Olecranon Fractures

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Introduction:

- General Comments
  - Diagnosis/Evaluation
  - Treatment Options
  - Complications
- Specific Injuries (Fractures & Dislocations)
  - Isolated Olecranon Fractures
  - Complex Fractures
  - Olecranon Fractures in Children and the Elderly

Olecranon Fracture Clinical Findings

- Patients present with deformity, swelling & pain
- Inability to Extend the Elbow
- Don't Miss:
  - Compartment Syndrome
  - Open wounds
    - Remember the ulnar border is subcutaneous and even superficial wounds can expose the bone
  - Nerve injuries (especially ulnar nerve)
    - Especially with open fractures

Treatment of Olecranon Injuries

- **Successful Functional Outcome Correlates directly with:**
  - Accuracy of Anatomic Joint Reduction
  - Restoration of Mechanical Stability that allows Early Motion
  - Respect for the Soft Tissues
  - Maintain the Extensor Mechanism

Classification

- Multiple attempts at classifying olecranon fractures:
  - Colton
  - Morrey
  - Schatzker
  - AO/ASIF
  - OTA
- Classification helps decide treatment options

Colton Classification

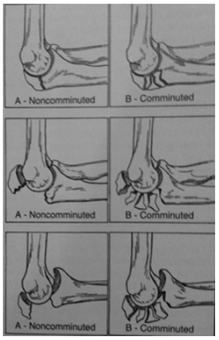
- Type I: avulsion
- Type II: oblique
- Type III: associated with dislocation
- Type IV: multisegmented

Mayo Clinic Classification

•Type I: Non-displaced 12%

•Type II: Displaced/stable 82%

• Type III: Elbow unstable 6%



Morrey BF, JBJS 77A: 718-21, 1995

Treatment Overview

- If Nondisplaced
  - Treat with Early Motion
- If Displaced – Treat with Open Reduction
  - Transverse: Tension Band
  - Oblique: Add Lag Screw
  - Comminuted: Plate options
- If not repairable – Treat with Excision

Non-Operative Treatment

- If No Articular Incongruity:
  - <1-2 mm displacement
- AND able to actively extend the elbow

Non-Operative Treatment

- Immobilize 60-90 degrees for 7-10 days then gentle motion.
- Repeat x-rays to be sure does not displace
- At 6-8 weeks allow weight-bearing.

Indications for Surgery

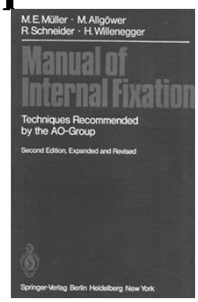
All Displaced Fractures
All Patients without Active Extension
Failure of Non-Operative Treatment

Position

- Surgeon's Preference
  - Supine, lateral, or prone

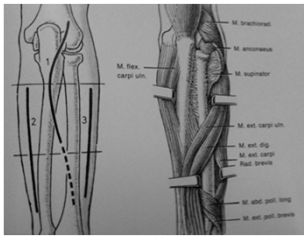
Technique Illustrations

- From



Incision

- Midline posterior incision curved radially to avoid the tip of the olecranon



Technique Choice

- Evaluate the **dorsal cortex**
  - Tension band technique Converts dorsal distraction forces to compression at articular surface & fracture site
  - If the dorsal cortex is comminuted, mechanical stability is lost
- **So**
  - If intact: consider tension band wire
  - If comminuted, consider a plate or intramedullary device

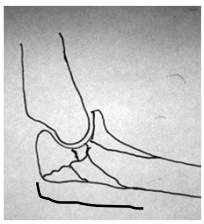


Illustration from Capo, John: Orthtopaedic Trauma Association Resident Syllabus

Technique Choice

- Evaluate **fracture line orientation**
  - If Transverse: tension band wire effective
  - If Oblique: a lag screw technique should be considered
  - If Comminuted – usually a plate

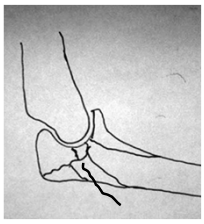
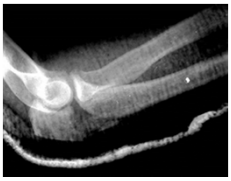


Illustration from Capo, John: Orthtopaedic Trauma Association Resident Syllabus

Tension Band: Indications

- Displaced fractures proximal to coronoid process and not at risk of compressing the olecranon fossa.
- Contraindicated if the articular surface is comminuted and unstable.

