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# Spontaneous Full Recovery of High Radial Nerve Palsy Following Closed Reduction and Percutaneous Pinning of Gartland IV Supracondylar Fracture: A Case Report

## Authors' Contribution:

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Data Collection B  
Statistical Analysis C  
Data Interpretation D  
Manuscript Preparation E  
Literature Search F  
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**Conflict of interest:** None declared

**Patient:** Male, 8-year-old  
**Final Diagnosis:** Supracondylar fracture with radial nerve neuropraxia  
**Symptoms:** Wrist and finger drops  
**Medication:** —  
**Clinical Procedure:** —  
**Specialty:** Orthopedics and Traumatology

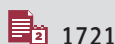
**Objective:** Unusual clinical course  
**Background:** Supracondylar fracture is one of the most common pediatric traumatic fractures. It is subclassified into 2 entities: the extension type, which is predominantly seen, and the flexion type. It can be further classified into 4 types according to the Gartland classification, which assesses the anatomical severity of the fracture depending on the lateral radiographs of the elbow and operative findings. The usual mechanism of injury is falling on outstretched hands.

**Case Report:** This study presents a rare case of high radial nerve palsy seen in an 8-year-old previously healthy male patient after closed reduction and percutaneous pinning of a Gartland type IV supracondylar fracture using 2 lateral diverging pins and 1 medial crossing pin. Several attempts of forceful maneuvers were needed to anatomically reduce the fracture. X-rays and contrasted CT scan were done after the surgery, confirming proper placement of pins and intact vascularity. However, a CT scan revealed a large hematoma in the posterior compartment of the arm and subcutaneous edema with soft-tissue swelling at the left elbow. A conservative management plan was established with serial physical examination and follow-up for the next 3-6 months. Subsequently, the patient experienced dramatic improvement of nerve function over 6 weeks following the surgery, and complete recovery of radial nerve motor and sensory function was achieved 2 months after the operation.

**Conclusions:** Most nerve injuries are a neuropraxic nerve injuries, which resolve spontaneously without intervention. Physicians usually reserve any surgical intervention in case of progressive worsening of neurological deficit or if no improvement occurs in 3-6 months.

**Keywords:** Humeral Fractures • Radial Nerve • Remission, Spontaneous

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## Background

Supracondylar fracture is one of the most common pediatric traumatic fractures. It accounts for 13% of all pediatric fractures and 60% of upper-limb fractures among children in the first decade of life, with peak incidence at age 5-7 years. Supracondylar fractures are subclassified into 2 entities: extension and flexion fractures. Extension type accounts for 98% of supracondylar fractures, which usually occurs when children fall on an outstretched hand with extension of the elbow trying to protect themselves from falling. The flexion type generally accounts for less than 2% of supracondylar fractures. This fracture is further classified into 4 types according to the Gartland classification, which assesses the anatomical severity of the fracture depending on the lateral radiographs of the elbow and operative findings: type I (non-displaced), type II (partially displaced with intact posterior cortex), type III (displaced with disrupted posterior cortex but the periosteal hinge is intact), and type IV (complete periosteal disruption with instability in flexion and extension). Type IV mostly diagnosed with examination under anesthesia during surgery [1-3].

Supracondylar fractures are likely to be associated with neurologic and vascular injuries, accounting for 15-20% and 15% of all supracondylar fractures, respectively, in which anterior interosseous nerve [1,2,4] and brachial artery [1,5] injuries are the most commonly injured structures. Other complications (eg, compartment syndrome) may co-manifest, like, but

