

When Is a Medial Epicondyle Fracture a Medial Condyle Fracture?

Misty Loyd Lynsky, MS, CNP, and Allan Beebe, MD

CASE REPORT

An otherwise healthy 10-year-old boy initially presented to the senior author (A.B.) for evaluation of persistent right elbow stiffness after fracture management. The right-hand-dominant patient sustained an injury to the elbow approximately 10 weeks earlier, while playing football. Within a few hours of the injury, he underwent evaluation in a pediatric emergency department (ED), where he presented with moderate right elbow pain and weakness with movement. He reported no history of numbness, tingling, or associated injuries. Clinical findings included swelling and tenderness on the medial aspect of the right elbow. The patient had decreased range of motion (ROM) secondary to pain, with sensory function and pulses intact, and brisk distal capillary refill. Physical examination and systems review were otherwise unremarkable. Lateral and anteroposterior (AP) radiographs of the right elbow (Figure 1) were obtained in the ED. There was an elbow effusion. On the lateral radiograph, a small bony fragment was noted anterior to the distal humeral metaphysis; there was no identifiable fracture line on the AP view. A long-arm posterior splint was applied, with the elbow at 90° of flexion and the wrist in neutral position. The patient was discharged home with follow-up instructions.

The patient presented to a local orthopedic surgeon and sports medicine specialist, who diagnosed a right medial epicondyle humerus fracture. Treatment consisted of long-arm casting for 3 weeks. The patient was then instructed to perform ROM exercises at home. On his return 6 weeks after injury, he was still having difficulty with motion. Physical therapy was initiated. Nine to 10 weeks after injury, a fairly rigid block to further progression of elbow ROM was noted.

The patient was referred to our pediatric orthopedic surgery subspecialty center. On initial presentation,

Ms. Lynsky is Pediatric Nurse Practitioner, Department of Orthopedic Surgery, Nationwide Children's Hospital, Columbus, Ohio.

Dr. Beebe is a member of the Department of Orthopedics, Nationwide Children's Hospital; Assistant Program Director, Mount Carmel Residency Training Program, and Clinical Assistant Professor of Orthopaedics, The Ohio State University College of Medicine, Columbus, Ohio.

Address correspondence to: Misty Loyd Lynsky, MS, CNP, Department of Orthopedic Surgery, Nationwide Children's Hospital, 700 Children's Dr, Columbus, OH 43205 (tel, 614-722-3808; fax, 614-722-3373; e-mail, misty.lynsky@nationwidechildrens.org).

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right elbow ROM was markedly decreased (approximately 50° to 95° of flexion). The boy was having difficulty with activities of daily living, such as eating, buttoning his clothing, and manipulating a belt buckle. The elbow had full supination and pronation. The patient was nontender to palpation and had no appreciable edema. Injury radiographs showed ossification anterior to the metaphysis, seen best on the lateral view (Figure 1).

The medial epicondyle appeared to be subtly displaced, medial and superior. The medial epicondyle appeared in normal anatomic position on the uninjured side. Two-month follow-up radiographs showed periosteal new bone along the medial column. The trochlea

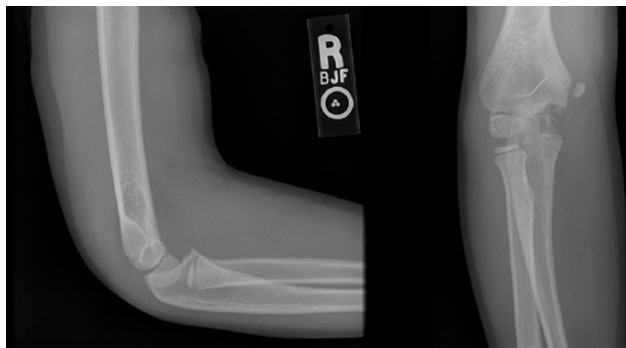


Figure 1. Two radiographic views of injured right elbow.



Figure 2. Anteroposterior and oblique radiographs of injured side of right elbow 2 months after injury.



Figure 3. Magnetic resonance imaging (MRI) of right elbow. (A) Coronal view. (B) Coronal view shows anterior trochlear deviation and fracture line involving metaphysis adjacent to trochlea and epiphysis. (C) Coronal 3-dimensional gradient echo sequence shows 8.5-mm separation of trochlear cartilage.

demonstrated an irregular, stippled ossification center (Figure 2), symmetric with comparison radiographs.

