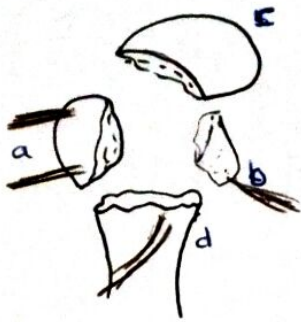
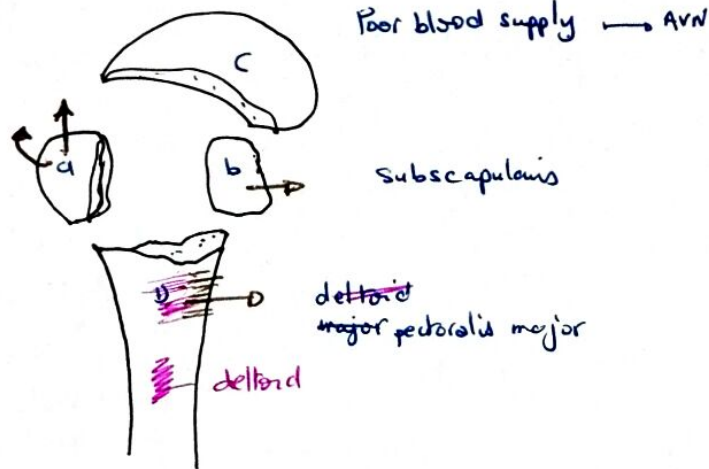


Proximal humerus fractures



- a. Greater tuberosity
- b. Lesser tuberosity
- c. Humeral head
- d. Surgical neck/shaft

Supra-
Infra-scapularis



Poor blood supply → AVN

subscapularis

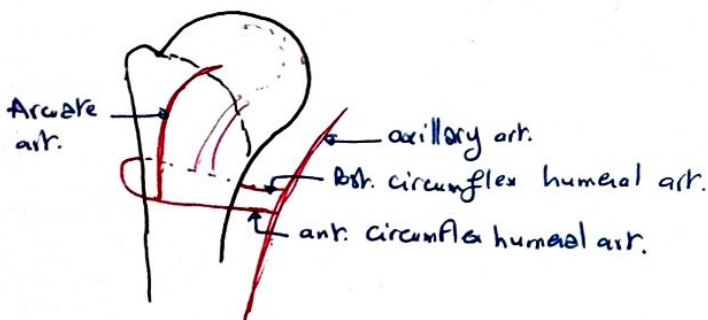
deltoid
major pectoralis major

deltoid

- a → Greater tuberosity: insertion of supra-/infra-scapularis → migration → Proximally
- b → Lesser tuberosity → supscapularis → migration → Medially
- c → Humeral head → no tendon attachment
- d → Shaft: Deltoid/Pectoralis → Medially

Blood supply

Axillary artery → Ant. Post. Circumflex humeral artery → humeral head
↓
Arcuate artery!



Arcuate artery → Sternal ascending branch of ant. circumflex humeral artery

Damage of → AVN

Arcuate artery → generally damaged in fractures

Perfusion from post. c. h. art could be enough for head survival

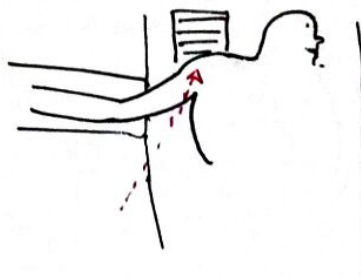
Radiography

Glenohumeral

True AP → you see the joint space (≠ AP → Chest x Ray focused on shoulder area)

Transcapular Y → Y relationship between humerus and scapula

Axillary view → better vision of tuberosities



CT scan: Articular surface

head splitting injury

Tuberosity displacement especially lesser one

Non displaced

80%

↓
non operative

Trt

Displaced

20%

↓
Fx pattern

Head viability

Bone quality

Implant limitation

Patient age and conditions

↓
OP

↓
non OP

Near classification dof. $>1\text{cm}$ $>45^\circ$

Codman's 4 parts

AO classification: not really used in proximal humerus

A. Extra articular

B. Partial articular

C. Complete articular

Prediction of ischaemia

Fracture pattern anatomic neck

Loss of integrity of medial hinge

Metaphyseal head extension $<8\text{mm}$

Implant limitations Non locked / locked plates

True AP → Joint

Transcapular Y → relation with scapula

Axillary → Tuberosities

Elderly Non/Hood displaced $\rightarrow$ non OP

Significant displacement + poor bone quality $\rightarrow$ OP $\left\{ \begin{array}{l} \text{heavy suture through rotator cuff insertion} \\ \text{locking plate} \end{array} \right.$

