

Ulnar nerve snagged on Kirschner wire following surgery for supracondylar fracture of humerus

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ABSTRACT

A 9-year-old boy fell off his skateboard, resulting in a supracondylar fracture of his left humerus. The fracture was surgically repaired on the same day using two Kirschner wires inserted from the medial and lateral sides. Following surgery, the patient developed ulnar nerve palsy, prompting reoperation. It was discovered that the ulnar nerve was located anterior to the medial epicondyle and was snagged on the Kirschner wire, causing compression. Despite clear confirmation of the wire entry site, the presence of an unstable ulnar nerve anterior to the medial epicondyle necessitates caution to prevent ulnar nerve injury.

Keywords: supracondylar fracture, humerus, ulnar nerve palsy, Kirschner wire, ulnar nerve dislocation

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INTRODUCTION

Supracondylar fractures of the humerus are the most common elbow fractures in children, and various treatment methods are used to manage these fractures.^{1,2} Among them, stabilization of reduced fractures by percutaneous pin fixation is currently a widely accepted treatment method.³ However, a complication associated with these fractures is nerve injury. The incidence of traumatic nerve injuries has been reported to be 12% to 35%, while the incidence of iatrogenic nerve injuries has been found to be 2% to 6%.² In particular, the ulnar nerve is the most commonly affected nerve in percutaneous pin fixation.⁴ Subluxation and dislocation of the ulnar nerve have been reported, with frequencies that are by no means low.⁵ Here, we report a case of supracondylar fracture of the humerus, in which the ulnar nerve was dislocated over the anterior aspect of the medial epicondyle of the humerus. After surgery for the fracture, while the ulnar nerve was trying to return posteriorly, it was snagged on a Kirschner wire. The patient's mother was fully informed that the patient's data would be submitted for publication, and she

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provided her consent.

CASE REPORT

A 9-year-old boy fell from a skateboard and sustained injuries to his left hand, and was transported to the hospital by ambulance on the same day. At the initial examination, the patient had swelling and pain in his left elbow joint. Plain X-ray revealed findings of Gartland type III supracondylar fracture of the left humerus⁶ (Fig. 1). Dimpling of the skin with subcutaneous hematoma, so called “a pucker sign”, was observed on the anterior side of the left elbow. He complained of numbness in his left thumb, and the radial pulse in the wrist was weak (Fig. 2). Because manual reduction was difficult and there was a risk of injuring the neurovascular bundle, open surgery was performed under general anesthesia on the same day. Using an air tourniquet (250 mmHg), a skin incision was made on the flexor side of the elbow centered at the fracture site, and the central fracture end was exposed from the anterior aspect. The fascia was gently incised, and the neurovascular bundle was separated. No damage to the median nerve as well as the brachial artery and vein was observed. Then, reduction of the fracture was conducted, and a Kirschner wire was inserted from the lateral epicondyle with the elbow in flexion. Next, the medial epicondyle and the ulnar nerve groove were palpated carefully to confirm that the sites were clear of the ulnar nerve, and a Kirschner wire was inserted via the medial epicondyle with the elbow in flexion (Fig. 3). After surgery, the elbow was fixed with a splint at 60-degree flexion.

On the day after surgery, sensory disturbance in areas innervated by the median nerve had improved compared with the time of initial examination. However, sensory disturbance in the left ring finger and little finger was detected, which was not found before surgery, and full extension of the ring finger and little finger was not possible. We assumed that these were caused by injury of the ulnar nerve during the surgical procedure, and a revision surgery was performed 33 hours after the initial surgery. An incision was made centered at the medial epicondyle where the Kirschner wire was inserted from the medial side of the elbow joint, and the ulnar nerve groove



Fig. 1 Plain X-ray findings at initial examination
A completely displaced supracondylar fracture of the left humerus is observed.



Fig. 2 Physical findings at initial examination

The left elbow joint is severely swollen, and a pucker sign is observed on the anterior side of the elbow joint.

