

Delayed Radial Nerve Laceration by the Sharp Blade of a Medially Inserted Kirschner-Wire Pin: A Rare Complication of Supracondylar Humerus Fracture

Mohammad Javad Fatemi, MD, Mohammadali Habibi, MD, Aydin H. Pooli, MD, and Maryam Jafari Mansoori, MD

Supracondylar humerus fracture is one of the most common fractures in children and the most common pediatric elbow fracture. It usually occurs during a fall onto an outstretched hand¹ and is associated with considerable morbidity, including neurovascular complications, malunion, myositis ossificans, and compartment syndrome.¹⁻³ The most common complication is nerve damage, which in some cases causes paralysis. Primary nerve injuries occur in up to 20% of displaced supracondylar fractures.^{2,4} Secondary nerve injuries are usually caused by stretching, laceration, or entrapment of the nerve between the ends of the fracture.²

In most cases of supracondylar humerus fractures, the treatment of choice is closed reduction and percutaneous pinning.⁵⁻⁷ After 3 to 4 weeks of immobilization, the pins should be removed. During Kirschner-wire (K-wire) pin placement, there is a risk for nerve damage, particularly ulnar nerve damage during insertion of a medial pin.⁵⁻⁹

The literature includes many reports of ulnar nerve damage during medial pinning, but radial nerve laceration by a medially inserted pin that crosses the anterolateral cortex of the humerus is rare. In this article, we report the case of a patient who, 8 years after being treated for a supracondylar humerus fracture, presented with radial nerve palsy caused by repeated trauma from the sharp blade of a medially inserted K-wire pin. We have obtained the patient's guardian's informed, written consent to publish the case report.

Dr. Fatemi is Associate Professor of Plastic and Reconstructive Surgery, Dr. Habibi and Dr. Pooli are Research Fellows, and Dr. Mansoori is Plastic and Reconstructive Surgeon, Iran University of Medical Sciences, Tehran, Iran.

Address correspondence to: Mohammad Javad Fatemi, MD, Department of Plastic Surgery, Hazrat Fatemeh Hospital, 21 Seyed Jamaladin Asad-Abadi Ave, Iran University of Medical Sciences, Tehran, Iran (tel, 98-21-8872-3150; fax, 98-21-8871-5216; e-mail, fatemimd@gmail.com).

Am J Orthop. 2009;38(2):E38-E40. Copyright, Quadrant HealthCom Inc. 2009. All rights reserved.

CASE REPORT

At our clinic, a 17-year-old girl was evaluated for persistent left wrist drop and left hand numbness. Eight years earlier, she had fallen, sustained a supracondylar fracture of the left arm, and undergone closed reduction and percutaneous medial- and lateral-entry pinning without complication. Two years before presenting to our clinic, she experienced gradual impairment in left wrist and left hand function. Physical examination revealed complete radial nerve palsy, and conduction studies and electromyography confirmed the diagnosis. Radiographs of the left elbow showed an unusually long K-wire pin traversing the full width of the bone and entering the lateral soft tissue of the left arm (Figure 1).

With the patient under general anesthesia, the radial nerve was explored in its anatomical location. The nerve was surrounded by severe fibrosis and scar tissue. The tip of the K-wire pin was crossing the anterolateral cortex of the humerus, and the radial nerve was pierced distal to the intermuscular septum (Figure 2).

The pin was removed through a medial stab wound. The scarotic portion of the nerve was excised, and the nerve was repaired with end-to-end anastomosis (Figure 3). The arm was immobilized in elbow flexion for 2 weeks. Six months after surgery, the patient had limited wrist extension. One year after surgery, she was able to actively extend the wrist and fingers to a full range of motion.

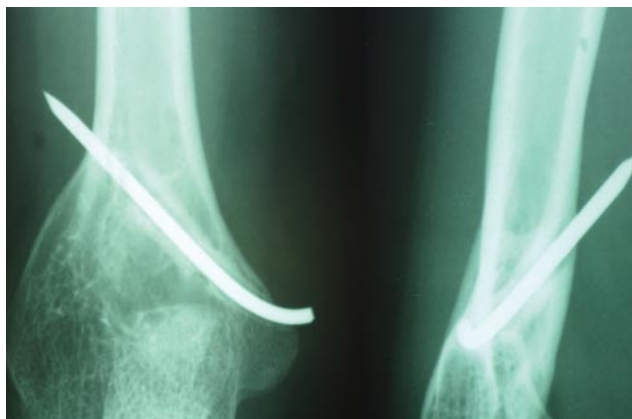


Figure 1. Anteroposterior and lateral radiographs of left arm show a long, medially inserted Kirschner-wire pin.