Elderly
Non displaced
Hd displaced

$\downarrow$
non OP

Significant displacement
Poor Bone quality

OP:

- suture through rotator cuff insertion
- locking plates

Good bone quality

OP:

- Closed reduction percutaneous pins
- ORIF

B-Type

ORIF: standard plates $\rightarrow$ failure, especially if poor bone quality

locking plates improved fixation

Hemiarthroplasty $\rightarrow$ surgical neck fracture

pain relief

good for d.p. on anatomic tuberosity placement

shoulder flexion above 90° is difficult to achieve

C-Type: rate of AVN

unless able to fix it anatomically $\rightarrow$ better to replace

Young

Good bone quality

1st objective: preservation of function

Anatomic reduction / soft tissue sparing
Stable fixation

Hemiarthroplasty only if non-reconstructable for

Elderly

Poor bone quality

1st obj: Pain relief

Fr stable + early motion $\rightarrow$ Non op for

Unstable:

• Fr reducible + head viable $\rightarrow$ ORIF

• not reducible
or
head non viable $\rightarrow$ hemiarthroplasty

Young

displaced reconstructable $\rightarrow$ ORIF
unreconstructable $\rightarrow$ hemip

Stable $\rightarrow$ non OP

Unstable (displaced) $\rightarrow$ OP $\begin{cases} \rightarrow$ ORIF
 $\rightarrow$ hemiarthroplasty (HAP) \end{cases}

Young

ORIF

Unreconstructable $\rightarrow$ HAP

Humerus

Retroversion

Circonflexe ant

Elderly

Old

Reduceable + viable head $\rightarrow$ ORIF

IF not $\rightarrow$ HAP

Femur

Anteversion

Circonflexe post.



Fractures of Proximal Humerus

Introduction

Incidence

Etiology

Pathophysiology

Muscular anatomy

Vascular anatomy

Clinical evaluation

Physical

Radiographic

Classification: Neer's

Treatment:

Non operative

Operative:

1. Two part surgical neck fracture.
2. Percutaneous pin fixation
3. ORIF
4. Two part isolated Tuberosity fractures
5. Three part fractures
6. Four part fractures
7. Surgical fixation of 4 part prox

Prognostic indicators

Fractures of special importance

Complications

1. Neurovascular injuries
2. Stiffness or frozen shoulder
3. AVN
4. Malunions and nonunions

Introduction

State in life ↑ : osteoporosis

Muscular attachments → deforming forces → **difficult** closed reduction

Fragments displaced overlapping } → difficult radiologic evaluation

↓
non reliable classification

Communication → **AVN**

Incidence

All age groups : - elderly : osteoporosis → **♀ >>> ♀**
- young : high energy trauma (Polytrauma)

4-5% of all fractures

75% of humeral fractures

Displacement : [undisplaced or minimal → **85%**
[displaced → **15%** → Therapeutic challenge

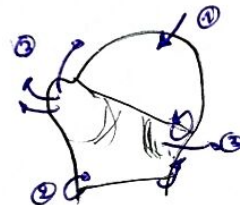
Etiology

Common : Fall on the outstretched
hand from a standing height
arm

Younger : high energy trauma

Direct energy to prox. humerus

Pathophysiology



Add. : forced ext. rotation in abduction
Violent m. contraction from a seizure
activity
electrical shock
athletic events

- 1. compression at the head
- 2. Bending at surgical neck
- 3. Tension (avulsion) at GT & tubercle

Proximal humerus

very thin cortex
- periosteal bone

slightly thicker cortex

- bicipital groove
- muscular attachments

Low energy forces

Fracture

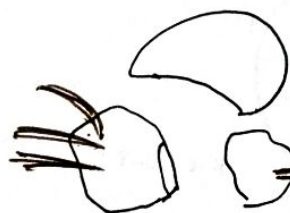
High energy forces

Avulsion

Muscular Anatomy

supra-spinatus
infra-spinatus
teres minor

Sup
post



med

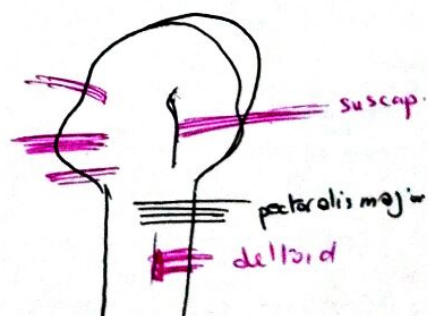
subscapularis

ant
med

Pectoralis major



Surgical neck fr.

