



Surgical Techniques

Olecranon Fracture Fixation: Surgical Technique

Benjamin R. Campbell, MD¹^a, Ariana A. Reyes, MD¹, Daniel A. Nemirov, MD¹, William L. Justice, MD¹, Kamil M. Amer, MD¹, Asif M. Ilyas, MD MBA¹

¹ Rothman Orthopaedic Institute at Thomas Jefferson University, Philadelphia, PA, USA

Keywords: Olecranon fractures, Tension band, Locking Plate, Olecranon fixation, Elbow surgery

<https://doi.org/10.58616/surgicoll.00006>

SurgiColl

Vol. 1, Issue 1, 2023

Fractures of the olecranon occur from fall on the elbow or the outstretched hand resulting in eccentric contracture of the triceps musculature and subsequent avulsion of the proximal aspect of the ulna. These fractures are both inherently intra-articular and unstable, and therefore surgical repair is generally indicated. We will present two surgical techniques for the repair of olecranon fractures, including tension band wiring and locking plate constructs.

INTRODUCTION

Olecranon fractures are a relatively common orthopedic injury that comprises approximately 10% of all upper extremity fractures.¹ Due to their intra-articular nature and instability secondary to the deforming forces of the triceps at its insertion, these injuries generally warrant surgical fixation. Even in minimally displaced fractures, there is a high risk of progressive displacement and the need for prolonged immobilization, which can compromise its outcome with non-operative treatment.

Overall, olecranon fracture fixation has positive outcomes and a low nonunion rate, with Karlsson *et al.* reporting up to 96% good to excellent results at 15-25 years.² However, a thorough understanding of the relevant anatomy and fixation strategies is necessary to avoid potential complications such as wound breakdown, loss of reduction, or loss of elbow mobility. The purpose of this article is to review the surgical technique for two methods of olecranon fracture fixation: tension band wiring and locking compression plate fixation.

INDICATIONS AND CONTRAINDICATIONS

Most olecranon fractures are indicated for operative fixation. Contraindications for operative fixation of olecranon fractures include active elbow infection, open fractures with gross contamination and loss of posterior skin, and/or generally compromised posterior soft tissue. Non or minimally displaced fractures, or fractures in patients unsafe for surgery, can be treated non-operatively. However, non-

operative treatment may require prolonged immobilization with potentially secondary displacement or stiffness. There is also evidence that even displaced or comminuted fractures in elderly patients may be treated non-operatively, with an estimated 75% of cases developing a fibrous but functional nonunion.³

Tension band wiring constructs with Kirschner wire ("K wire") fixation are best indicated for simple, isolated, displaced olecranon fractures without significant comminution, distal extension, or humeral-ulnar instability.⁴ This technique offers absolute theoretical stability by translating tensile triceps forces into compressive forces to facilitate early motion and primary healing across the fracture site.⁵ Locking plate fixation is best indicated for fractures with ulnohumeral instability, oblique or comminuted fractures, fractures involving the coracoid process, distal shaft extension, and trans-olecranon fracture dislocations.^{4,5}

SURGICAL TECHNIQUE

SURGICAL PREPARATION

For either fixation technique of an olecranon fracture, the patient may be anesthetized with general anesthesia or sedated with a regional block. The patient may be positioned lateral or prone with the injured extremity being suspended with the hand down. Alternatively, the patient may be positioned supine with the injured extremity bent across the chest on top of pillows or blankets under the drape for support. A sterile tourniquet may be applied proximally at the upper arm. An incision is marked just lateral to the midline along the posterior elbow to avoid the skin directly overlying

^a Corresponding Author:

Benjamin Campbell, MD

Rothman Orthopaedic Institute, 925 Chestnut Street, 5th Floor, Philadelphia, PA 19107, USA

benjamin.campbell@rothmanortho.com

ing the olecranon tip. Prior to incision, a local anesthetic such as 10-20cc of 0.5% bupivacaine with epinephrine may be injected for postoperative pain relief. A miniature C-arm is used to capture intra-operative radiographs and confirm fracture reduction.

SURGICAL EQUIPMENT

For tension band wiring, necessary equipment includes: 1.6 or 1.5 mm K-wires, 1.2 or 1.0 mm stainless wiring, wire driver, drill with 2.0 bit, heavy needle drivers, wire cutter, tamp, mallet, and fluoroscopy.

For locking plate fixation, necessary equipment includes a 3.5 mm AO (*Arbeitsgemeinschaft für Osteosynthesefragen*) reconstruction plane or anatomically pre-contoured 2.5 to 3.5 mm locking olecranon plate and screws, drill, and fluoroscopy.

