Distal humeral f# Apley

Distal humeral f# in adults

Intro.

Type A supracondylar f#

Treatment

Type B and C : intra articular f#

Imaging.

Trt
- undisplaced
- displaced
  - ORIF
  - Ex fix
  - Approach + implants choice
  - Post op

Alternative trt
- elbow hemi arthroplasty
- total elbow replacement
- bag of bones technique

Complications:
- early → neuro V/S injury
- late → elbow stiffness

Introduction

Distal humeral f# in adults

- high energy injuries
  - + neuro V/S injuries
  - + soft tissue damage
- osteoporotic bone

Complex surgical techniques may be required

Elbow stiffness : the challenging challenge
- prevention / early
  - stabilization
  - mobilisation

AO - ASIF group:

A → Extra articular supracondyler f#

B → Intra articular uncondylar f#

C → Bicondylar f# with vary degree of comminution

ORIF for displaced and most undisplaced f#

Type A Extra articular

Rare in adults

Displaced + Unstable ∴ no tough periosteum to tether the fragments

High energy injuries → comminution of the distal humerus

Bony landmarks relationship maintained

Trt:

ORIF

Approach: Post. (Triceps sparing, Olecranon osteotomy)

sometimes olecranon osteotomy can be avoided by triceps elevating approach.

Simple transverse F#:

Reduction

Fixation: medial and lateral contoured plate screws

Type B and C Intra articular

High energy injury + soft tissue damage

Osteoporotic bone

Severe blow on the point of the elbow

Olecranon driven upwards

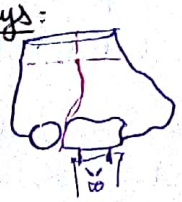
Splitting the condyles apart

Bony landmarks distorted

Swelling (can hide #)

Careful examination for neurovs injury

xRays:



F#: from lower humerus to elbow joint

it may extend to the metaphysis

T or Y shaped break

One or both condyles involvement

- difficult to tell if undisplaced

Comminution can be underestimated

CT scan: planning surgical approach

Trt

Undisplaced → post. slab

Displaced → ORIF

Ex fix if open

K wires, plates and screws, pre-contoured locking plates, independent lag screws, headless compression screws

Alternatives

- hemiarthroplasty
- total elbow replacement
- bag bones technique

B and C intra art. Trt

Undisplaced ⚠

Post. slab
- elbow flexed ≈ 90°
- mvts after 2 weeks
- check x ray +++

1 week after injury:
- displacement and comminution are not obvious on the initial x Ray
- late displacement.

Displaced

ORIF Trt of choice for [displaced and most undisplaced f# in adults

Even undisplaced ! ?
- under appreciating of minor displacement and comminution can leading to displacement
- conservative trt → stiffness + pain

External fixation:
Open fracture with soft tissue contamination
Soft tissue loss → plastic surgeon may be needed ?
Consult if before ex fix application

ORIF:

Minimal articular involvement → Triceps preserving approach
Comminution → good exposure needed → +/- olecranon osteotomy [intra-or extra articular

Ulnar nerve: identify
decompress
protect
+/- transposition →  new ulnar nerve position

Reduction + temporar contention with K. wires

Use of: Plates and screws [parallel orthogonal dpd on f# configuration of the lateral column.
Pre contoured locking plates → osteoporotic bone

Post op

Sling for comfort
Immediate active mobilization
- patient lying supine
- shoulder flexed 90°

no splint no cast
passive stretch avoided

F# heals within 12 weeks
Often full extension is not regained
Some cases restricted mvt (severity)

A
ORIF

B/C
Undispl
post slab
2 weeks

displaced
ORIF + sling
tx fix
Alternative
immediate mobilisation

Alternatives

Anticipation → osteosynthesis poor outcome
- ° of comminution (3)
- bone quality (2)
- soft tissue damage (4)
- patient compliance (1)

Patient
Bone
F# comminution
Soft tissue damage

Elbow hemi arthroplasty

~~Young~~ Elderly
Osteoporotic
Very comminuted
Replacement of distal humerus alone
No surgery on the ulna

Total elbow replacement

Unreconstructable distal humerus f#
Pre existing joint disease.