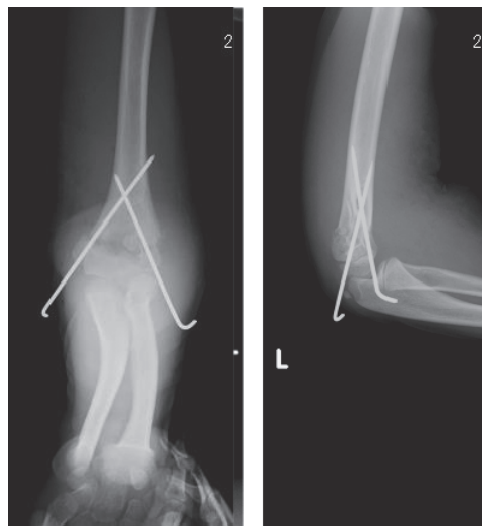


Fig. 3 Plain X-ray findings after the first surgery

Cross pinning from the medial and lateral sides.

was exposed. However, the ulnar nerve was not found at that site. The ulnar nerve was located anterior to the medial epicondyle, and was snagged on the Kirschner wire and being compressed (Fig. 4). Hence, the Kirschner wire was removed and the ulnar nerve was explored. When the

elbow joint was in flexion, the nerve was in the anteriorly dislocated position. However, when the elbow joint was extended, the ulnar nerve was found to move posteriorly from the anterior position, and return to the ulnar nerve groove. We moved the ulnar nerve anteriorly and fixed it loosely, and reinserted the wire on the medial side taking care not to interfere with the ulnar nerve. After surgery, the elbow was fixed with a splint for 4 weeks, and then elbow joint range of motion exercises were started. Fourteen months after surgery, only slight numbness remained at the tip of the little finger, but there was no difference in range of motion between the left and right elbow joints. Plain X-ray findings showed no deformity (Fig. 5). No impairment in activities of daily living was observed. Furthermore, no signs of ulnar nerve dislocation in the unaffected elbow joint were detected.

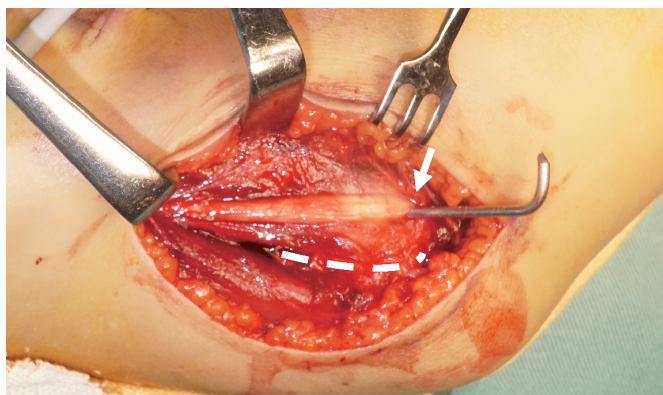


Fig. 4 The medial side of the elbow joint at the time of reoperation

The ulnar nerve (white arrow) is dislocated to the anterior side of the elbow joint and snagged on the Kirschner wire. The white dotted line is the ulnar nerve groove.

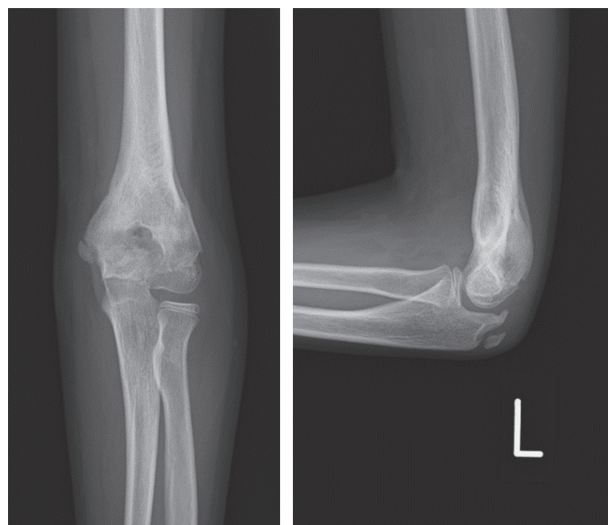


Fig. 5 Plain X-ray findings at 14 months after surgery

Bone union is good, and there is no deformity.