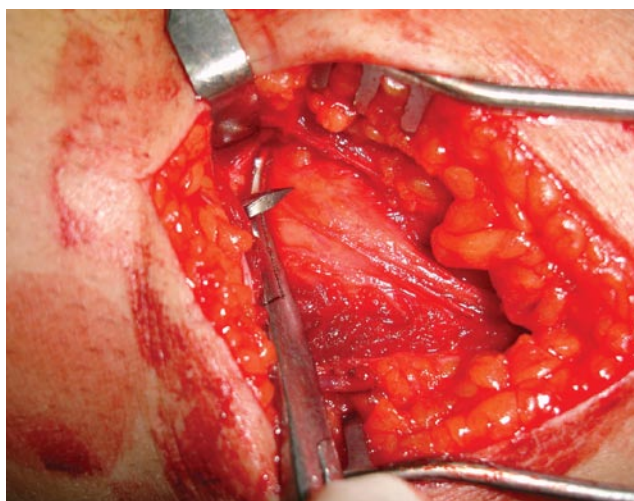


Figure 2. Tip of Kirschner-wire pin passing through radial nerve.

DISCUSSION

The radial nerve, more than any other major nerve, is injured through orthopedic trauma.^{10,11} Radial nerve paralysis occurs in approximately 12% of humeral shaft fractures. Primary radial nerve palsy is more common and accounts for about three fourths of radial nerve injuries. The rate of iatrogenic nerve injuries ranges from 2% to 5%.⁸ Spontaneous recovery within 8 to 16 weeks has been reported in more than 70% of cases. Although transient neurologic problems are common in supracondylar humerus fractures, radial nerve laceration is seldom associated with these fractures, most likely because of the soft-tissue protection provided by the muscle surrounding

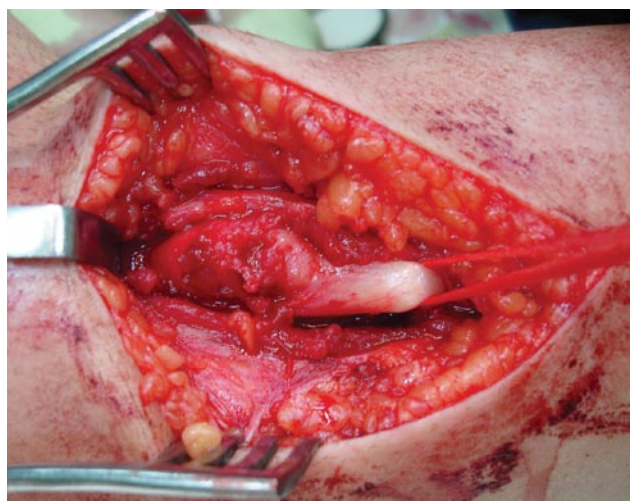


Figure 3. Scarotic portion of radial nerve was excised, and nerve was repaired with end-to-end anastomosis.

usually occurs during pinning; the medially inserted pin crosses the cortex of the humerus and directly pierces the radial nerve at the opposite part of the humerus.^{11,14}

For injury prevention, the recommendation is to limit the length of pin penetration in the opposite cortex of the humerus to 1 to 2 mm.¹⁴ During pinning, if the medial pin protrudes past the cortex, it should be backed out slightly.

In our patient's case, the medial pin did not contribute to ulnar nerve damage; instead, the pin's sharp blade, on the anterolateral side of the humerus, was responsible for radial nerve palsy. We think that, in this particular case, late laceration of the radial nerve involved 2 main mechanisms:

“In our patient's case, the medial pin did not contribute to ulnar nerve damage; instead, the pin's sharp blade...was responsible for radial nerve palsy.”

the nerve sheath.¹¹⁻¹³ The muscular cuffs of triceps in the arm and brachialis in the antecubital fossa offer protection against trauma. Nerve injuries represent neuropraxia in almost all cases, and conservative treatment is recommended for nerve deficits except when the injury occurs after manipulation or when it does not clinically improve by 5 months.^{12,13}