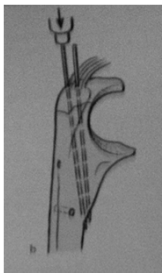


Tension Band Technique

- Reduce fracture with pointed forceps
  - May drill cortical hole for purchase distally

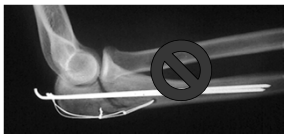
Tension Band Technique

- Drill 2 parallel K-wires obliquely into anterior cortex



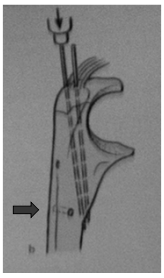
Anchor Pins

- 71% of patients – migration of k-wires or prominent and painful
- 3x more likely to back out if not anchored in anterior cortex.



Tension Band Technique

- Drill a transverse hole distally
  - should be bicortical to decrease chance of stress fracture.

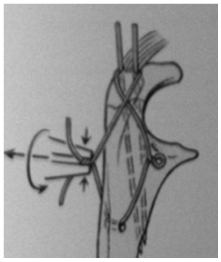


Tension Band Technique

- Loop 18- or 20 gauge wire or braided cable in a figure-of-8 pattern.
- Placement ***under*** the triceps minimizes strangulating the tendon
- Can use an IV cannula to guide the wire.

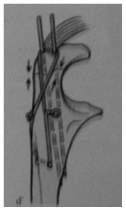
Tension Band Technique

- Tightening the loops creates inter-fragmentary compression.



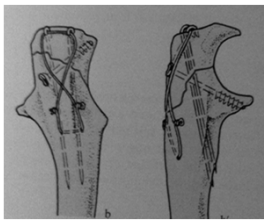
Tension Band Technique

- Ends of k-wires and cut and bent 180 degrees and hammered into bone
- Split triceps longitudinally and impact k-wires into the posterior cortex (close triceps over the ends) – to minimize hardware prominence.



Tension Band Technique

- Can combine the figure of eight tension band with lag screw fixation for oblique fractures



Tension Band Example

- Transverse fracture

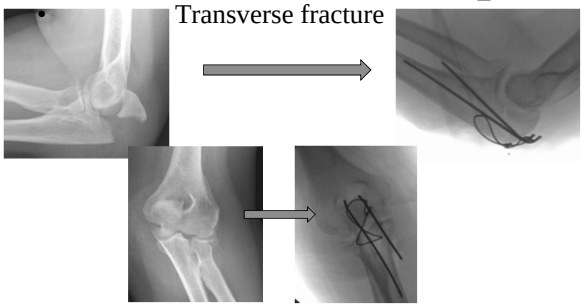


Plate Fixation

- For comminuted fractures , and fractures at or extending distal to the coronoid process including into the shaft and those with oblique fracture lines.
- More stable than tension band if comminuted or if fracture extends distal to coronoid process – also for plates extending into the shaft
- Lateral plating less prominent – less implant pain.

Bone Anatomy

Coronoid process and the Radial Head resist Anterior-to-Posterior Dislocation

- Beware of narrowing the trochlear (semi-lunar notch) when treating comminuted fractures of the olecranon.

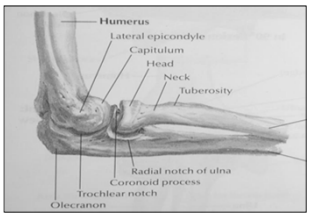


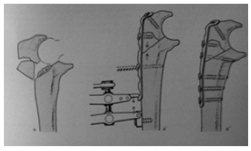
Plate Technique

- Standard Technique:

  Rigid anatomic fixation when fragments are large enough

  Plate can be used to create tension or lag screws through the plate for oblique fractures.