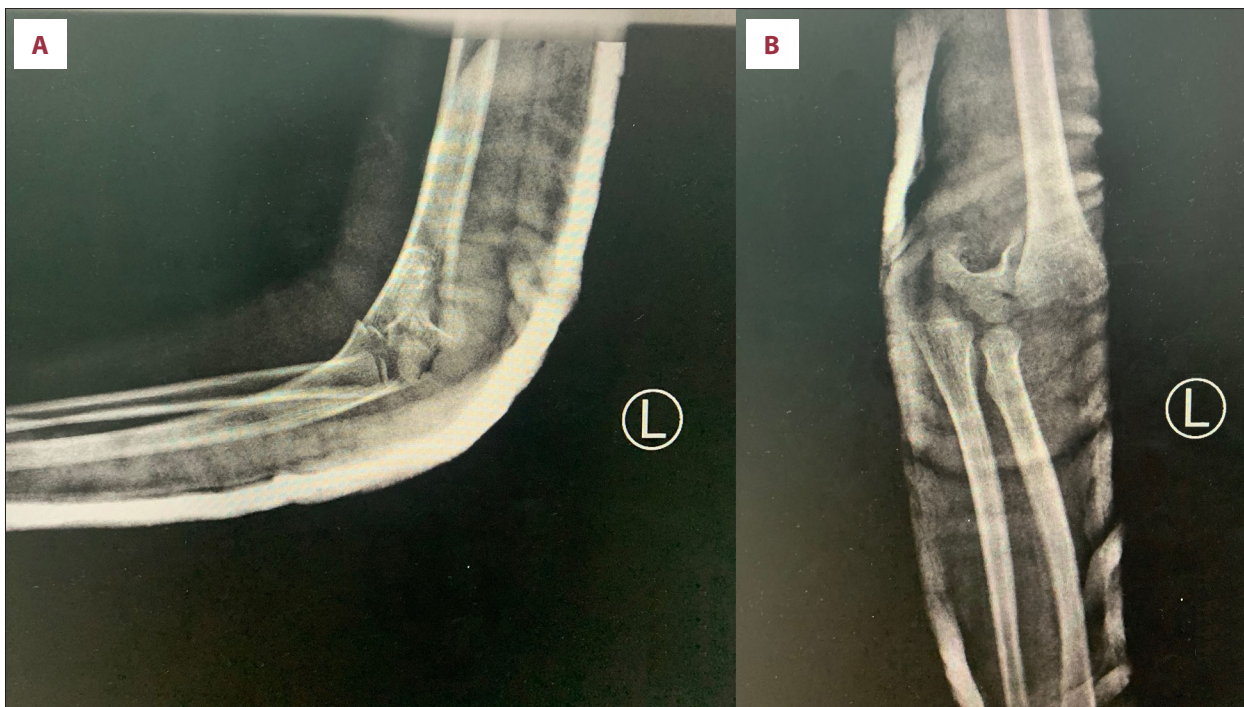
compartment syndrome is a very rare complication and occurs in less than 1% of this type of fracture [1,5].

Here, we present a rare case of high radial nerve palsy after closed reduction and percutaneous pinning of a Gartland type IV supracondylar fracture.

