CORONOID FRACTURES Vasu Pai

Coronoid fractures are rarely isolated injuries; they are most commonly encountered in association with other elbow injuries as part of 3 major instability patterns.

Type 1 fractures are usually associated with terrible triad injuries.
Type 2 fractures are associated with varus posteromedial rotatory instability.
Type 3 fractures are associated with trans-olecranon fracture-dislocations.

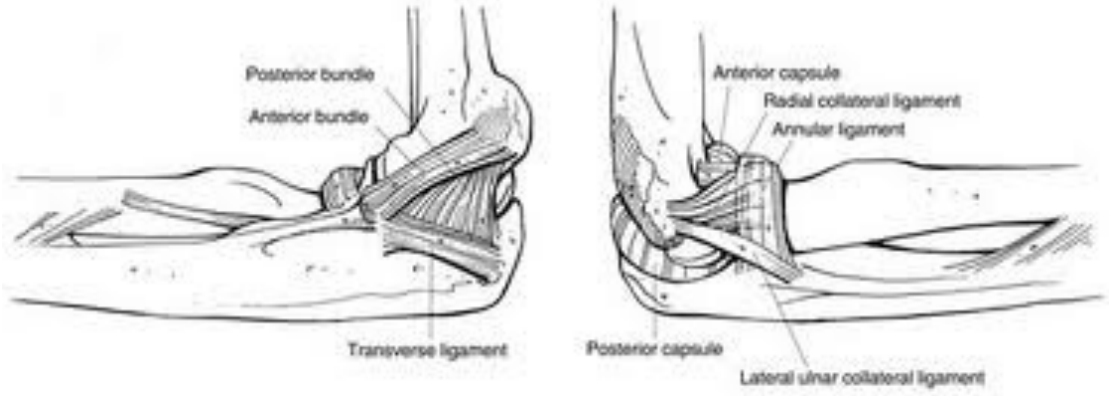
Current recommendations are to **repair all coronoid fractures** associated with elbow instability, regardless of fragment size.

Anatomical consideration

Carrying angle: Males 11-14°
Females 13-16°

The coronoid's anteromedial facet extends medially from the ulna, lengthening the articular surface of the elbow and helping to prevent varus instability. In type II coronoid fracture this is compromised.

Ligaments: Medial collateral Lateral collateral



Anterior bundle of MCL is important in stabilizing elbow for valgus. Lateral ulnar collateral ligament is important for varus and its damage results in postero-lateral instability.

Muscles:

Posterior extensor: Supplied by radial N Triceps

Lateral	PIN	Extensor and supinator
Medial	Median and Ulnar N	Flexor-Pronator
Anterior	Musculocutaneous N	Brachialis Biceps

Joint Stability

Valgus in extension:	MCL; Capsule and articulation share equally
Valgus in Flexion:	Mainly by MCL [80%]
Varus in Flexion:	Mainly by the articulation
Varus in Extension	Mainly by the articulation and some by Capsule

Forces on the joint

Eating and dressing 300 N

Getting out of the chair 1700N

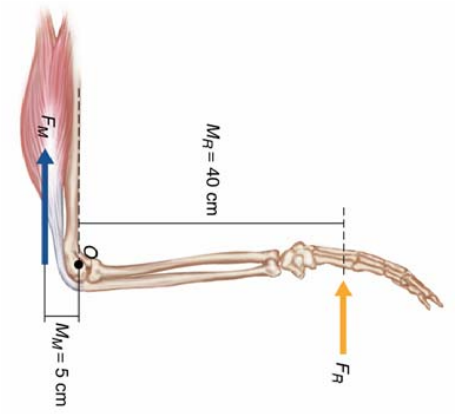
Force transmission through the coronoid is highest at 60° of flexion or more. In extension, force transmission occurs more through the radial head.