  Plate acts as a tension band



Technique for Plate Fixation

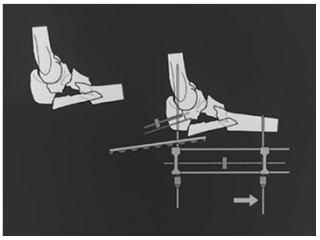
- Reduce and provisionally fix the intra-articular fragments
  - Then attach to the shaft
- Use
  - Recon or 3.5 LC-DC or Specialized Olecranon Plates
  - Use Mini-fragment (2.7) for smaller patients
- Include Lag screws

Steps

- Isolate Ulnar Nerve
  if comminuted fracture)

Technical Tips for Fixation of Olecranon Fractures

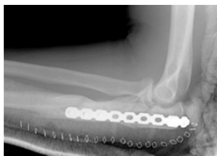
- Use Indirect Reduction Techniques Preserving Soft Tissue Attachments



From Coter, J: OTA Resident Fracture Syllabus

Plate Location

- No mechanical difference between posterior or lateral placement -*King et al, J Shoulder Elbow Surg 5:437, 1996*
- Less problems with plate prominence when placed laterally
  - Also can get bicortical screw purchase
- Posterior Plate allows more advantageous screw placement
  - Coronoid screw
  - IM screw
  - Olecranon tip screw
- But Lateral plate allows bicortical fixation at the level of the joint



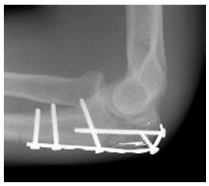
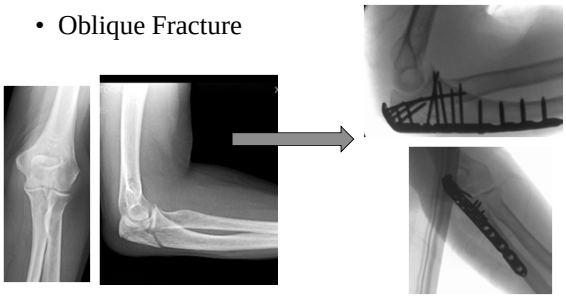


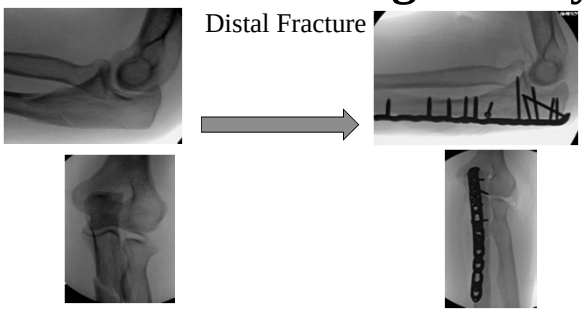
Plate Example

- Oblique Fracture



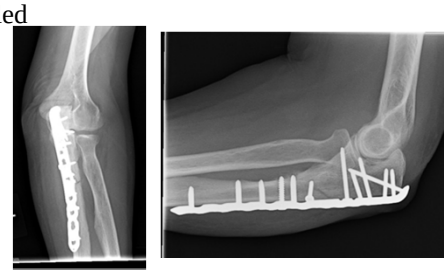
Fracture Extending Distally

Distal Fracture



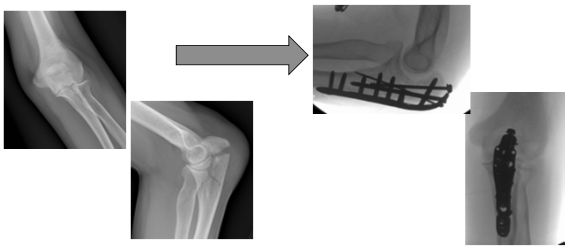
Distal fracture

- Healed



Comminuted Fracture

- Example Plate Fixation for Comminuted Fracture



Minimally Invasive Plating

- Advantages:
  - Does not disrupt soft tissues at the fracture site
  - Less surgical trauma
    - Theoretically less surgical time, less bleeding, lower risk of infection
  - Cosmetically more acceptable scars