## Case Report

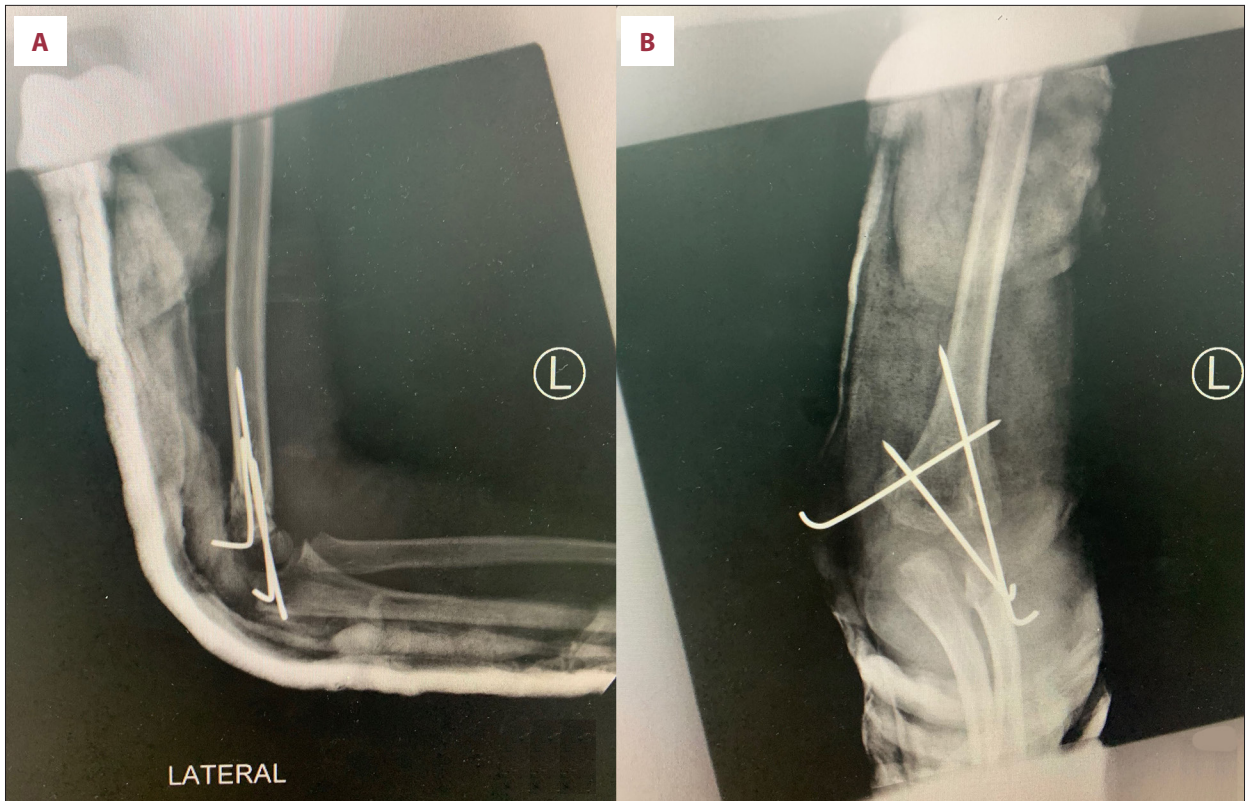
A previously healthy 8-year-old boy presented to our Emergency Department as a referral from a tertiary hospital after falling down on outstretched hands, complaining of left elbow pain, and inability to move the joint for 4 h. On examination; the patient was in a backslab cast with 45 degrees flexion. The backslab cast was removed, revealing severe swelling and gross deformity of the left elbow. However, there were no open wounds, the neurovascular system was intact, and there was good hand perfusion, with capillary refill within 2 s.

X-ray imaging (**Figure 1**) revealed a supracondylar fracture of extension type. The patient was admitted to the hospital, closed reduction and percutaneous pinning was performed 8 h later. After surgery, we classified the fracture as Gartland type IV. Vigorous reduction maneuvers were attempted, and the fracture was fixed with 2 lateral diverging pins and 1 medial crossing pin. An X-ray was taken postoperatively (**Figure 2**). In the recovery room, the patient had intact neurological features,



**Figure 1.** Left elbow X-ray. Lateral (A) and AP (B) views, with both figures showing posteromedially displaced supracondylar fracture extension type.