TENSION BAND WIRING

Following exposure with full-thickness skin flaps and debridement of the fracture site, a 2mm unicortical opening is drilled in the ulna, roughly 2-4 cm distal to the fracture site. A towel clip is placed across the proximal fracture fragment at the triceps insertion to help facilitate proximal ulnar fragment manipulation and fracture reduction. Pointed reduction forceps are placed across the fracture site, keying into the olecranon tip proximally and the unicortical pre-drilled hole distally. Utilization of these fixation points allows for sufficient space both proximally and distally for subsequent K-wire insertion. Surgeons should be cautious with reduction techniques in patients with osteoporosis or poor bone quality to prevent over-compression or further iatrogenic articular injury during reduction.

A 1.6 mm K-wire is then drilled antegrade through the posterior olecranon, roughly 20 degrees off the axis of the ulna, to accommodate the anatomic varus angulation of the ulnar shaft. A second 1.6 mm K-wire is inserted parallel and approximately 1-1.5 cm medial or lateral to the first K-wire. Subsequently, a transverse 2.5 mm bicortical drill hole is established roughly 3 cm distal to the fracture, anterior to the dorsal cortex. This is done from a medial to lateral orientation to protect the ulnar nerve. A 1.2 mm stainless steel wire is introduced through this pre-drilled hole in the ulnar shaft.

A second 1.2mm wire is then introduced proximal to the two inserted K wires across the dorsal ulnar cortex, deep to the triceps tendon, and across the proximal olecranon fracture fragment. The limbs of both the proximal and distal wires are connected on opposite sides across the fracture site. The wires are twisted around one another and tightened symmetrically with even tension. The excess wire is trimmed, and the tensioned knot construct is tamped down to the ulnar cortex on both sides to reduce soft tissue irritation and implant prominence. Attention can now be returned to the protruding 1.6 mm K wires in the posterior olecranon. To establish the hooked wire ends, the region where the wire penetrates soft tissue is marked using a sterile surgical marker. Each wire is then withdrawn 1 cm, grasped with a heavy needle driver at the marked site, and

bent 180 degrees using the needle driver as a fulcrum. This wire is subsequently trimmed to a length of approximately 5 mm, rotated 180 degrees, and tamped into the posterior olecranon to capture the proximal end of the underlying tension band construct. Fluoroscopic confirmation of fracture construct and assessment of passive flexion, extension, pronation, and supination should be carried out at this time to ensure adequate fracture reduction and no prominent hardware between the anterior ulna and radius distally before the closure [Figure 1].

LOCKING PLATE FIXATION

Once the fracture has been exposed and debrided, the reduction can be obtained using a point-to-point reduction clamp. Provisional 1.6 mm K-wires can also be drilled in the antegrade direction on either side of the reduced olecranon fragment to stabilize and hold the reduction. Either a 3.5 mm AO reconstruction plate is bent and contoured, or an anatomically pre-contoured locking olecranon plate is selected and applied along the dorsal cortex of the ulna. Once properly sized, the triceps is split longitudinally at the tip of the olecranon to allow for full seating of the plate on the dorsal posterior surface of the olecranon to fully capture the proximal fragment. Alternatively, the plate can be applied over the triceps tendon without splitting it. If possible, the plate can be pinned proximally and distally in place. Fixation is begun first distally by placing a cortical screw in the ulnar shaft in a compression fashion to secure the plate. Second, a non-locking compression screw is placed in the proximal aspect of the plate perpendicular to the fracture site and proximal to the bend of the plate for interfragmentary compression of the fracture as well as compression of the plate along the dorsal surface of the ulna. Before full compression, the distal shaft screw should be loosened to allow the plate to advance distally and re-tightened. Care should be taken that this posterior screw does not violate the articular surface of the trochlea of the ulnohumeral articulation. Once satisfied with the fracture reduction and plate positioning, the remaining holes are filled with unicortical locking screws proximally and bicortical non-locking screws distally.

Following confirmation of reduction and hardware positioning on fluoroscopy, the elbow is taken through a full range of motion to ensure the stability of the construct and no mechanical blocks to motion [Figure 2]. Of note, for any cases of intra-articular comminution, an arthrotomy from a medial or lateral approach can be performed to directly visualize the joint, facilitate reduction, or remove loose bodies. Furthermore, excessive dissection of the proximal olecranon fracture fragment should be avoided to preserve vascularity and compromise the triceps insertion.