Bridge Plating

- Similar to Minimally Invasive Plating
  - But not necessarily through small incisions
    - MIP – fracture site not visualized except radiographically: indirect reduction +/- percutaneous lag screws
    - Bridge Plating – can be MIP, or fracture site visualized with partial direct reduction, but periosteal attachments still maintained
  - More soft tissue damage from surgical trauma than MIP, but less chance of malreduction

Olecranon Bridge Plate Case Example

- 20y/o male –elbow Gunshot
  - Injury X-rays:

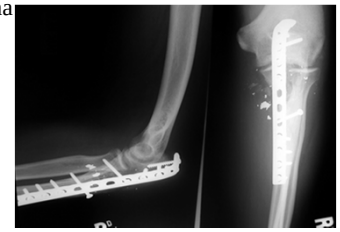
Olecranon Bridge Plate

I&D

because subcutaneous ulna higher risk of infection than most GSW's

ORIF allows early motion

- 6 month follow-up:



Monteggia Fracture-Dislocations

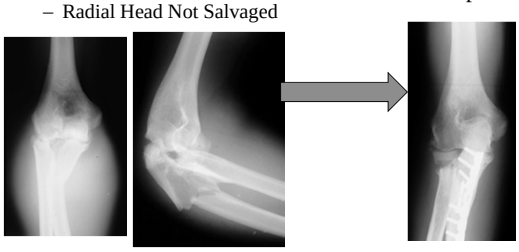
- Classic:
  - Fracture of Proximal 1/3 Ulna with Dislocation of Radial Head

Monteggia Fx-Dx

- Best Treatment
  - ORIF w. Plate Fixation of Diaphyseal Fracture
  - Joint Usually Reduces Indirectly and is stable
  - If Unstable: open reduction of joint
  - If irreducible – usually because the diaphyseal fracture has been mal-reduced

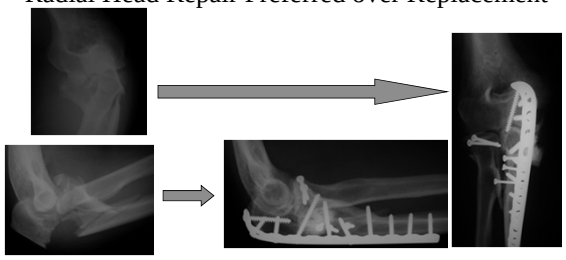
Complex Fractures

- Monteggia Variant
  - Radial Head Not Salvaged
- Radial Head Spacer



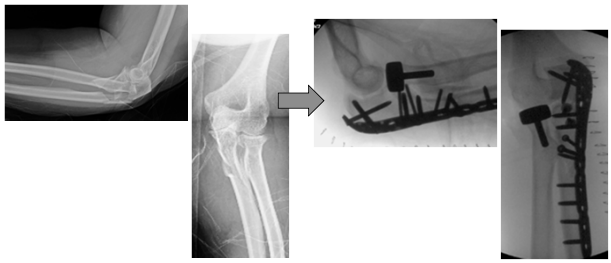
Complex Fractures

- Radial Head Repair Preferred over Replacement



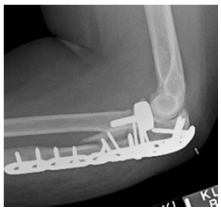
Monteggia Variant

- Unstable fracture requiring radial head replacement



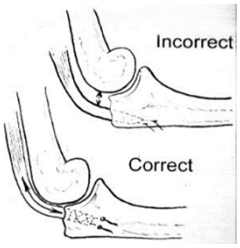
With Radial Head

- Final Images



Excision Technique

- Reattach anteriorly close to the articular surface to preserve strength
- Resection more than 50% of the olecranon leads to instability



Gartsman et al, JBJS 63A:718, 1981

Intra-Medullary Options

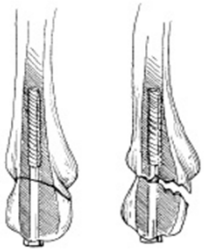
- Intra-medullary Screws
- Intra-medullary rods

Disadvantages of Intra-medullary Fixation

- Large diameter screws: higher rate of fixation failure than tension band
- Engage intra-medullary cortex – increased torque instead of compression
- But if canal large – poor purchase and inadequate compression.
- Can combine with tension band technique

Anatomy of the Proximal Ulna

- Beware of the bow of the proximal ulna, which may cause a medial shift of the tip of the olecranon if a long screw is used.