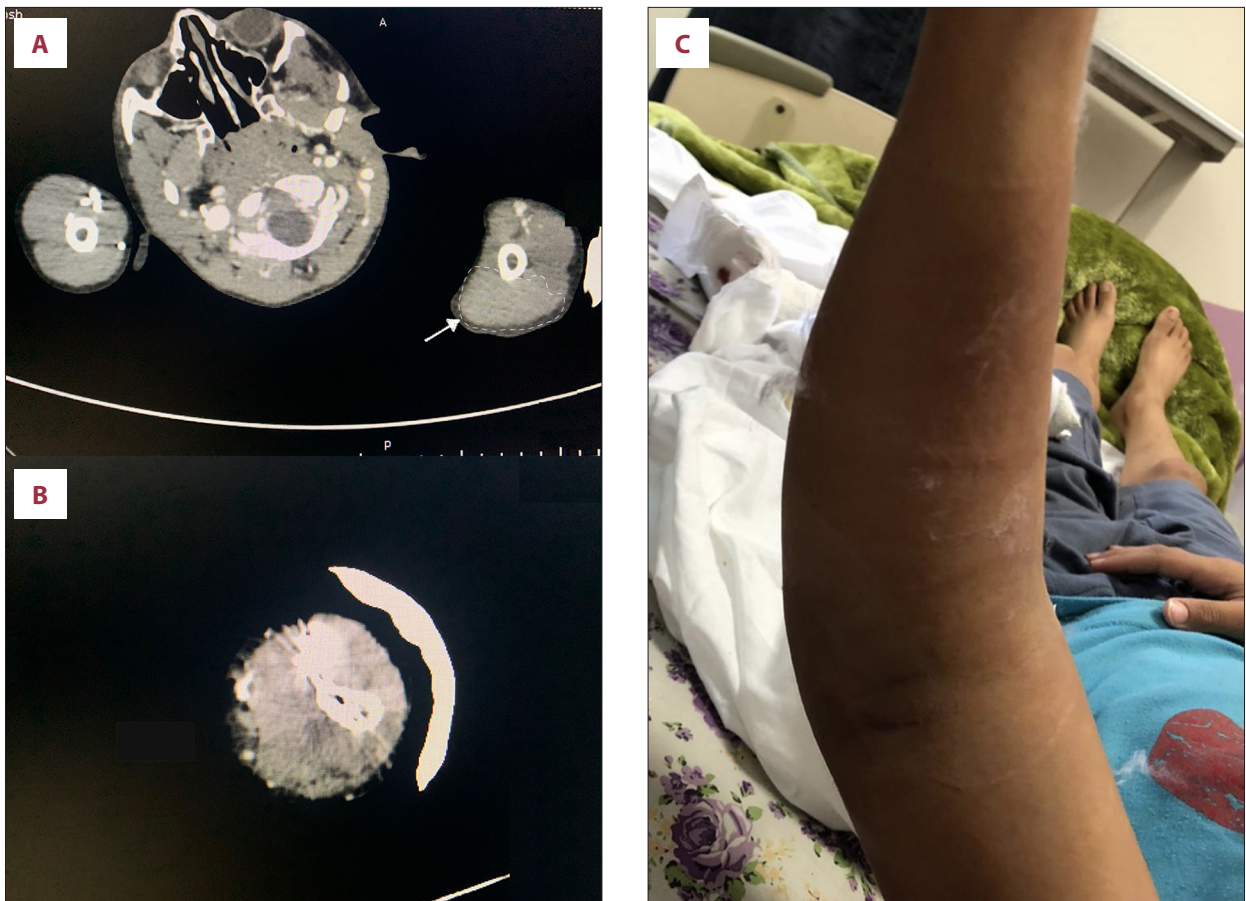
**Figure 2.** X-ray after CRPP left elbow. Lateral (A) and AP (B) views. Both figures show proper placement of the pins inserted during the procedure (2 lateral diverging pins and 1 medial crossing pin).



**Figure 3.** Left wrist drop; gross image demonstrates left wrist drop the morning after surgery.

intact distal pulses, and good hand perfusion, with no immediate complications. The morning after the surgery, a physical examination showed intact distal pulses with good hand perfusion. However, the patient could not abduct or extend his left thumb. A weak index finger extension and wrist drop was noted, with loss of sensation over the dorsum of the hand, dorsum of the forearm, and dorsoradial aspect of the thumb (Figure 3). A contrast CT was ordered (Figure 4) to ensure the proper placement of the K wires and to detect any potential vascular injury. The CT scan showed accurate placement of the 3 pins and intact vascularity, and also revealed a large hematoma in the posterior compartment of the arm and subcutaneous edema, with soft-tissue swellings at the left elbow. The management plan was to follow up the patient by doing serial physical examinations for early detection any signs of compartment syndrome and to observe the evolution of the neurological function. The patient was hospitalized for 4 days, then followed up in the out-patient clinic weekly for 1 month; no medication or nerve nutrients were given to the patients. During the inpatient stay, the nerve function showed no improvement. One month after the surgery, pins were removed in the clinic (Figure 5). The wrist extension was completely recovered, while thumb abduction and extension did not show any improvement. There was some recovery of sensory function, more notable over the dorsum of the forearm. Six weeks

