Suture Anchor Supplemental Fixation of Medial Epicondyle Fractures

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Abstract: Operative fixation of medial epicondyle fractures is becoming increasingly popular due to a rising concern for symptomatic valgus instability, stiffness, and long-term functional effects of nonunion in patients treated nonoperatively. Expanding surgical indications and the desire to restore elbow stability has led to the development of a novel fixation method that stabilizes soft tissues, promotes bony healing, and does not necessitate a second implant removal surgery. This paper presents a minimally traumatic technique for operative fixation of medial epicondyle fractures that restores ligamentous stability of the ulnar collateral ligament (UCL) and flexor-pronator mass utilizing a bone suture anchor to augment K-wire fixation without the need for operative implant removal and with reduced risk of avulsion fragment comminution and postoperative stiffness.

Key Points:

- Operative fixation of medial epicondyle fractures is utilized to prevent nonunion with possible valgus instability, medial elbow pain, limited range of motion, and ulnar nerve symptoms.
- Suture anchor supplemental fixation provides soft tissue stabilization by restoring ligamentous stability of the UCL and flexor-pronator mass.
- Suture anchor supplementation is ideal for young patients with small fractures or patients with comminuted medial epicondyle fractures.
- Advantages of suture anchor technique include no need for operative implant removal, earlier range of motion, and reduced risk of iatrogenic comminution.

Introduction

Medial epicondyle fractures are common, accounting for 11-20% of all pediatric elbow fractures.[1,2] The medial epicondyle serves as the anatomic origin of the forearm flexor mass (palmaris longus, flexor carpi radialis, flexor carpi ulnaris, flexor digitorum superficialis, part of pronator teres) and the UCL.[2–5] The incompletely ossified bone is susceptible to fail before the more robust soft tissue attachments, leading to avulsion of the medial epicondyle with the flexor-pronator mass.[4] There is a high risk for nonunion with nonoperative treatment.[8,9] Although the majority of patients with nonunion are asymptomatic, there is risk for chronic elbow pain, instability, and stiffness in high-demand patients and overhead athletes.[5,8–13] Surgical fixation has become popular as the number of children participating in competitive and specialized sports is growing.[5,14] Fixation with a cannulated screw is a common technique despite risk of iatrogenic comminution in small fracture

fragments and with occasional stiffness and need for implant removal.[3,15]

This paper presents a novel, minimally traumatic technique for operative fixation of medial epicondyle fractures designed to restore ligamentous stability of the UCL and flexor-pronator mass utilizing a bone suture anchor as supplemental fixation combined with K-wire fixation. Enhanced fixation (as compared with K-wires alone), reduced stiffness, and decreased comminution risk is achieved without the need for later operative implant removal.

Indications for Suture Anchor Fixation

Supplemental suture anchor fixation, in addition to K-wire fixation, is ideal for young patients with small or primarily cartilaginous medial epicondyle fractures. This technique should be considered when the fractured fragment is at risk for comminution, or there is anticipated difficulty with rotational stability of the fragment with a screw or K-wires. Additionally, this technique allows for earlier range of motion and should be considered in patients at increased risk for stiffness, particularly those with severe soft tissue injury. Suture anchor fixation in isolation should not be considered, as some component of more rigid bone-to-bone stability is important for fracture stabilization.

Surgical Technique

A medial approach to the elbow is performed with a curvilinear incision over the anterior aspect of the medial epicondyle extending distally over flexor wad. The ulnar nerve is identified and protected throughout the case. Dissection is performed to fracture site, and medial epicondyle avulsion fracture is identified, gently debrided, and irrigated, with minimal disruption of capsular attachments. The flexor wad aponeurosis, pronator origin, and UCL, attached to the medial epicondylar fragment, are whipstitched with FiberWire® #2 (Arthrex Inc., Naples, FL) suture, and the medial epicondyle is reduced under fluoroscopic guidance. The suture limbs are used to achieve reduction with proximal traction without the need to clamp the avulsed