Bag of bones technique

Pre existing medical condition
Poor compliance
Cast
Elbow 90° flexion or
collar and cuff
for 2-3 weeks
→ initial healing
→ pain settled
Active range mvts as soon as possible.

Complications

Early

Vascular
- pulse
- cappillary refill

distal to the f#

Nerve
- Ulnar → most common
- Radial → may be
- Media → reported

Hand examination
Record findings before any txt is commenced

Late

Stiffness : Most common cpc
Prevention is the best management plan
→ early stabilization
→ early active mobilization
→ avoidance of painful passive stretch

Stiffness with unacceptable fct:
- elbow arthrolysis
  - establish the cause
  - adress it correctly
- average gain ≥30°

Causes

Intrinsic

intra articular adhesions
capsular contracture
joint incongruity
instability

Extrinsic

heterotrophic ossification
nerve entrapment.

Patient	elderly	Joint disease	medical condition poor compliance
Bone	osteoporotic		
Comminut°	very	unreconstructable	
Alternative	hemiarthroplasty	total replacement	Bage of bones technique

Distal humerus f# - Adults

A

Extra articular

Displaced, instable

ORIF

B - C

Intra articular

Undisplaced

post. slab

displaced

ORIF
Ex Fix
Alternative
- hemi arthroplasty
- total arthroplasty
- bag of bones

Elderly + osteoporotic + comminution → hemiarthroplasty
+ joint disease → total arthroplasty
+ medical condition / poor compliance → bag of bones

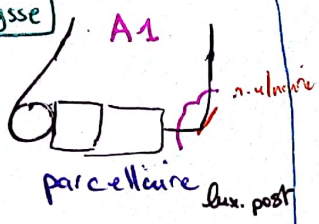
Non op undisplaced / severly debilitated patients
Op (ORIF) displaced

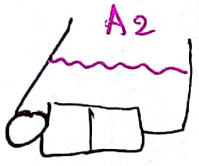
Plates and screws
Locked pre contoured ~~set~~ plates. osteoporotic.

Ao/

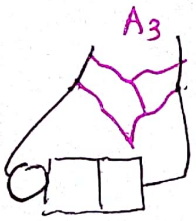
	A	B	C
	Extra arti	Uni. condyl.	Bi-condyl.
1	parcellaire	condyl. méd.	E.S + I.S
2	supra condyl. simple	condyl. lat.	E C + I S
3	" complexe	f# frontales	E.C + I.C

Marion et Faysse

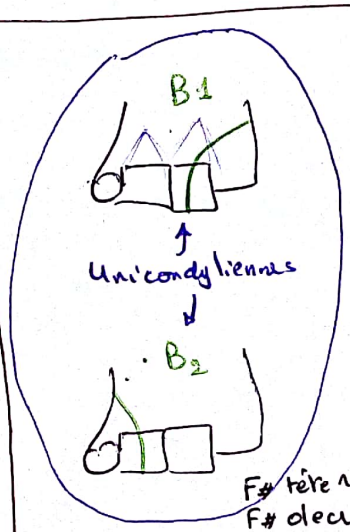


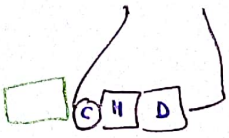


Rigault

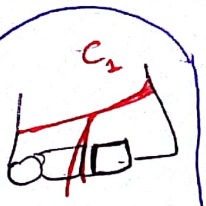


Extra articulaires





F# tête radiale
F# olecrane
lux. coude
Fx recit frontal



Sus et Intra condylienne

Risebourgh et Radin

Intra articulaires

AO ——→ ///

Française —→ ///

- classification : enfant ++
- classification : adulte ++
- association possible

Distal humerus fractures

Essential

Relevant anatomy

- 3 bony points relationship
- Carrying angle
- Stability of the angles elbow
- Ossification around the elbow
- Mechanisms of injury: indirect, direct