Magnetic resonance imaging (MRI), performed to further evaluate the extent of the medial-sided injury (Figures 3A–3C), showed the fracture was truly a medial condyle fracture with anterior and superior displacement of the condyle and with diastasis of 8.5 mm (Figures 3A–3C). Computed tomography with 3-dimen-



Figure 4. Computed tomography with 3-dimensional reconstruction, right elbow.

sional reconstruction also delineated the extent of injury (Figure 4).

The extent of bony healing was thought to preclude any possibility of joint restoration. The patient continued therapy. At last follow-up, he was noted as having elbow ROM from 15° to 125° with full supination and pronation.

The patient's parents provided written informed consent for print and electronic publication of this case report.

DISCUSSION

The medial humeral condyle fracture is intra-articular, as it involves the articular surface of the trochlea. The fracture line intersects the distal humerus and the medial metaphyseal-epicondylar segment.¹ The fracture is caused by a direct impact to the apex of the flexed elbow, as in a fall, which forces the olecranon into the medial condyle of the humerus.^{2,3} Another potential mechanism of injury is avulsion of the medial humeral condyle, caused by a fall on the outstretched hand stressing the medial collateral ligament and flexor insertions.^{2,4} Chacha⁵ postulated that the lesion results from varus stress placed on the extended elbow. Medial condyle fracture most commonly occurs between 8 years and 12 years of age.^{3,6} The condition is rarely mentioned in the clinical literature, and Ingersoll⁷ declared it improbable in children. In our thorough review of the literature published over 64 years, we found occurrence rates of less than 1% to 2% relative to all other pediatric elbow fractures.^{8–14} Three epidemiologic analyses of elbow fractures (300, 355, and 589 children) found no isolated medial condyle humeral fractures.^{10,13,15} Although infrequent, this injury presents with multiple diagnostic challenges, and complications are prevalent, with rates of up to 33% reported.^{8,14} The

lesion is often mistaken for the much more common fracture of the medial humeral epicondyle, which occurs 5 to 10 times as much and has a much more benign course with significantly lower risk for functional complications.^{14,16,17} Herein lie the diagnostic and treatment challenges of pediatric medial humeral condyle fractures.

A thorough understanding of the developing anatomical features within the pediatric elbow is essential for accurate assessment and diagnosis and for recognition of several potential complications. Multiple distal humeral ossification centers develop at different ages in infancy and adolescence (Figure 5).

The neonatal distal humerus is completely cartilaginous, with the first ossific nucleus forming at the capitellum around 1 year of age, followed by onset of ossification of the medial humeral epicondyle at age 4 or 5 with continuation through ages 9 to 13. Epicondylar-humeral unification may occur as late as age 15 or 16.^{8,18} Trochlear ossification, which encompasses the medial condyle, typically initiates at multiple nuclei and usually does not occur until ages 7 to 13.^{4,8,18} The last center to develop is the lateral humeral epicondyle, at ages 12 to 14.

As medial humeral condyle fractures usually occur between ages 8 and 12, the medial epicondylar ossific nucleus may be evident on radiographic studies, while trochlear ossification is absent or incomplete at this stage (Figure 6A). Consequently, medial humeral condyle fractures (Figure 6B) are often mistakenly diagnosed as isolated medial epicondyle fractures (Figure 6C).

Proper distinction of these 2 entities is very important, as their respective treatments and outcomes are widely divergent. The literature strongly supports nonsurgical treatment of medial epicondyle humeral fractures displaced less than 2 mm up to 5 mm, with extensive evidence for good functional outcomes.^{16,19-21} Moreover, Farsetti and colleagues¹⁷ found comparable nonsurgical outcomes in medial epicondyle fractures displaced more than 5 mm up to 15 mm, including those progressing to nonunion or fibrous union. According to Wheelless,²² surgical care of the medial epicondyle fracture is indicated in cases displaced more than 5 mm, and in cases involving fragment entrapment within the joint, ulnar neuropathy, or valgus instability. Conversely, the

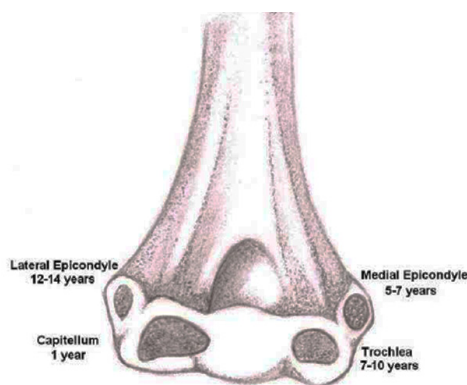


Figure 5. Pediatric distal humeral ossification centers.