POST-OPERATIVE MANAGEMENT

The wound is thoroughly irrigated and closed in a layered fashion. The elbow is immobilized in a bulky soft dressing or a plaster posterior long arm splint for approximately 10-14 days which can be tailored based on the severity of the injury and surgeon preference. Patients are then sub-

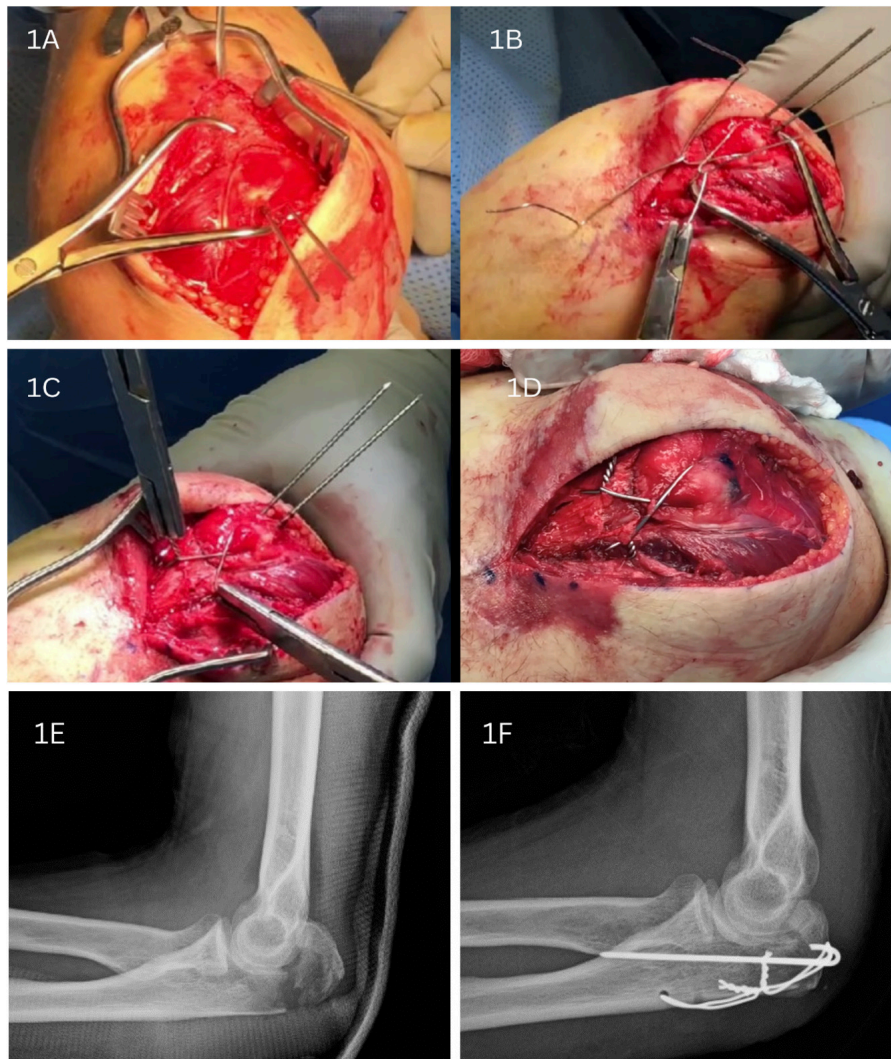


Figure 1. Olecranon Fixation with a Tension Band Construct.

A. Provisional fracture reduction using two 1.6mm K wires and pointed reduction clamp. B. Crossed K wire tension band configuration prior to tightening. C. Sequential tightening of crossed K wires to secure final reduction. D. Intra-operative view of final tension band construct. E. Pre- and F. Post-operative lateral radiographs of the elbow demonstrating a tension band construct for a displaced olecranon fracture

Table 1. Pearls and Pitfalls for Surgical Fixation of Olecranon Fractures

Pearls	Pitfalls
Create full thickness flaps to optimize visualization and coverage of hardware	Avoid placing incision over olecranon tip to prevent wound breakdown and scar discomfort
Tighten K wires simultaneously for even compression and proper positioning (Tension banding)	Do not loosen or adjust K-wire construct once tightened to prevent weakening and construct failure (Tension banding)
Fracture reduction can be assisted by a unicortical screw hole through the proximal ulna for docking of pointed reduction clamps	Beware of excessive compression during reduction in cases with severe comminution or poor bone quality
Provisional K wires or an arthrotomy can be used to assist with articular reduction	Avoid excessive dissection of the proximal fracture fragment to preserve vascularity and integrity of the triceps insertion
Early gentle mobilization within 2-3 weeks can expedite return to function and limit stiffness	Avoid strengthening exercises until full fracture healing to prevent displacement

sequently instructed to resume the use of the arm for activities of daily living and initiate a passive and active-assisted range of motion exercises. However, strengthening and resistance training are withheld until fracture healing

is confirmed between 8-12 weeks post-operatively to avoid the risk of fracture displacement. A complete list of pearls and pitfalls for surgical fixation of olecranon fractures can be found in [Table 1](#).