Supracondylar f#

- Mechanism
- Pathoanatomy
  - Types: extension, flexion
  - Displacements
- Pg:
  - Presenting complaint
  - Examination
  - Rx
- Treatment:
  - a. closed reduction and percutaneous K wires fixation
  - b. open reduction and K wire fixation
  - c. continuous traction
- Complications
  - immediate → injury to: brachial artery, nerves median radial
  - early → Volkmann's ischemia
    - pathophysiology
    - Pg
    - trr
  - late
    - malunion
    - myositis ossificans
    - Volkman ischaemic contracture VIC

Lateral condyle f#

- Pathoanatomy
- Pg
- Trr
- Cpc
  - non union
  - Cubitus valgus deformity
  - OA

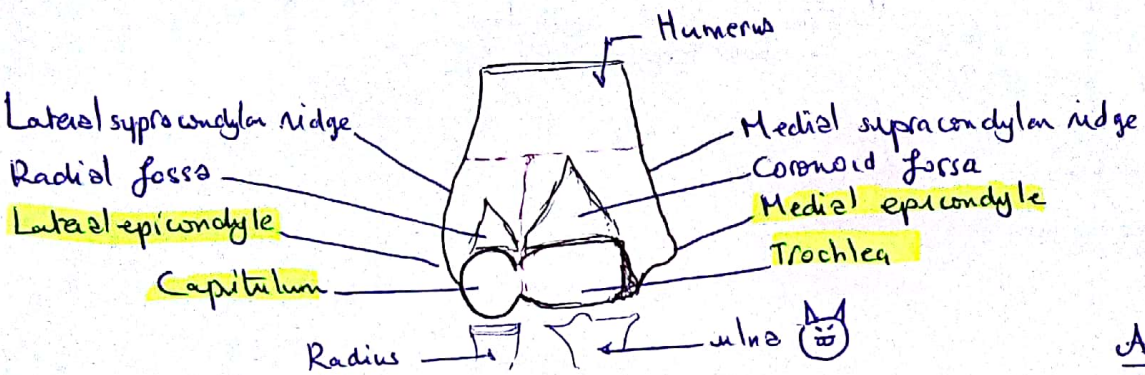
Intercondylar f#

- Pg
- trr
- Cpc
  - stiffness
  - malunion
  - OA

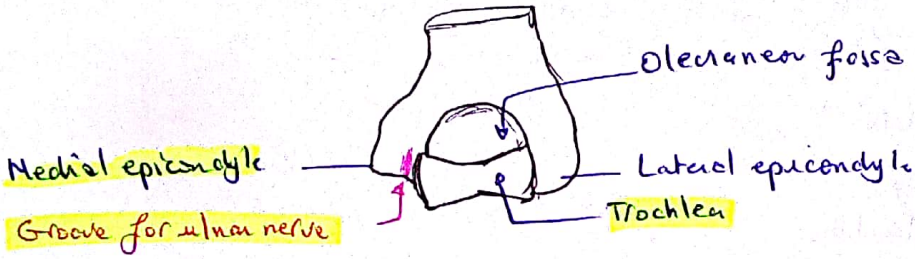
Medial epicondyle

Distal humerus fractures

Anatomy



Anterior view



Posterior view

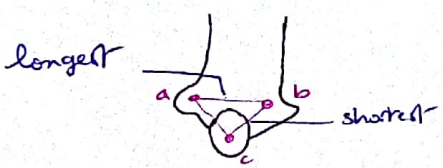
Condyle
- lat. → capitulum + lat. epicondyle
- med. → trochlea + med. epicondyle + cubital tunnel