Load transmission around elbow:

Force transmission: 60% Ulno-humeral joint

40 % Radio-humeral joint

More transmission (thro' Radio-humeral joint): at 0-30° flexion

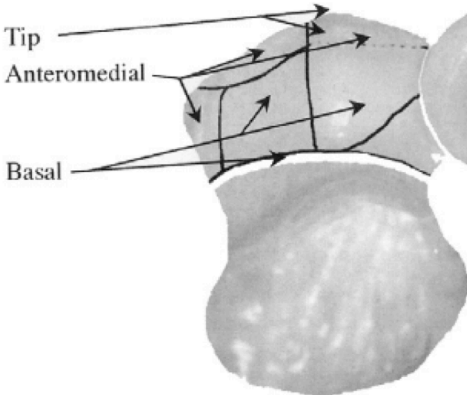


First order lever arm

CLASSIFICATION

O'Driscoll classification of coronoid fractures because it takes into account the injury patterns associated with coronoid fractures, which helps predicts associated injuries

Fracture	Subtype	Description
Tip	1	≤ 2 mm of coronoid bony height
	2	> 2 mm of coronoid height
Anteromedial	1	Anteromedial rim
	2	Anteromedial rim + tip
	3	Anteromedial rim + sublime tubercle (± tip)
Basal	1	Coronoid body and base
	2	Transolecranon basal coronoid fractures



Terrible triad injuries

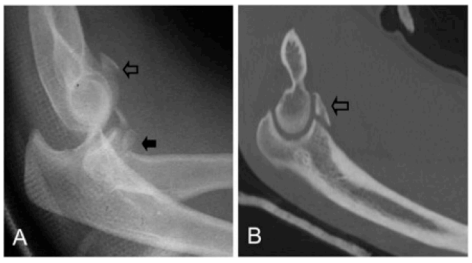
1. Fractures of the coronoid
2. Radial head
3. Lateral collateral ligament [LCL] tear, frequently following an elbow dislocation).

Type I [Tip]:

Tip of the olecranon is important for attachment of the anterior capsule.

These fragments can be important to elbow stability because reattaching the fragment augments the coronoid's bony buttress against posterior subluxation and hence stability.

Usually associated with fracture radius



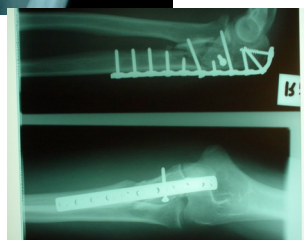
Type II [Rang]

Here there is fracture of the anteromedial facet of the coronoid.
These are associated with varus posteromedial rotatory instability (VPMRI)
Usually occurs from an elbow subluxation, not a dislocation.
The radial head is usually not injured in VPMRI injuries.
The anterior band of the MCL is usually intact.

If left untreated, the resulting varus **instability due to the LCL injury** and disrupted anteromedial facet allows the lateral ulnohumeral joint to gap open, which causes point loading and increased stresses on the now incongruent medial ulnotrochlear joint under gravitational varus load. This rapidly leads to medial ulnohumeral post-traumatic arthritis. A VPMRI injury should be suspected in cases of isolated coronoid fractures without a radial head fracture or a history of dislocation.

With type II fractures, anteroposterior radiographs will demonstrate progressive narrowing of the medial ulnotrochlear joint space. CT 3-dimensional) reconstructions of the medial ulnotrochlear joint can show subtle posterior ulnohumeral subluxation.

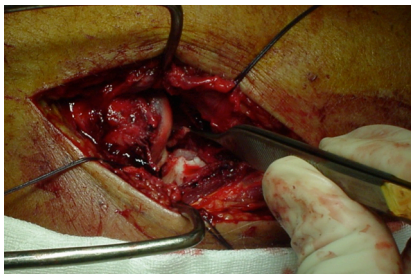
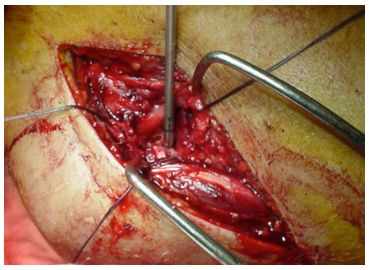
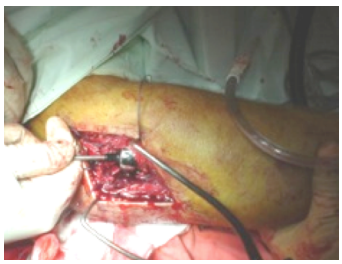
Type III



Fractures are large fractures involving 50% or more of the coronoid height and are associated with transolecranon fracture-dislocations.
In anterior olecranon fracture-dislocations, **the collateral ligaments are usually spared.** These injuries have less soft tissue disruption than other patterns.
Unfortunately, these fractures are often comminuted.