accepted threshold is much lower for surgical assessment and treatment of the medial humeral condyle fracture. Stable nondisplaced fractures may be candidates for simple immobilization,^{14,23} but open visualization of the immature elbow joint is advised whenever there is potential displacement of the medial humeral condyle.²⁴ Timeliness of surgical intervention is another important factor, as the potential for successful restoration of articular congruity diminishes within mere days after injury.²⁵ Surgical intervention becomes increasingly more difficult as fracture margins dull and eventually are overcome by callus and scar tissue.⁴ Accurate reduction and secure fixation are thought to be required for proper treatment,^{2,23} as this injury carries a high incidence of poor outcomes related to malunion and nonunion, with associated cubitus varus deformity, loss of motion, and long-term functional limitations.³ The preponderance of reports illustrates poor outcomes in surgical treatment of old lesions.^{8,26} As historically supported, Ippolito and colleagues²⁶ suggested better long-term function in untreated nonunions than in joints sustaining necrotic distal humeral collapse.

A critical feature of pediatric medial humeral condyle fractures is growth center involvement. The distal humerus is supplied by a solitary nutrient vessel.²⁷ Therefore, vascular insult has a significant impact on healing and subsequent humeral development. Vascular supply to the trochlear epiphysis may be diminished, leading to suppression of growth and/or fracture union, and resultant

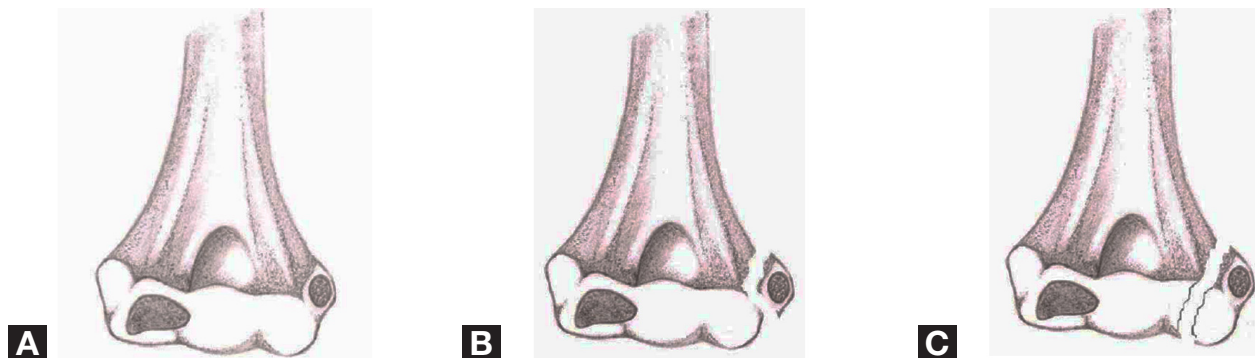


Figure 6. At 8 to 10 years of age: (A) intact distal humerus, (B) medial humeral epicondyle fracture, (C) medial humeral condyle fracture.

cubitus varus deformity.^{3,28} Alternatively, growth may be stimulated at the injury site, yielding a cubitus valgus state. If blood flow to the area ceases, osteonecrosis results.³ One must also consider the risk for ulnar neuropathy in displaced medial condylar humerus fractures, given the relative proximity of the ulnar nerve.⁶ These potential complications have a significant impact on overall long-term elbow function outcomes.^{6,14,28}