3 Bony points relationship:

3 Bony points
- lat. epicondyle
- med. epicondyle
- olecranon tip

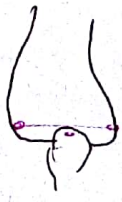
Elbow

90° flexion



near isosceles Δ

extension



straight horizontal line

Carrying angle

Elbow joint fully
- extended and
- supinated

→ The angle between the forearm and arm = carrying angle

Carrying angle
- ♂ → 11°
- ♀ → 14°
- elbow injury ↑ or ↓

Ossification around the elbow:

Captain Roy Makes Troubles On Leave

Capitulum ——— 2
Radial head ——— 4
Medial epicondyle —— 6
Trochlea ——— 8
Olecranon ——— 9
Lateral epicondyle — 12

Appearance and fusion of ossification centers
→ mistaken for a fracture

Mechanism of injury

Indirect
fall onto outstretched hand

Valgus → Radial head f#
Radial neck f#
Med. epicondyle avulsion

Varus → Lat. condyle f#

Hyperextension → supra condylar

Axial force → Capitulum f#
elbow dislocation

Direct
fall on the point of the elbow
direct hit on the olecranon
→ olecranon f#
→ intercondylar f#

Supra Condylar f#:

Mechanism:
Fall on outstretched hand Elbow in hyperextension

Pathoanatomy

extension ← Type → flexion

backward (80%) | distal frgt tilted | forward (20%)

Displacement distal frgt

Shift
posterior
proximal
medial or lateral

Tilt
posterior
medial
→ Varus deformity

rotation
internal rotation

Diagnosis

Presentation
Child often
Hx of fall
pain
swelling
deformity
inability to move the arm

Physical exam

Early:
Post. prominence of the point of the elbow (backward tilting of the distal sgt)
3 Bony relationships maintained (supra condylar #)
Late: Gross swelling hiding these signs

Neuro Vx
brachial artery: radial + ulner SP, pulses
median → pointing index
radial → wrist drop

X Rays
Child → ossification centres may make undisplaced # difficult to see
→ compare on x Ray of the opposite elbow

AP	Lat.
proximal shift	posterior shift
lat/med. shift	posterior tilt
med. tilt	rotation
rotation	

Treatment

Closed reduction Percutaneous K wires fixation
Open reduction and K wires fixation
Continuous traction

- Traction with elbow in 30-40° flexion
- Traction in flexion
- Pressure over the olecranon

1) Closed reduction Percutaneous K wires fixation:

Traction with the elbow in 30-40° flexion
Traction applied for 2 min with counter-traction at the arm (assistant)
While in traction: - Elbow gradually extended
- forearm fully supinated

⇒ Correction of proximal mod/lat displacements
if required → carrying angle corrected at this stage.

Flexion in traction
Assistant: one hand maintains the traction
the other grasps the upper arm: fingers over the biceps
thumb resting on the olecranon

Traction applied: Elbow slow flexion

Pressure over the olecranon
While the above manoeuvre is continued
The thumb presses the olecranon and with it the distal fragt forward into the flexion
Traction is maintained as the elbow is flexed to beyond 90°.

Feel the radial pulse → if obliterated on flexion → extend the elbow until pulse is felt again → posterior slab in whatever position achieved

Elbow flexed + above 90° → frgts locked intact periosteum } on the dorsal aspect
triceps

⇩ like

an internal splint

Posterior slab in this position (if possible) for 3 weeks

*Ray control : J2 , J8 ?? W3 → remove if no displacement

30-40° flexion
extended
supinated
thumb/fingers placement
flexed in traction
olecranon pressure.
>90° flexion

Ex
Super
Power
Flying in the
Ocean

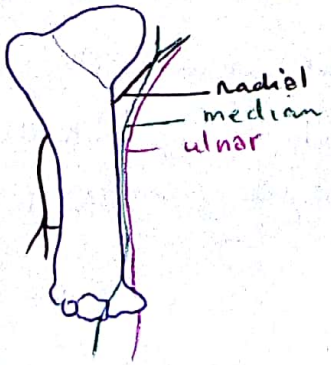
2) Open reduction and k wires fixation

Good position not achieved (un reduced) } → open reduction + k wires fixation
Redisplacement after reduction

c) Continuous traction no longer used

Trt
- Closed R. — most displaced
- Open R. — unreduced, redisplaced
- Contin → tract — excessive swelling, bad wound