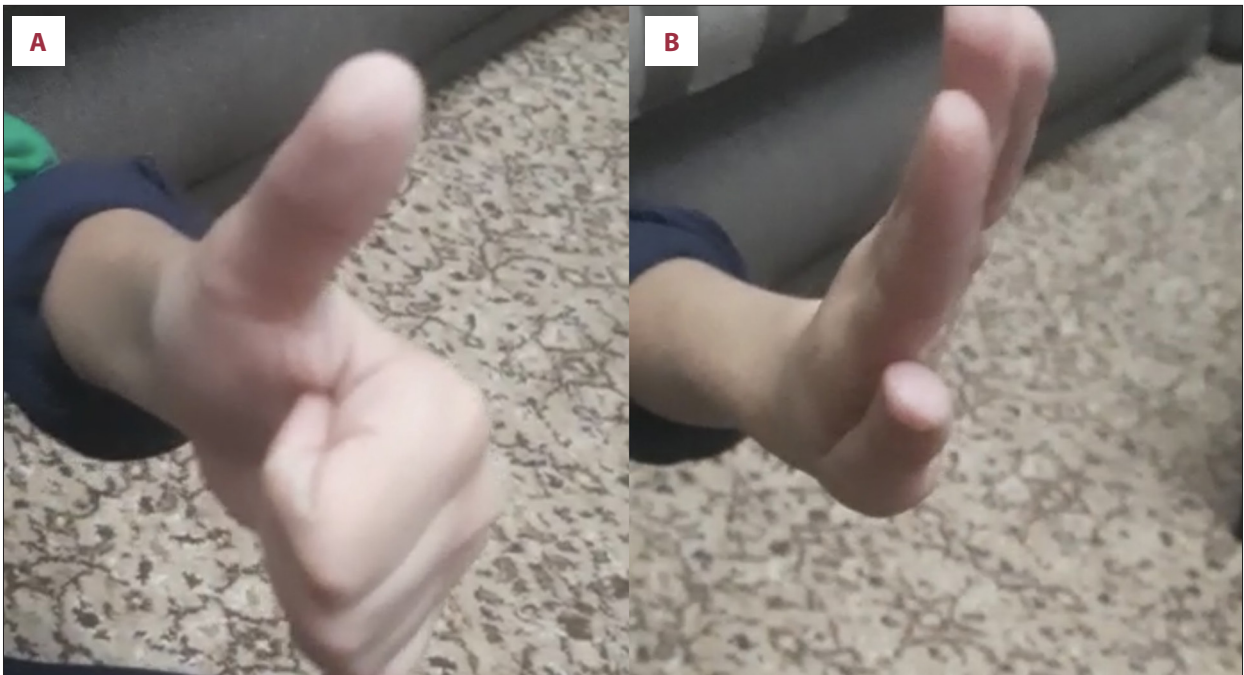




**Figure 4.** (A) Cross-sectional CT scan of both upper limbs. This image reveals a large hematoma in the posterior compartment of the arm. Arrow and dashed circle indicate the hematoma. (B) Cross-sectional contrast CT study of left arm reveals a large hematoma in the posterior compartment of the arm and subcutaneous edema. (C) Left elbow gross image; the figure shows significant tense swelling over the posterior aspect of the arm, elbow, and forearm.



**Figure 5.** Left elbow x-ray after k wires removal 4 weeks after the surgery. AP (A) and lateral (B) views, showing proper healing of the fracture.



**Figure 6.** (A, B) Gross image of the left hand 2 months after surgery, demonstrating full recovery of wrist extension, thumb abduction and extension, and index finger extension.

after the surgery, the thumb extension and abduction were fully recovered with return of sensation over the dorsum of the hand and dorsoradial thumb. He was able to extend the index finger 2 months after the surgery (Figure 6).

## Discussion

Radial nerve injury is a common complication following humerus fractures, particularly those involving the distal end of the humerus, supracondylar, and the shaft. The literature reports radial nerve injury to be the most common nerve injury associated with supracondylar fractures [6,7]. The most recent literature reports anterior interosseous nerve injury to be the most common neurological injury (34%) associated with the extension-type supracondylar fracture and the ulnar nerve (91%) in the flexion type. In addition to traumatic injuries, iatrogenic injuries that occur during treatment have been reported and are estimated to account to 3-6% of the neurological injuries associated with these types of fractures [7].