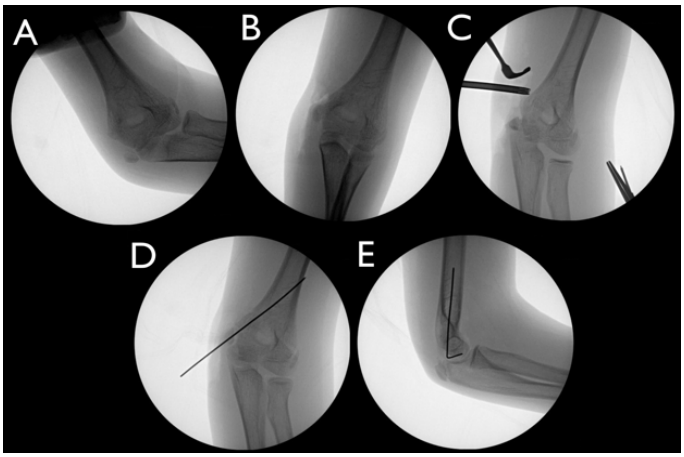

Figure 1. *Intra-operative radiographs. Valgus instability is confirmed under fluoroscopic guidance (A). Dissection performed down to fracture site and medial epicondyle is reduced (B). Flexor-pronator flexor wad aponeurosis and UCL are whipstitched, fragment is reduced, and fracture is stabilized with K-wire and suture anchor (C, D, E).*

epicondyle. Once reduction is achieved, a single or multiple percutaneous K-wires are placed to secure the avulsed fragment. The FiberWire stitch is fastened with a 2.5mm biocomposite arthroscopic anchor (PushLock®, Arthrex Inc., Naples, FL). The medial metaphysis of the humerus is drilled approximately 1cm proximal to the proximal aspect of the fracture, upon the medial ridge of the metaphysis, being sure to direct the anchor out of the olecranon fossa. This anchors the aponeurosis to the humeral shaft, securing the avulsed fragment in a reduced position (Figures 1, 2). Stability is confirmed fluoroscopically. The incision is irrigated, closed with absorbable suture, and a well-padded long-arm cast applied. At 2 to 3 weeks postoperatively, cast and K-wires are removed, and the patient may begin protected active range of motion.

Case Presentation

A 10-year-old female gymnast presented with a left displaced medial epicondyle fracture sustained while doing a cartwheel (Figure 3). There was no endpoint to valgus stress on exam under anesthesia, and operative fixation was pursued. The medial epicondyle fragment was cartilaginous and quite small, making it unsuitable

for screw fixation without a substantial comminution risk. The fracture was stabilized with the described technique utilizing a single percutaneous K-wire and suture anchor. She was placed in a long-arm cast. At 2 weeks postoperatively, radiographs revealed stable fixation, K-wire was removed in clinic, and she was placed in a hinged elbow brace with increased elbow extension by 15° per week. At 2-month follow-up, radiographs revealed stable, healing fracture; she had no pain, full elbow range of motion, and stability to valgus stress symmetric to her contralateral side (Figure 3). She resumed full activity, including gymnastics, and had no complaints at 1-year follow-up.

Discussion

Historically, satisfactory outcomes are reported for nonoperative treatment of medial epicondyle fractures, with an acceptable range of motion and function for fractures displaced up to 15mm. In two studies with over 30-years follow-up on nonoperative management, nonunion is reported at 55-90% with 10-12.5% of patients with symptomatic nonunion.[8,9] Only one patient, however, was reported to be a manual laborer, and none were reported to be overhead athletes. Despite the majority of patients doing well with nonunion, there is a subgroup with valgus instability, medial elbow pain, limited range of motion, pain with lifting weights or throwing, and ulnar nerve symptoms.[5,10–13] Damage to medial stabilizing structures is increasingly recognized as a risk for poor outcome.[12,15,16]

Recently, operative decision making is based upon medial elbow stability, with recommendations for operative fixation with any valgus instability.[12,15]Associated elbow dislocation or significant displacement should increase suspicion for damage to medial capsuloligamentous structures, but elbow instability is reported even in fractures without a history of dislocation that appear minimally displaced.[12,15] The UCL is the primary restraint to valgus force on the elbow, and nonunion or fibrous union of the medial epicondyle may predispose to UCL laxity and