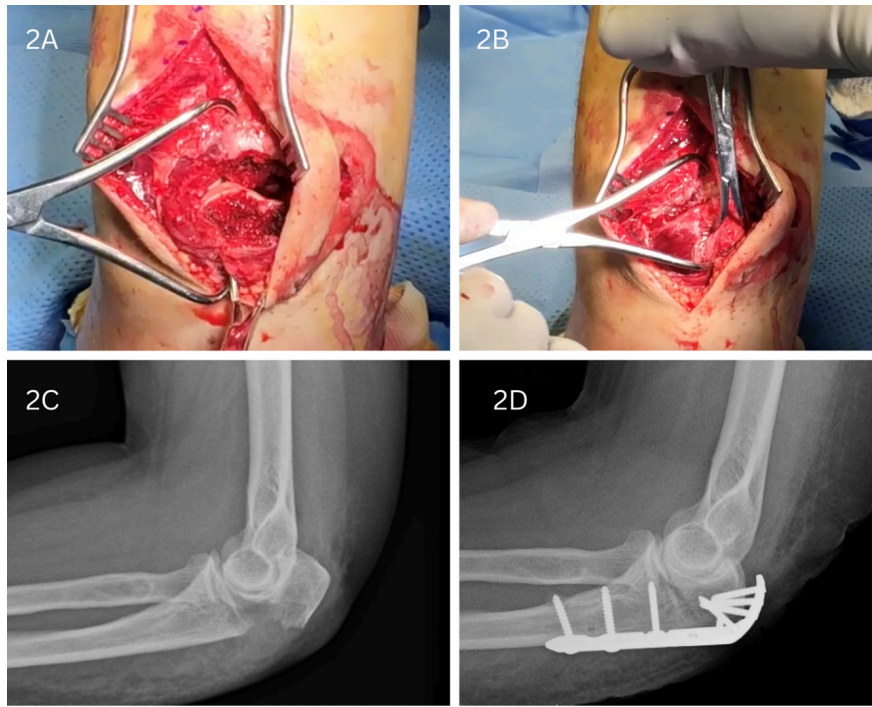


Figure 2. Olecranon fixation with a locking plate construct.

A and B. Intra-operative image demonstrating reduction of an olecranon fracture using a pointed reduction clamp docked via a unicortical hole drilled into the proximal ulna and assisted with a small fracture tenaculum manipulating the proximal fragment (inferiorly). C and D. Pre-operative and post-operative lateral radiographs of the elbow demonstrating locking plate fixation for a displaced olecranon fracture.

DISCUSSION

Surgical treatment of olecranon fractures provides predictable, durable outcomes with high patient satisfaction rates. Karlsson et al. found 84% excellent and 12% good results in patients treated for olecranon fractures at a mean of 19 years postoperatively.² Factors associated with worse outcomes include older age and increased injury severity; however, most patients still recover functional range of motion with low rates of persistent elbow pain.^{2,6} Additionally, nonunion occurs in as low as 1% of cases and is more frequent in high-energy injuries.⁷

While most patients regain adequate elbow function following fixation, complications can arise, which may impact the recovery process. Hardware irritation and removal is the most frequently encountered complication of olecranon surgery and has been reported to be as high as 82% in previous literature.⁸ However, hardware removal following fracture healing can typically be performed safely at an appropriate time interval without impacting fracture stability and often improves pain and satisfaction once addressed. Decreased range of motion following olecranon fractures is fairly common, which occurs most often with loss of terminal extension and is associated with symptomatic hardware or post-traumatic arthrosis.⁶ Although ulnar neuritis and infection are less common complications and a possible byproduct of the initial injury and postoperative inflammation, surgeons and patients should be aware of these risks throughout the perioperative period.

