with recent studies documenting this association in 9%.[6] At present, a greater major association of radial paresis with a certain type of fracture of the distal humerus[9] has been put in doubt.[5-7]

The radial nerve is particularly vulnerable in high-energy trauma, through its close association with the humerus surrounded by the lateral head of the triceps at the level of the diaphysis. Its vascularization is also easily compromised at this level, contributing as a further risk factor.[9]

Primary paresis occurs at the time of the lesion and is found during the exploration of the patient. Approximately 10% to 20% of paresis are developed in the course of treatment, especially after closed reduction, and are called secondary paresis. These secondary paresis occur more often in fractures of the middle and distal thirds the humeral diaphysis.[3] If the brachioradialis or carpi radialis longus extensor muscles are not functional at the time of injury, neurological damage is located at the level of the humeral diaphysis.

The peripheral nerve can be injured in different ways, from simple compression, to complete section, laceration or elongation to a traction injury of the brachial plexus (including avulsion of the nerve roots at the spinal level).[10] Radial paresis may be partial or complete; complete motor deficit occurs in 50% of cases.[5]

When radial paresis occurs after fracture manipulation (secondary paresis), many surgeons advocate direct examination of the nerve due to the suspicion of nerve interposition in the fracture.[9] However, the review by Shao[3] found no differences between the recovery of primary and secondary paresis without surgery, with results of 88.6% and 93.1% respectively. No prospective, there are no randomized trials that compare observation with early surgical treatment of radial paresis after humeral diaphysis fracture.

An electromyogram could distinguish between neuropraxia and axonotmesis, between 9 and 11 days after the injury, when a complete Wallerian degeneration has occurred and the muscle action and sensory potentials show changes.[10-12] However, sensitivity increases from 21-30 days after the injury (depending on the length of the distal nerve stump). In experienced hands, an echo can detect an interposition or nerve transection, being useful in the choice of treatment.[13,14]

Echo, CT and MRI techniques may be helpful in certain cases (brachial plexus lesion), but their implementation should not delay surgical nerve exploration when urgently indicated.[15]

In our case, the patient presented a diaphyseal fracture with interposition and secondary radial paresis, so an open reduction and exploration of the radial nerve were performed.

When this type of fracture is suspected, reduction efforts should be carried out under direct fluoroscopic control, to avoid having a false sensation of unstable fracture in case of irreducible fracture. An open reduction may be indicated, so as not to cause secondary paresis or worsening of the neurological injury by fracture manipulation.

Consequently, when diagnosing a humeral diaphysis fracture with skin retraction at the focus,[1] with no crepitation, we must consider the possibility of interposition. In that is confirmed by image intensifier, we do not recommend attempting closed reduction, and open reduction with radial nerve exploration should be considered if there is an associated prior paresis. Faced with the possibility of neurological damage, the surgeon should be prepared for surgical repair of the peripheral nerve.

In our case, the surgical treatment of humeral fracture with soft tissue interposition associated with radial paresis with open reduction and synthesis with needles was effective.

Adequate studies are needed to clarify the appropriate management of this type of lesion.

## Level of evidence

Level of evidence V.

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