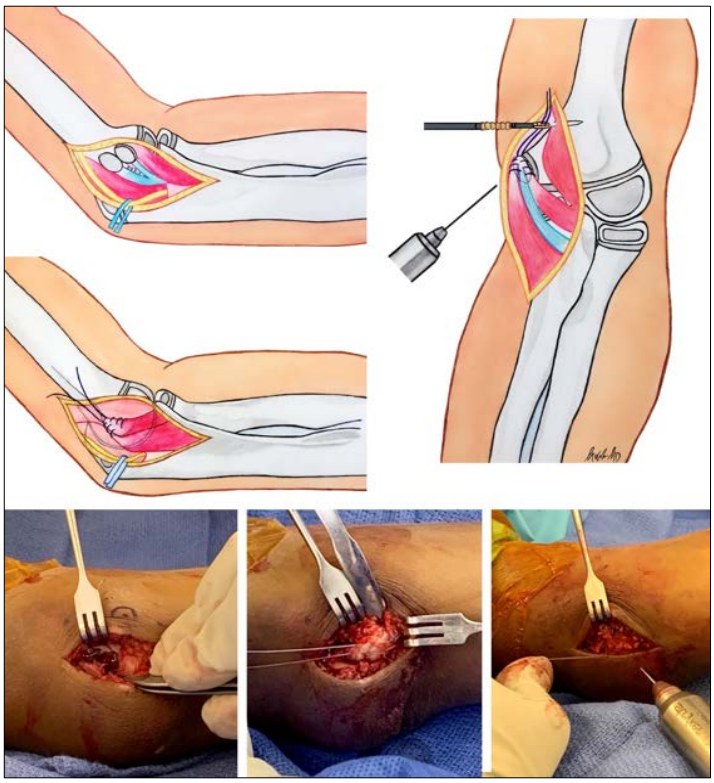

Figure 2. *Dissection is performed down to fracture site with protection of ulnar nerve and minimal capsular disruption. Flexor-pronator mass and UCL are whipstitched and suture limbs are then used to aid in reduction. K-wire is placed through reduced avulsed fragment followed by suture anchor placement, which anchors the aponeurosis to the humerus securing the avulsed fragment in a reduced position.*

continued elbow symptoms.[5,12,16] There is particular concern for symptomatic nonunion and continued instability in high-demand patients, repetitive overhead athletes (baseball, volleyball), and upper extremity weight-bearing athletes (gymnasts and wrestlers). The present technique is inspired by the importance of soft tissue stability in these fractures, and restoration of UCL and flexor mass stability is the primary goal, with bony union as a secondary outcome.

Despite excellent outcomes with traditional cannulated screw fixation, there are reported complications.[3,15, 17] Symptomatic medial epicondyle screws may require hardware removal, and some authors are routinely

removing all medial epicondyle screws.[3,12,15] Suture anchor fixation in combination with K-wires eliminates the need for an additional surgery for implant removal and provides further stability than K-wires alone. Due to internal stability conferred by suture anchor, early motion may be considered with early K-wire removal (2 or 3 weeks instead of 4 weeks) in compliant patients with acceptable fracture healing based on radiographic and clinical data. A hinged elbow brace is used in these patients with a gradual increase in range of motion, which allows for earlier motion and reduced risk of stiffness. Stiffness is a known complication following medial epicondyle fractures, particularly those with severe soft tissue injury,[3,12,17,18] and immobilization for longer than 2 weeks has been associated with decreased elbow range of motion.[19]

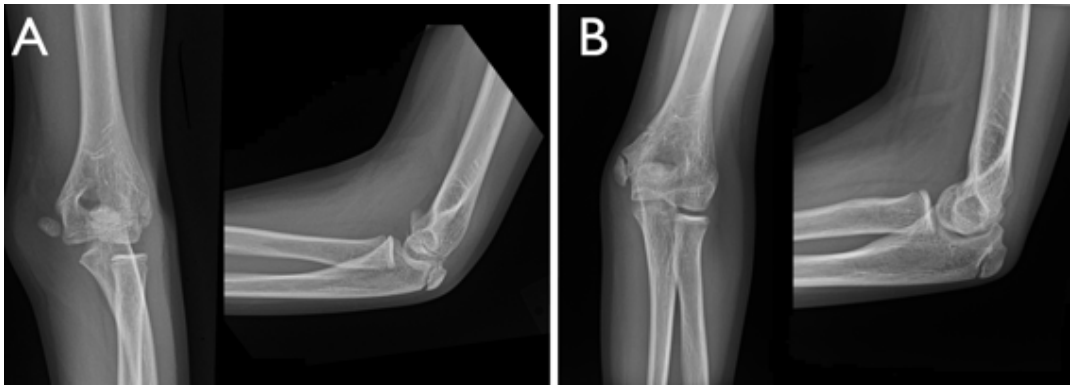

Figure 3. *Initial radiographs, anteroposterior and lateral, showing a medial epicondyle fracture (A). Radiographs at 2 months show maintenance of medial epicondyle reduction (B).*