The preference of hardware for olecranon fixation may be controversial; however, no high-quality randomized

studies demonstrate a superior method. Retrospective comparative studies have suggested some advantages and disadvantages to both techniques, but there have yet to be consistent differences in clinical outcomes. Hume et al. found a higher rate of loss of reduction and hardware discomfort in tension band constructs versus plate fixation.⁹ Others have found longer time to union and decreased range of motion in patients undergoing plate fixation compared to tension bands.¹⁰ Overall, we believe both constructs can provide stable fixation of olecranon fractures when performed by experienced surgeons. Our group prefers tension band fixation for simple, minimally-comminuted fractures that can tolerate compression at the fracture site. In contrast, plate fixation is reserved for more complex injuries with significant comminution and or fractures with distal shaft extension.

DECLARATION OF CONFLICT OF INTEREST

The authors do NOT have any potential conflicts of interest for this manuscript.

DECLARATION OF FUNDING

The authors received NO financial support for the preparation, research, authorship, and publication of this manuscript.

DECLARATION OF ETHICAL APPROVAL FOR STUDY

The institutional review board at the Rothman Institute at Thomas Jefferson University does not require ethical approval for reporting surgical technique papers.

DECLARATION OF INFORMED CONSENT

There is no information in the submitted manuscript that can be used to identify patients.

ACKNOWLEDGEMENTS

Not applicable

Submitted: December 14, 2022 EDT, Accepted: February 17, 2023 EDT



This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CCBY-4.0). View this license's legal deed at <http://creativecommons.org/licenses/by/4.0> and legal code at <http://creativecommons.org/licenses/by/4.0/legalcode> for more information.

REFERENCES

1. Baecher N, Edwards S. Olecranon fractures. *J Hand Surg Am*. 2013;38(3):593-604. [doi:10.1016/j.jhsa.2012.12.036](https://doi.org/10.1016/j.jhsa.2012.12.036)
2. Karlsson MK, Hasselius R, Karlsson C, Besjakov J, Josefsson PO. Fractures of the olecranon: a 15- to 25-year follow-up of 73 patients. *Clin Orthop Relat Res*. 2002;403:205-212. [doi:10.1097/00003086-200210000-00030](https://doi.org/10.1097/00003086-200210000-00030)
3. Chen MJ, Campbell ST, Finlay AK, Duckworth AD, Bishop JA, Gardner MJ. Surgical and Nonoperative Management of Olecranon Fractures in the Elderly: A Systematic Review and Meta-Analysis. *Journal of Orthopaedic Trauma*. 2021;35(1):10-16. [doi:10.1097/ot.0000000000001865](https://doi.org/10.1097/ot.0000000000001865)
4. Duckworth AD, Clement ND, White TO, Court-Brown CM, McQueen MM. Plate Versus Tension-Band Wire Fixation for Olecranon Fractures. *The Journal of Bone and Joint Surgery*. 2017;99(15):1261-1273. [doi:10.2106/jbjs.16.00773](https://doi.org/10.2106/jbjs.16.00773)
5. Wiegand L, Bernstein J, Ahn J. Fractures in brief: olecranon fractures. *Clinical Orthopaedics & Related Research*. 2012;470(12):3637-3641. [doi:10.1007/s11999-012-2393-5](https://doi.org/10.1007/s11999-012-2393-5)
6. Rommens PM, Küchle R, Schneider RU, Reuter M. Olecranon fractures in adults: factors influencing outcome. *Injury*. 2004;35(11):1149-1157. [doi:10.1016/j.injury.2003.12.002715](https://doi.org/10.1016/j.injury.2003.12.002715)
7. Papagelopoulos P, Morrey B. Treatment of nonunion of olecranon fractures. *J Bone Joint Surg Br*. 1994;76-B(4):627-635. [doi:10.1302/0301-620x.76b4.8027154](https://doi.org/10.1302/0301-620x.76b4.8027154)
8. Wilkerson JA, Rosenwasser MP. Surgical techniques of olecranon fractures. *J Hand Surg Am*. 2014;39(8):1606-1614. [doi:10.1016/j.jhsa.2014.05.014](https://doi.org/10.1016/j.jhsa.2014.05.014)
9. Hume MC, Wiss DA. Olecranon fractures. A clinical and radiographic comparison of tension band wiring and plate fixation. *Clin Orthop Relat Res*. 1992;285:229-235. [doi:10.1097/00003086-199212000-00031](https://doi.org/10.1097/00003086-199212000-00031)
10. DelSole EM, Pean CA, Tejawani NC, Egol KA. Outcome after olecranon fracture repair: Does construct type matter? *Eur J Orthop Surg Traumatol*. 2016;26(2):153-159. [doi:10.1007/s00590-015-1724-0](https://doi.org/10.1007/s00590-015-1724-0)