The American Academy of Orthopaedic Surgeons has reported normal elbow ROM to be 0° to 150°. ^{29,30} Morrey and colleagues³⁰ found that most activities of daily living occur in the range of 30° to 130° of elbow flexion. Good functional outcomes of medial condyle humerus fractures are directly related to early and accurate assessment and appropriate treatment.^{3,11,24,27} However, delay or failure of proper diagnosis is common, in large part because of the radiolucent cartilaginous structures involved.^{4,31} Lack of awareness and rarity of the injury may also lead to inadequate evaluation and, in turn, insufficient treatment. Although the unossified structures are not visible on radiographic studies, plain radiographs may provide other valuable evidence. The appearance of medial epicondylar displacement, or metaphyseal flaking in the younger child, may be associated with injury to adjacent structures. A hallmark of our patient's case was the appearance of the epicondyle proximal to the continuation of the medial metaphyseal line (Figures 3, 4A). Medial column involvement should be assessed with lateral, AP, and oblique radiographs. Including an oblique radiograph may help in identifying a medial column fracture line and improving assessment of degrees of displacement.¹⁴ Localized soft-tissue edema and fat-pad signs may provide additional evidence for more extensive injury or may be the only radiographic indication of occult fracture.^{3,31,32} Although the fat-pad sign should increase suspicion for intra-articular fracture, its absence does not exclude the diagnosis, as this radiographic feature results from blood and/or other fluid accumulating within an essentially intact joint capsule. Trauma may compromise the integrity of that capsule, thus diffusing the fluids throughout surrounding tissues, causing localized ecchymosis and/or soft-tissue swelling.³¹ As supported in the literature, any of these radiographic and clinical clues is an indication for further investigative measures, including examination of valgus joint stability under anesthesia, stress radiographs, arthrography, and MRI.^{4,14,33,34} As one-third of valgus stability in the fully extended elbow is attributed to osseous articulation,³⁵ a fracture that involves the intra-articular surfaces may produce valgus laxity. Gogola³⁴ found direct associations between condylar fracture nonunion, or displacement, and articular cartilage damage identified on arthrogram or MRI. Timely, secure, and appropriate fixation and close follow-up are required to achieve the best possible outcome with this complex entity.^{2,3,6,23}

CONCLUSION

Our patient initially presented with osseous radiographic evidence of an apparent medial epicondylar humerus fracture before trochlear ossification. Further investigation revealed malunion of the displaced medial condyle fracture. The patient's relatively mature stage of healing and open growth center involvement compounded the already significant risks for complications associated with medial condyle fractures. Surgical treatment potentially raised the additional possibility of harm to the limited vascular supply of the distal humerus, which can lead to malunion, nonunion, asymmetric growth patterns, and avascular necrosis.^{3,8,25} Although still lacking approximately 15° to 20° of end extension and 25° of end flexion, the patient 1 year after injury had regained functional ROM through diligent physical therapy. His case illustrates a common potential complication associated with a difficult-to-diagnose fracture involving the immature distal humeral medial condyle. Accurate assessment and diagnosis and adequate reduction and fixation are essential for long-term functional outcomes. For these outcomes to be possible, one must have knowledge of the complex anatomy and development of the elbow joint, subtle radiographic and clinical indications for further investigation, and awareness of common complications.

AUTHORS' DISCLOSURE STATEMENT

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

REFERENCES

- Walsh JJ IV, Patterson LA, Rectenwald J. Medial humeral condyle fracture. <http://emedicine.medscape.com/article/1231290-overview>. Accessed June 25, 2011.
- Ghawabi MH. Fracture of the medial condyle of the humerus. *J Bone Joint Surg Am*. 1975;57(5):677-680.
- Beatty JH, Kasser JR. The elbow: physeal fractures, apophyseal injuries of the distal humerus, osteonecrosis of the trochlea, and T-condylar fractures. In: Rockwood CA, Wilkins KE, Beatty JH, Kasser JR, eds. *Rockwood and Wilkins' Fractures in Children*. 6th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2006:615-619.
- Fowles JV, Rizkallah R. Intra-articular injuries of the elbow: pitfalls of diagnosis and treatment. *Can Med Assoc J*. 1976;114(2):125-131.
- Chacha PB. Fracture of the medial condyle of the humerus with rotational displacement. Report of two cases. *J Bone Joint Surg Am*. 1970;52(7):1453-1458.
- Peterson HA. Physeal fractures. In: Morrey BF. *The Elbow and Its Disorders*. Philadelphia, PA: Saunders; 1985:228-236.
- Ingersoll RE. Fractures of the humeral condyles in children. *Clin Orthop*. 1965;(41):32-42.
- Ryu K, Nagaoka M, Ryu J. Osteosynthesis for nonunion of the medial humeral condyle in an adolescent: a case report. *J Shoulder Elbow Surg*. 2007;16(3):e8-e12.
- Boyd HB, Altenberg AR. Fractures about the elbow in children. *Arch Surg*. 1944;49:213-224.
- Landin LA, Danielsson LG. Elbow fractures in children. An epidemiological analysis of 589 cases. *Acta Orthop Scand*. 1966;57(4):309-312.
- Bensahel H, Csukonyi Z, Badelon O, Badaoui S. Fractures of the medial condyle of the humerus in children. *J Pediatr Orthop*. 1986;6(4):430-433.
- Papavasiliou V, Nenopoulos S, Venturis T. Fractures of the medial condyle of the humerus in childhood. *J Pediatr Orthop*. 1987;7(4):421-423.
- Houshian S, Mehdi B, Larson MS. The epidemiology of elbow fracture in children: analysis of 355 fractures, with special reference to supracondylar humerus fractures. *J Orthop Sci*. 2001;6(4):312-315.