DISCUSSION

According to the review article on ulnar nerve subluxation and dislocation by Bordes et al,⁵ it is quite common to find that upon elbow flexion, the ulnar nerve is displaced out of the ulnar nerve groove, relocates medial or anterior to the medial epicondyle, and returns to its correct anatomical position upon extension. Zaltz et al⁷ found that the ulnar nerve was unstable in 28 of 52 (54.8%) children aged 6 to 10 years. In another study, ultrasonographic evaluation of 237 children revealed that when the elbow joint was flexed to 90–120 degrees, the ulnar nerve was moved from the cubital tunnel and subluxated or dislocated anteriorly onto the medial epicondyle at rates of 40–58%.⁸ Furthermore, Yıldırım et al⁹ evaluated 76 elbows of healthy children (12 girls and 26 boys) aged 4 to 12 years using an ultrasonographic device during gradual flexion of the elbow, and reported that the distance between the medial epicondyle and the ulnar nerve decreased by up to 1.1 mm when the elbow was fully flexed, which may pose a risk to the nerve during medial pinning in supracondylar humeral fractures.

In order to maintain the reduced position of a supracondylar humerus fracture, a flexed position of the elbow joint is probably preferred and used by many surgeons. However, if a mobile ulnar nerve is positioned over the insertion site of the medial pin, the risk of serious injury increases. Soldado et al¹⁰ used intraoperative ultrasonography to monitor the location of the ulnar nerve during the fixation procedure for supracondylar humerus fracture, and found that ulnar nerve subluxation occurred during elbow hyperflexion in all 15 children. They proposed that the elbow should be extended to approximately 90 degrees before inserting the medial pin. In addition, Shih et al¹¹ recommended to exercise caution even when attempting to insert a wire medially into an extended elbow, and to use a mini-open approach to identify the ulnar nerve before inserting the medial pin.

In wire fixation of supracondylar humerus fractures, medial crossed pin fixation, as opposed to two lateral pin fixation, has been shown to have biomechanical advantages.¹² In addition, Pavone et al¹³ compared two different techniques for the treatment of displaced supracondylar humerus fractures in children; cross pin fixation and two lateral pin fixation, and reported that both techniques showed comparable results in terms of recovery of joint function and complications, and both configurations achieved satisfactory results. On the other hand, Brauer et al¹⁴ compared the surgical results of using medial + lateral entry pins and lateral entry pins, and found that the former had a higher risk of ulnar nerve injury, but provided more stable fixation. Furthermore, Abbott et al¹⁵ reported that cross pinning caused more neurological complications than lateral pinning.

In the present case, we paid special attention to the ulnar nerve, and performed cross pinning by inserting a Kirschner wire from the medial epicondyle after confirming that the ulnar nerve was not present at the site. Nevertheless, the procedure resulted in numbness after surgery. In this patient, it was unclear whether the ulnar nerve dislocation existed before the injury or the ulnar nerve was dislocated anteriorly at the time of fracture injury. However, during the reoperation, the ulnar nerve was found to have been snagged on the wire as shown in Fig. 4, indicating clearly that the ulnar nerve was displaced over the anterior aspect of the medial epicondyle when the wire was inserted from the medial side. Previous report has shown the need to confirm the position of the ulnar nerve under direct visualization during surgery.¹⁶ However, there are no reported cases of the ulnar nerve dislocated anteriorly out of the ulnar nerve groove and becoming snagged on the Kirschner wire, as in the case reported here. Therefore, it is necessary not only to confirm that the ulnar nerve is not present at the wire insertion site at the medial epicondyle of the humerus, but also to check whether the nerve is dislocated from the ulnar nerve groove and moved anteriorly.

CONCLUSION

Even after the wire insertion site has been confirmed to be clear, an unstable ulnar nerve may be dislocated anterior to the medial epicondyle, which may pose a risk of ulnar nerve injury. Caution should be exercised.

CONFLICTS OF INTEREST STATEMENT

The authors declare that there are no conflicts of interest in this study and no specific funding was achieved to support this work.

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