The radial nerve receives branches from all nerve roots from C5-T1 and exits the axilla as a terminal branch of the posterior cord of the brachial plexus. When it leaves the axilla, it has a sensory branch to the posterior arm and branches that innervate long and medial heads of the triceps. The radial nerve travels from medial to lateral direction within the spiral groove of the humerus. This location makes the nerve susceptible to injury when humeral shaft fractures occur, especially when it

is associated with traction and angulation forces. At the spiral groove the radial nerve branches into the inferior lateral cutaneous nerve of the arm and the posterior cutaneous nerve of the forearm, and branches to lateral and medial heads of the triceps and the anconeus muscles. The radial nerve has branches to the brachioradialis and extensor carpi radialis longus as it pierces the lateral intermuscular septum, 7.5-10 cm above the lateral epicondyle of the humerus after it exits the spiral grooves. Knowledge of the anatomy is essential to identify the level of the injury; injury of the nerve at the axilla is usually associated with proximal sensory loss and weakness of elbow extension. The radial nerve gives innervation to the triceps as it exits the axilla and the elbow extension is usually spared in supracondylar fractures and humeral shaft fractures. From 86% to 100% of the injuries are neuropraxic and usually resolve spontaneously within 3 to 6 months after the injury. Although axonotmesis and nerve laceration are rare sequelae, a few reports have confirmed their association with this type of fracture [6-9].

Nerve injuries associated with supracondylar fractures usually occur due to nerve tenting or entrapment within the sharp proximal bone fragment, while iatrogenic injury occurs due to excessive traction and manipulation of the bone during closed reduction or as a complication of wire insertion, especially when the medial wire is inserted, or as a direct injury during open surgery [7,9-12]. Iatrogenic injury associated with closed reduction and percutaneous spinning usually affects the ulnar nerve, as the greatest risk is with K wire cross-fixation. The

mini-open approach for a medial wire usually decreases the risk of ulnar nerve injury. Some cases have been reported of median and radial nerve injuries associated with lateral k wire insertion; most of the cases retain full nerve function with the removal of the wire and with a conservative approach [10-15]. In our case, the patient had a normal neurological examination before the closed reduction and percutaneous pinning, but on the morning after the surgery, he developed a wrist drop and with loss of sensory function proximally, indicating high radial nerve injury at the level of the spiral groove. After this finding, we ordered contrasted CT scan and AP and lateral X-rays to reassure the proper location of the wires and to assess vascularity. The CT scan revealed a large intramuscular hematoma. Due to the proximal involvement of the nerve, we excluded the direct injury of the nerve by the bone fragments. Also, the patient had a good pulse and good hand perfusion with very mild pain, so compartment syndrome was excluded. After the CT findings, we were hesitant to perform surgical exploration and possible hematoma evacuation, but since the risk of surgery exceeds the risk of expectant management, a decision was made to follow up the patient for the next 3-6 months, as it was most probably a neuropraxic injury. If improvement did not meet expectations or was halted/arrested, then nerve conduction study and surgical exploration of the nerve were to be planned. Previous studies have agreed on a similar approach to the one applied in this case [7,9,13]. Electrodiagnostic studies along with history and physical examination usually guide the management plans for peripheral nerve injuries. Electrodiagnostic studies can differentiate high-grade nerve injury (neurotmesis and axonotmesis) from low-grade injury (neuropraxia). Nerve conduction and electromyography are affected by a variety of factors; therefore, there is often no precise information about the site of nerve involvement, and its usefulness in the acute setting in

making a decision for conservative or surgical management is questionable. Often, a trial of conservative management is instituted, and if there are no signs of recovery on follow-up examination and electrodiagnostic studies, surgery is indicated [16]. According to Pulos et al, in the management of iatrogenic nerve injuries, initial electrodiagnostic examination is indicated 3 to 4 weeks after the surgery if the neurological deficit continues and there are no signs of recovery [17].

Our patient regained full function of the nerve 2 months after surgery. Based on this, we concluded that either the vigorous reduction maneuvers during the surgery or the large hematoma or both had exerted a traumatic level of tension on the radial nerve, and this probably was responsible for the resultant injury.

## Conclusions

Based on the findings of this case study, it can be concluded that, although radial nerve injury occurs in the setting of supracondylar fractures, it is less frequently seen following surgical treatment. In addition, neuropraxia is still the most common type of nerve injury encountered, which can be attributed to compressive or tensile traumatic forces applied on the nerve or to both forces, as seen in our case. Most neuropraxic nerve injuries resolve spontaneously without intervention, as reported in this case. We usually only perform surgery when there is progressive worsening neurological deficit or if no improvement occurs in 3 to 6 months.

## Conflict of Interest

None.



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