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14. Leet AI, Young C, Hoffer MM. Medial condyle fractures of the humerus in children. *J Pediatr Orthop*. 2002;22(1):2-7.
15. Maylahn DJ, Fahey JJ. Fractures of the elbow in children; review of three hundred consecutive cases. *JAMA*. 1958;166(3):220-228.
16. Herring JA, ed. *Tachdjian's Pediatric Orthopaedics*. 4th ed. Philadelphia, PA: Saunders Elsevier; 2008.
17. Farsetti P, Potenza V, Caterini R, Ippolito E. Long-term results of treatment of fractures of the medial humeral epicondyle in children. *J Bone Joint Surg Am*. 2001;83(9):1299-1305.
18. Hoffman AD. Radiography of the pediatric elbow. In: Morrey BF. *The Elbow and Its Disorders*. Philadelphia, PA: Saunders; 1985:153-160.
19. Ezaki M, Mencio GA. Elbow and forearm: pediatric aspects. In: Beaty JH, ed. *Orthopaedic Knowledge Update 6*. Rosemont, IL: American Academy of Orthopaedic Surgeons; 1999:313-321.
20. Josefsson PE, Danielsson LG. Epicondylar elbow fracture in children: 35-year follow-up of 56 unreduced cases. *Acta Orthop Scand*. 1986;57(4):313-315.
21. Ogden JA. *Skeletal Injury in the Child*. 2nd ed. Philadelphia, PA: Saunders; 1990.
22. Wheelless CR III. Medial epicondyle frx of the humerus. In: Wheelless CR 3rd, ed. *Wheelless' Textbook of Orthopaedics*. http://www.wheelessonline.com/ortho/medial_epicondyle_fr_x_of_the_humerus. Updated March 7, 2011. Accessed June 25, 2011.
23. Canale ST. Fractures and dislocations in children. In: Canale ST, Beaty JH, eds. *Campbell's Operative Orthopaedics*. 11th ed. Philadelphia, PA: Mosby Elsevier; 2008.
24. De Boeck H, Casteleyn PP, Opdecam P. Fracture of the medial humeral condyle. Report of a case in an infant. *J Bone Joint Surg Am*. 1987;69(9):1442-1444.
25. Fowles JV, Kassab MT. Displaced fractures of the medial humeral condyle in children. *J Bone Joint Surg Am*. 1980;62(7):1159-1163.
26. Ippolito E, Tudisco C, Farsetti P, Caterini R. Fracture of the humeral condyles in children: 49 cases evaluated after 18-45 years. *Acta Orthop Scand*. 1996;67(2):173-178.
27. Kimball JP, Glowczewskie F, Wright TW. Intraosseous blood supply to the distal humerus. *J Hand Surg Am*. 2007;32(5):642-646.
28. Ring D, Jupiter JB. Fractures of the distal humerus. *Orthop Clin North Am*. 2000;31(1):103-113.
29. American Academy of Orthopaedic Surgeons. *Joint Motion* [booklet]. Chicago, IL: American Academy of Orthopaedic Surgeons; 1965.
30. Morrey BF, Askey LJ, Chao EY. A biomechanical study of normal functional elbow motion. *J Bone Joint Surg Am*. 1981;63(6):872-877.
31. Harrison RB, Keats TE, Frankel CJ, Anderson RL, Youngblood PY. Radiographic clues to fractures of the unossified medial humeral condyle in young children. *Skeletal Radiol*. 1984;11(3):209-212.
32. Skaggs DL, Mirzayan R. The posterior fat pad sign in association with occult fracture of the elbow in children. *J Bone Joint Surg Am*. 1999;81(10):1429-1433.
33. Pring M, Rang M, Wenger D. Elbow—distal humerus. In: Wenger DR, Pring ME, eds. *Rang's Children's Fracture*. 3rd ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2005:115-116.
34. Gogola GR. Pediatric humeral condyle fractures. *Hand Clin*. 2006;22(1):77-85.
35. Morrey BF, An KN. Articular and ligamentous contributions to the stability of the elbow joint. *Am J Sports Med*. 1983;11(5):315-319.