From Hak and Golladay, JAAOS, 8:266-75, 2000

Intramedullary Rod Systems

- Have Advantages over Intramedullary Screws
- Indicated to treat simple olecranon fractures and osteotomies of the olecranon.

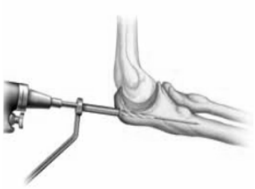
IM Fixation Advantages

- System minimizes articular step-off after osteotomy
- Stable thread connection between nail and end cap provide compression between fragments
- Reduced soft tissue irritation
  - Nail buried in medullary canal and threaded screw head also below the surface of the bone
- Stable fixation

The screw heads contacting the nail, combined with the angled screws, prevent toggling of the implant in the medullary canal regardless of the size of the canal

Technique Rods

- Cortex Perforation & Canal Preparation
- Insert guide wire down center of canal
- Be sure not to bend the guide wire.
- Drill over the guide wire while drilling.

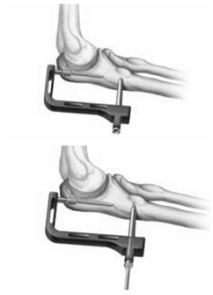


Rod Technique

- Can use Awl to perforate the cortex and prepare the canal.
- The awl passes straight into the canal

Rod Technique

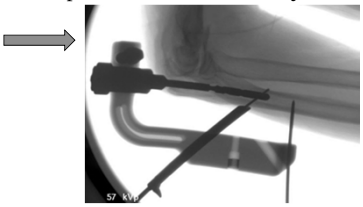
- Place the Rod
  - Locking screws and compression devices vary by manufacturer



Example (Osteotomy)

Distal Humerus Fracture Requiring Olecranon Osteotomy for Fixation

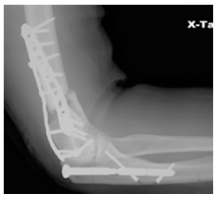
Rod is placed Before osteotomy



Case Example From Synthes

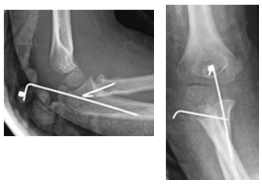
Rod Placement

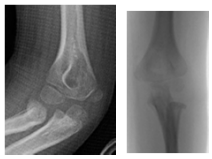
- After Fixation is completed:



Pediatric Fracture

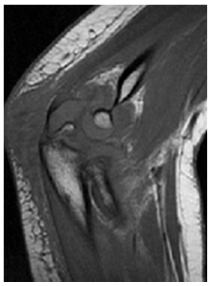
- Pin Fixation of Unstable Olecranon Fracture





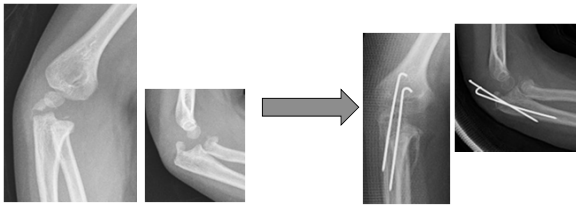
Pediatric Fracture

- MRI showing Step-off of articular surface



Pediatric Fracture

- Open Reduction and Pin Fixation

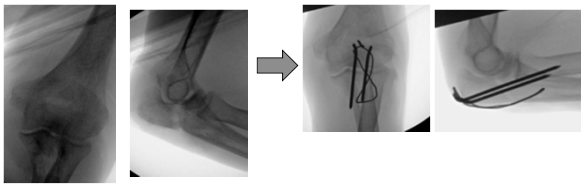


Geriatric Olecranon Fractures

- Excision with Triceps Advancement for “unrecoverable” olecranon fractures especially in the elderly with low functional demands.