Complications
- Immediate
  - Neuro Va injuries:
  - brachial artery
  - nerves [ulnar, median, radial]
  - → Immediate cpc
    - Brachial artery injury by the sharp edge of the proximal frgt → [just pressure, complete disruption]
      - Collaterals → keep the hand alive
      - forearm muscles may suffer → ischemic damage → Volkmann's ischemia
      - gangrene may happen
    - Nerves injury : Median, Radial,
      - Spontaneous recovery +++
- Early
  - Volkmann's ischaemia
- Late
  - Malunion
  - Myositis ossificans
  - VIC



Nerves

→ Early cpc

Volkmann's ischaemia:

Supracondylar f# → brachial artery occlusion → ischaemic injury to [muscles / nerves] of the flexor compartment of the forearm → muscle edema → compartment syndrome

Supracondylar f#
↓
Injury to the brachial artery : Ant. interosseous branch (end-artery)
↓
Ischaemia
Nerves
Muscles → flexor pollicis longus
→ medial half of flexor digitorum profundus
(flexors compartment)
forearm
↓
Edema
↓
Compartment Sd → (End stage) Volkmann's Sd

Dg

Pain: severe pain in the forearm (unusual doses of analgesics)
limiting fingers mvts
in the flexors aspects of the forearm when fingers are extended passively

Numbness
Swelling } Late

Tenderness on pressing the forearm muscles

Tnt

- Remove any external splints or bandages that might be causing constriction
- Elevate the forearm and encourage finger mvts
- No improvement within 2 hours → decompression / fasciotomy

Sliting the fascia covering flexor muscles of the forearm along its entire length.

→ Late

1- Malunion Commonest cpc

* Deformity: Cubitus varus = Gun stock deformity
the f# unites with the distal fgt tilted medially
in internal rotation

Cause → failure to achieve good reduction
→ secondary displacement of the fgts within the plaster

* Sometimes the f# unites with an excessive backward tilt → hyperextention of the elbow
+ limitation of the flexion

Malunion

Flexors?

Medial tilt
Internal rotation
↓
Cubitus varus or
Gun stock deformity

Excessive backward tilt
↓
Elbow hyper extention with
Flexion limitation

Cosmetic problem
Not much functional impairement

deformity
- mild → do nothing
- badely deforming → Correction: supra condylar corrective osteotomy (French osteotomy)

2- Myositis ossificans
Ectopic newbone formation around the elbow ⟶ stiffness
Major factor: massage following the injury
Little chances of regaining full elbow ROM

Trt

Early stages
- An above elbow slab for 3 weeks to rest the elbow.
- Gentle elbow mobilization

Late stages
- Excision of myositic bone
- Excision anthroplasty of the elbow

3- VIC Volkmann Ischaemic Contracture

Volkmann's ischemia ⟶ ischemic muscles ⟶ replaced by fibrous tissue ⟶ contracts ⟶ draws wrist fingers into flexion

Volkmann's ischemia
- muscles → replaced/fibrous tissue → Contracts → wrist and fingers flexion
- nerves → forearm + hand → sensory loss, motor paralysis

VIC clinical presentation

Forearm → marked atrophy

Wrists ~~Hands~~ and Fingers → flexion deformity

Nails → atrophic changes

Skin over forearm and hand → dry and scaly

Volkmann's sign:

Wrist	Fingers (in IP)
Flexed	Extension possible
Extended	Flexion

Why?