Standard treatment for most displaced supracondylar humerus fractures includes closed reduction, pinning, and cast immobilization. The recommended immobilization period is 3 to 4 weeks. Afterward, the cast and the K-wires should be removed.¹⁴ There still is controversy regarding the postreduction pinning technique, which mainly involves crossed pins and 2 or 3 lateral pins. The main disadvantage of cross-pinning is ulnar nerve injury caused by the medially placed pin. Compared with cross-pinning, lateral pinning provides less stability but has the advantage of posing minimal risk to the ulnar nerve.¹⁴⁻¹⁶

The rate of iatrogenic radial nerve injuries in supracondylar humerus fractures is less than 1%.¹⁴ Such an injury

the medial pin's protruding significantly from the lateral cortex of the humerus and the pin's not being retrieved for 8 years. Pin protrusion could have been the result of a pinning error, of using a long K-wire, or of around-the-pin bone resorption leading to K-wire loosening and pin migration. Unfortunately, the immediate postoperative radiographs that could have been helpful in identifying the cause were unavailable.

Although radial nerve palsy is seldom caused by medial pinning, this unusual complication is preventable with use of a K-wire of proper length, with anteroposterior and lateral radiographic documentation of the position of the inserted pin, and with appropriately timed pin removal. For unknown reasons, the pin in our patient's case had not been removed when it should have been.

AUTHORS' DISCLOSURE STATEMENT

The authors report no actual or potential conflict of interest in relation to this article.

REFERENCES

1. Battaglia TC, Armstrong DG, Schwend RM. Factors affecting forearm compartment pressures in children with supracondylar fractures of the humerus. *J Pediatr Orthop*. 2002;22(4):431-439.
2. Gosens T, Bongers KJ. Neurovascular complications and functional outcome in displaced supracondylar fractures of the humerus in children. *Injury*. 2003;34(4):267-273.
3. Hartigan BJ, Benson LS. Myositis ossificans after a supracondylar fracture of the humerus in a child. *Am J Orthop*. 2001;30(2):152-154.
4. Wilkins KE. The operative management of supracondylar fractures. *Orthop Clin North Am*. 1990;21(2):269-289.
5. Foad A, Penafort R, Saw A, Sengupta S. Comparison of two methods of percutaneous pin fixation in displaced supracondylar fractures of the humerus in children. *J Orthop Surg (Hong Kong)*. 2004;12(1):76-82.
6. Kocher MS, Kasser JR, Waters PM, et al. Lateral entry compared with medial and lateral entry pin fixation for completely displaced supracondylar humeral fractures in children. A randomized clinical trial. *J Bone Joint Surg Am*. 2007;89(4):706-712.
7. Brauer CA, Lee BM, Bae DS, Waters PM, Kocher MS. A systematic review of medial and lateral entry pinning versus lateral entry pinning for supracondylar fractures of the humerus. *J Pediatr Orthop*. 2007;27(2):181-186.
8. Rasool MN. Ulnar nerve injury after K-wire fixation of supracondylar humerus-fractures in children. *J Pediatr Orthop*. 1998;18(5):686-690.
9. Royce RO, Dutkowsky JP, Kasser JR, Rand FR. Neurologic complications after K-wire fixation of supracondylar humerus fractures in children. *J Pediatr Orthop*. 1991;11(2):191-194.
10. Omer GE Jr. Results of untreated peripheral nerve injuries. *Clin Orthop*. 1982;(163):15-19.
11. Samardzi M, Grujici D, Milinkovi ZB. Radial nerve lesions associated with fractures of the humeral shaft. *Injury*. 1990;21(4):220-222.
12. Martin DF, Tolo VT, Sellers DS, Weiland AJ. Radial nerve laceration and retraction associated with a supracondylar fracture of the humerus. *J Hand Surg Am*. 1989;14(3):542-545.
13. Shah JJ, Bhatti NA. Radial nerve paralysis associated with fractures of the humerus. A review of 62 cases. *Clin Orthop*. 1983;(172):171-176.
14. Kasser JR, Beaty JH. Supracondylar fractures of the distal humerus. In: Beaty JH, Kasser JR, eds. *Rockwood and Wilkins' Fractures in Children*. 6th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2006:543-589.
15. Zions LE, McKellop HA, Hathaway R. Torsional strength of pin configurations used to fix supracondylar fractures of the humerus in children. *J Bone Joint Surg Am*. 1994;76(2):253-256.
16. Lee SS, Mahar AT, Miesen D, Newton PO. Displaced pediatric supracondylar humerus fractures: biomechanical analysis of percutaneous pinning techniques. *J Pediatr Orthop*. 2002;22(4):440-443.