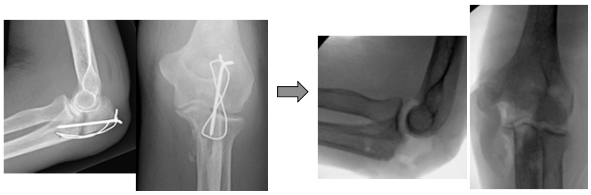
Excision

- 79 year old – fell – initial tension band technique



Excision

- Nonunion: hardware removed: excision with excellent functional outcome



Outcome

- 95% near normal function
- 20-50% patients develop radiographic evidence of arthrosis at 15-20 year
  - But usually asymptomatic

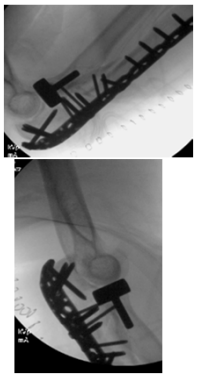
Potential Complications

- Hardware symptoms in 22 - 80%
- 34-66% require hardware removal
- Hardware failure 1-5%
- Infection 0-6%
- Pin migration 15%
- Ulnar neuritis 2-12%
- Heterotopic ossification 2-13%

Coter, J: OTA Resident Syllabus

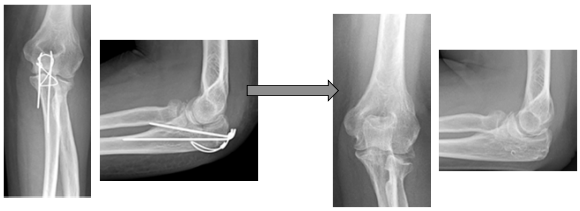
Contracture

- Extensor lag: 10-15%
- Always document intra-operative motion:
  - Or the physical therapist will blame your hardware for persistent limitations!
- Avoid with Early Motion



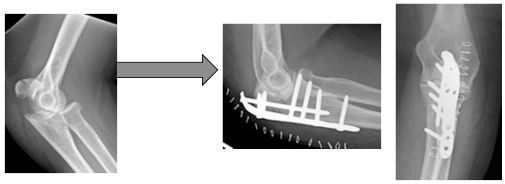
Hardware Pain

- Studies report up to 81% of patients require hardware removal due to proximal prominence



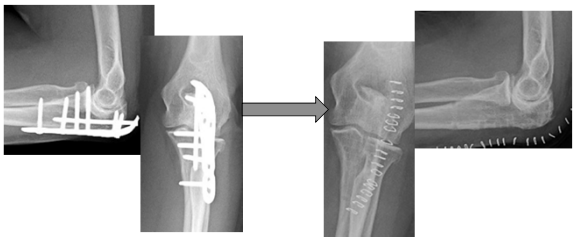
Prominent Hardware

- Comminuted Fracture: Plated with proximal edge off bone to allow two more screws in proximal segment and fixed angled intra-medullary screw (bending the plate distorts the locking hole)



Staged Hardware Removal

- Removal after healing

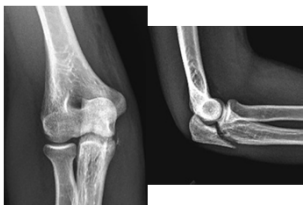


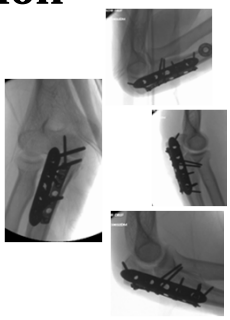
Nonunion

- Nonunion is usually due to poor BIOMECHANICS
  - **Poor Technique**
    - Failure to create a stable construct (too few screws, improper compression)
    - Overaggressive iatrogenic damage to soft tissues
  - **Poor Initial Fracture Characteristics**
    - Open Injury with periosteal stripping
    - Comminuted fracture where interfragmentary compression cannot be achieved
- Occurs both with operative and nonoperative Treatment

Non-Union

- Non-operative Treatment





Nonunion

- Healed



Conclusions for Treating Olecranon Fractures

- Achieve Mechanical Stability with Anatomic Reduction & Stable Internal Fixation
- Optimize the Biology of Healing with Anatomic Reduction, Indirect Techniques, & Maintenance of soft tissue attachments

And the Patient will have a Good Result

Dreyer Medical Clinic
Advocate

Thank you

LOYOLA
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AD MAIOREM DEI GLORIAM

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