Flexor muscle - tendon unit is: - shortened by Volkmann's ischemia
- stretched by wrist extension ⇒ fingers flexion

Hypoesthesia/Anesthesia

Treatment:

Deformity

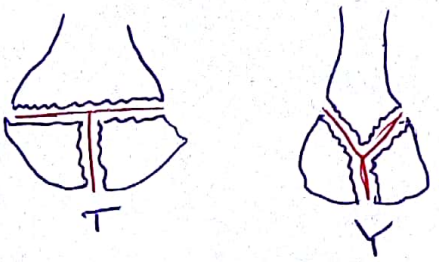
- Mild
  - Volkmann's Splint
  - Passive stretching of the contracted muscles by a turn-buckle splint
- Moderate
  - Macpige operation
  - Soft tissue sliding operation
  - Flexor m. released from their origins on:
    - ulna
    - medial epicondyle
- Severe
  - Bone operations
  - Forearm bone shortening
  - Carpel bone excision

Intra condyler f# Adults ++

Fall on the point of the elbow → olecranon driven into distal humerus splitting the 2 condyles apart.

Pathoanatomy:

T or Y shape



F# displaced
Comminuted

Dg: Elbow severe pain
swelling
ecchymosis
crepitus

× Rad ✓

Trt

Inter condylar f#

- Undisplaced → an above elbow ~~slab~~ plaster slab
  3-4 weeks
  followed by exercises
- Displaced → ORIF
- Severe comminution → olecranon pin traction

Complications

Elbow stiffness
Common
Intra-articular f#
+/- myositis ossificans
Trt: physiotherapy

Malunion
Cubitus varus or valgus deformity
Corrective osteotomy for severe deformities

Osteoarthritis

Medial epicondyle

More commonly injured > lateral.
because ~~it~~ méd. epicondyle appears early
fuses late with the main shaft of the lower humerus

Commonly associated with: post. dislocation
may be associated with ulnar nerve injury

Med. epicondyle	Trt
> lat. appears early fuses lat. ++ elbow post. dislocation +/- ulnar nerve injury	Conservative generally an above elbow slab displaced into joint → ORIF

Distal humerus f# Rockwoods (Adults)

Mechanisms
S — Sm
Imagings
Mechanismes

	Extra- and Complete articular	Partial articular
↓ energy	Fall from a standing height on the elbow Elderly: loss of protection reflex osteoporosis	Fall from a standing height on the outstretched hand Elderly: ♀ osteoporosis ↑ carrying elbow (> 80 y)
↑ energy Associated:	young adults Soft tissue damage Open f# Other f# Polytraum	young adults < 19 lig. tear Radial head f#
	Elderly: ↓ energy Young adult: ↑ energy	♀ bimodal < 19 > 80 osteoporosis ↑ elbow carrying angle ♂ unimodal < 19

Signs and Symptoms

History

Mechanism
Energy level — if ↑ → vigilance → identify → systemic injuries → ?
→ others f#
Time of injury
Pain: • polytraum
• inebriation
• drug use
→ difficult identification → delay identification is possible
↓
inform the family

PE Systemic injuries
Associated f#
Neuro → ulnar n. ++
V_a → brachial artery: Pulse Capillary refill, skin turgor, color.
⊕ find f# → brachial-brachial Doppler index
as sensitive and specific as brachial arteriography
if ↓ → vascular surgery consultation

Compartment sd → excessive pain
Dg → clinical or P measures → fasciotomy

Elderly patients

Evaluate for:

- Precipitants of the characteristic fall unDg
  - Cardiac arrythmias
  - cerebrovx disease
  - polypharmacy
  - alcohol dependence
- Comorbidities + reversible illness → impact on trt
  - active infection (UTI, diabetic ulcer) → absolute CI to arthroplasty
- Cooperation with rehabilitation is it possible?
  - mental status
  - ambulatory status
- Walking requirements

Imagings

Standard AP and L views of the elbow

- Dg
- Classification
- Surgical templating

Rx in plaster or splint may be obscured → repeat

Fx shortening, rotation, angulation → gentle traction with analgesia → better views

CT with 3D reconstruction

- less invasive ORIF approach contemplated (paratricipital rather than olecranon osteotomy)
- high comminution in elderly (reconstruct on arthroplasty)
- hemiarthroplasty consideration