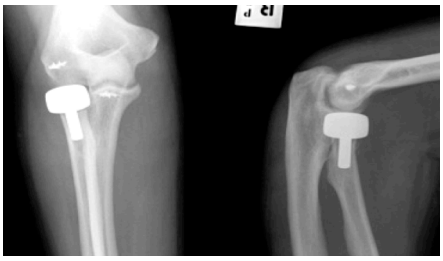
TREATMENT

As for all articular fractures, anatomic reduction, stable fixation, and early motion result in optimum outcome. Current recommendations are to repair all coronoid fractures associated with elbow instability, regardless of size. Only patients with small coronoid fractures, no subluxation, and no opening of the radiocapitellar joint

on varus stress radiographs can be treated non-operatively

Principle



The principles of the operative technique were to

(1) restore coronoid stability: Repair

(2) restore radial head stability :Fracture fixation or replacement

(3) restore lateral collateral ligament complex [Anchoring stitch]

(4) repair the MCL in patients with residual posterior instability

(5) apply a hinged external fixator when required.

TECHNIQUE

A posterior skin incision: Permits both medial and lateral side and provides good access

Alternatively, separate medial and lateral incisions can be used.

The first structure to be addressed was the coronoid.

For small type I tip fractures

Joint stability from restoration of the anterior capsular buttress is more important than restoring articular incongruity.

These fractures are often too small for reliable screw fixation and are usually best treated with suture fixation.

Iype I tip fractures that occur with terrible triad injuries can be exposed and fixed through the lateral arthrotomy used to treat the radial head injury. Retracting or removing the fractured radial head fragments from the wound facilitates this. Alternatively the anterior capsule can be repaired with a strong sutures are placed through tunnels drilled from the subcutaneous border of the ulna to the bed of the coronoid fracture near the joint.

Type II anteromedial fractures

As the most useful medial approach the coronoid is through the split in the flexor carpi ulnaris where the ulnar nerve is the cubital tunnel.

The anterior portion of the flexor pronator mass is elevated off the coronoid, leaving the anterior band of the medial collateral ligament intact.

Great care must be taken to protect the ulnar nerve from drills and retraction. An oscillating drill might be less likely to wrap up the nerve.

Fractures are best fixed using precontoured buttress plates that hold the fragment in position without screws placed directly into the fragment.

These are often supplemented by suture fixation through tunnels, suture anchor, or threaded K-wire fixation.

Uncommon type II fractures that are too small for screw fixation are best fixed with sutures passed through drill holes.

Type III fractures without an olecranon fracture require a medial exposure.

Type III fractures associated with an olecranon fracture can be exposed by mobilizing the olecranon fragment proximally, as one would do with an olecranon osteotomy, although anteromedial facet fragments still require a separate medial approach. Type III fractures are best treated by plate fixation, supplemented by additional fixation as needed. For large coronoid fractures or nonunions, the

combination of a headless screw and a buttress plate provides significantly greater biomechanical stability than either fixation device alone [Budoff].

Following fracture fixation and ligament repair, if there is concern regarding joint stability or fixation security, a hinged, dynamic external fixator is used for 4–6 weeks. However, this is uncommon for acute trauma.

A congruent but stiff elbow can be treated by contracture release compared to an unstable elbow with posttraumatic arthritis.

Summary

Coronoid fractures are typically associated with other elbow injuries.
O'Driscoll type I fractures are associated with terrible triad injuries; type II fractures are associated with VPMRI injury patterns; and type III fractures are associated with olecranon fracture dislocations.
Most coronoid fracture: suspected associated soft tissue injury or radial head fracture
When radius cannot be fixed use a radial head prosthesis.
Always repair anterior capsule with or without fragment to the coronoid..

PITFALLS

Assuming small fragment of coronoid unimportant.
Misidentification of antero-medial fracture as a tip fracture. This can be treated by Anatomic reduction and rigid fixation unlike tip fracture through a medial approach.
Any fragment in front of coronoid is from coronoid.
Common problem is instability or stiffness

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