The avulsed bone fragment may be too small for fixation with multiple wires or a screw; even with a larger fragment, there is risk of comminution with fixation. Comminution risk is reduced in this technique by only requiring a single K-wire, and by achieving reduction with tension on suture limbs instead of clamping the avulsed fragment. Inherent risks of K-wires and a cannulated screw system may be underappreciated in literature, including guide pin bending, breakage, unrecognized advancement, ulnar nerve injury, and iatrogenic radial nerve injury with cannulated screw fixation.[20,21]

Further, the effect of cannulated screws on the growth of the medial elbow is unknown. The medial epicondyle is a traction apophysis, and thus screw fixation should not disrupt longitudinal bone growth.[7,14] Yet in younger children, an apparent medial epicondyle fracture may actually be an intra-articular medial condyle fracture, and thus, cannulated screws may damage the growth plate; K-wires may cause less damage when used with medial condyle fractures.[12,22,23]

In a recent retrospective series of patients treated with a similar suture anchor technique, results were equivalent to K-wire fixation with 100% union and no postoperative complications such as pain, stiffness, or instability with 18.6 months average follow-up.[24] Although more long-term follow-up is needed on techniques utilizing suture anchors, preliminary results are promising, and there are significant advantages, including no need for operative implant removal, earlier range of motion, and reduced risk of radial nerve injury, fragment comminution, and physis disruption.

Conclusion

Increased pediatric sports participation and a rising concern for symptomatic valgus instability, stiffness, and long-term functional effects of nonunion in patients treated nonoperatively has prompted recent interest in surgical fixation of medial epicondyle fractures. Suture anchor supplemental fixation is a technique that, when combined with K-wire fixation, will restore ligamentous stability of the UCL and flexor-pronator mass, and may be considered in fractures at risk for comminution or when there is a desire for increased stability. The suture anchor technique eliminates the need for operative

implant removal, reduces fragment comminution risk, and allows for earlier range of motion.

Additional Links

https://posna.org/Physician-Education/Study-Guide/Humerus-Medial-Epicondyle-Fractures
https://journals.lww.com/jaaos/Fulltext/2012/04000/Medial_Epicondyle_Fractures_in_the_Pediatric.9.aspx

https://orthoinfo.aaos.org/en/diseases--conditions/elbow-fractures-in-children/

References

1. Flynn JM, Skaggs DL, Waters PM. Rockwood and Wilkins' fractures in children: Eighth edition. Lippincott Williams & Wilkins, editor. Rockwood and Wilkins' Fractures in Children: Eighth Edition. Philadelphia; 2014. 1–1252 p.

2. Gottschalk HP, Eisner E, Hosalkar HS. Medial epicondyle fractures in the pediatric population. J Am Acad Orthop Surg. 2012 Apr;20(4):223–32. https://doi.org/10.5435/JAAOS-20-04-223

3. Lee HH, Shen HC, Chang JH et al. Operative treatment of displaced medial epicondyle fractures in children and adolescents. J Shoulder Elb Surg. 2005 Mar;14(2):178–85. https://doi.org/10.1016/j.jse.2004.07.007

4. Glotzbecker MP, Shore B, Matheney T et al. Alternative technique for open reduction and fixation of displaced pediatric medial epicondyle fractures. J Child Orthop. 2012 Jun;6(2):105–9. https://doi.org/10.1007/s11832-012-0395-1

5. Beck JJ, Bowen RE, Silva M. What's New in Pediatric Medial Epicondyle Fractures? J Pediatr Orthop. 2018 Apr;38(4):e202–6. https://doi.org/10.1097/BPO.0000000000000902

6. Mencio GA. Fractures and Dislocations about the Elbow. In: Mencio GA, Swiontkowski MF. Green's Skeletal Trauma in Children. Saunders; 2014:182-245

7. Pathy R, Dodwell ER. Medial epicondyle fractures in children. Current Opinion in Pediatrics. 2015 Feb;27(1):58-66. https://doi.org/10.1097/MOP.0000000000000181

8. Josefsson PO, Danielsson LG. Epicondylar elbow fracture in children: 35-year follow-up of 56 unreduced cases. Acta Orthop Scand. 1986 Jan 8;57(4):313–5. https://doi.org/10.3109/17453678608994399

9. Farsetti P, Potenza V, Caterini R, et al. Long-term results of treatment of fractures of the medial humeral epicondyle in children. J Bone Jt Surg - Ser A. 2001 Sept;83(9):1299-305. https://doi.org/10.2106/00004623-200109000-00001

10. Shukla SK, Cohen MS. Symptomatic medial epicondyle nonunion: treatment by open reduction and fixation with a tension band construct. J Shoulder Elb Surg. 2011 Apr;20(3):455–60. https://doi.org/10.1016/j.jse.2010.12.017

11. Smith JT, McFeely ED, Bae DS, et a Operative fixation of medial humeral epicondyle fracture nonunion in children. J Pediatr Orthop. 2010 Oct-Nov;3-(7):644-8. https://doi.org/10.1097/BPO.0b013e3181ed4381

12. Park KB, Kwak YH. Treatment of Medial Epicondyle Fracture without Associated Elbow Dislocation in Older Children and Adolescents. Yonsei Med J. 2012;53(6):1190. https://doi.org/10.3349/ymj.2012.53.6.1190

13. Mirzayan R, Cooper JD. Chronic Medial Epicondyle Avulsion. J Am Acad Orthop Surg. 2019 Jan;27(2):e64–9. https://doi.org/10.5435/JAAOS-D-17-00446

14. Longo UG, Ciuffreda M, Locher J, et al. Maffulli N, Denaro V. Apophyseal injuries in children's and youth sports. Br Med Bull. 2016 Dec;120(1):139–59. https://doi.org/10.1093/bmb/ldw041

15. Louahem DM, Bourelle S, Buscayret F, et al. Displaced medial epicondyle fractures of the humerus: surgical treatment and results. A report of 139 cases. Arch Orthop Trauma Surg. 2010 May;130(5):649-55. https://doi.org/10.1007/s00402-009-1009-3

16. Woods GW, Tullos HS. Elbow instability and medial epicondyle fractures. Am J Sports Med. 1977 Jan

23;5(1):23–30.
https://doi.org/10.1177/036354657700500105

17. Herring JA, Ho C. Upper Extremity Injuries, in tachdjian's Pediatric Orthopaedics. 2013.

18. Ireland ML, Andrews JR. Shoulder and elbow injuries in the young athlete. Clin Sport Med. 1988 Jul;7(3):473-94.

19. Murphy RF, Vuillermin C, Naqvi M, et al. Early Outcomes of Pediatric Elbow Dislocation—Risk Factors Associated With Morbidity. J Pediatr Orthop. 2017;37(7):440–6.
https://doi.org/10.1097/BPO.0000000000000676

20. Marcu DM, Balts J, McCarthy JJ, et al. Iatrogenic Radial Nerve Injury With Cannulated FixationofMedial Epicondyle Fractures in the PediatricHumerus. J Pediatr Orthop. 2011 Mar;31(2):e13–6.
https://doi.org/10.1097/BPO.0b013e318209287d

21. Schwend RK, Hennrikus WL, O'Brien TJ, et al. Complications when using the cannulated 3.5 mm screw system. Orthopedics. 1997 Mar;20(3):221–3.

22. Skak Soren V, Grossman Edith WP. Deformity after internal fixation of fracture separation of the medial epicondyle of the humerus. J Bone Jt Surg Br. 1994;76-B(March):297–302.

23. Hines RF, Herndon WA, Evans JP. Operative treatment of Medial epicondyle fractures in children. Clin Orthop Relat Res. 1987 Oct;223(223):170–4.

24. Rigal J, Thelen T, Angelliaume A, et al. A new procedure for fractures of the medial epicondyle in children: Mitek® bone suture anchor. Orthop Traumatol Surg Res. 2016 Feb;102(1):117–20.
https://doi.org/10.1016/j.otsr.2015.09.035