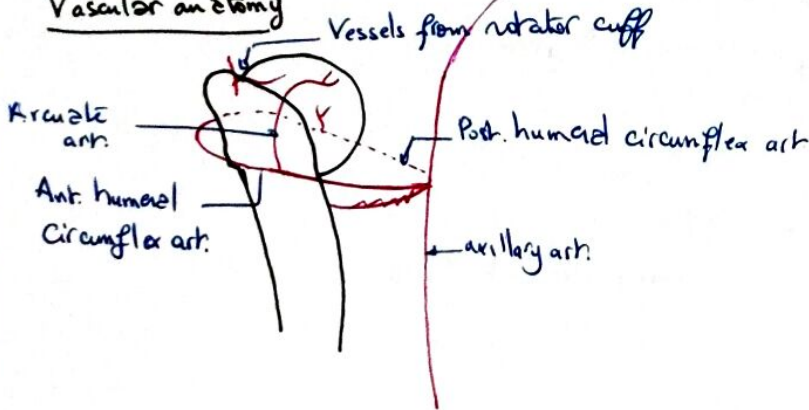




Proximal fragment: externally rotated

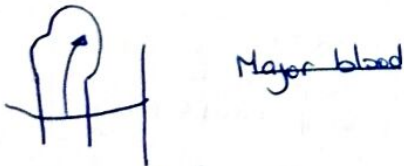
Distal fragment: displaced
 [upward: by deltoid
 [medially: by pectoralis major

Vascular anatomy



Proximal humerus

Axillary artery → Anterior humeral circumflex artery → descending branch: arcuate artery

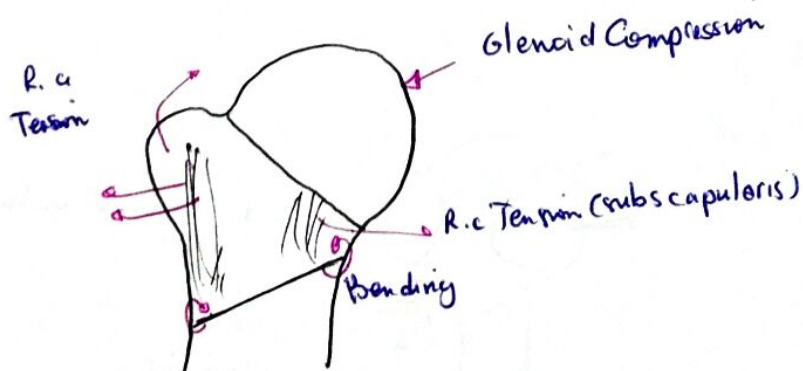
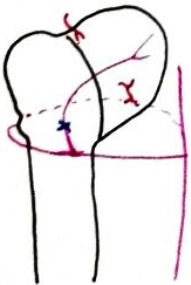


Proximal humerus

Blood supply

Major: arcuate artery

Additional: - post. humeral circumflex art. → small portion postero-inferior part of the articular surface
 - vessels entering through rotator cuff insertions



Clinical evaluation

Physical Examination

Immediately: inflammation signs at the shoulder

Pain

Swelling

Loss of function: - Restricted shoulder movements
- Arm supported by the other hand.

24-48 h after: ecchymosis

↑ probably trauma → more extensive soft tissue damage → early ecchymosis within few hours

History: Mechanism of injury

Seizure

Electrical shock

Elderly: medical history

Indirect → ↑° of Fr displacement
→ Posterior dislocation

Physical exam:

Palpation with caution (x further injuries)

Associated injuries: - ipsilateral scapular and rib fractures

- lung auscultation: • PNO • hemoPNO

Young: Polytrauma

NeuroVx injuries

Neuro: axillary nerve, brachial plexus

Axillary nerve injury:

- Ant. fracture - dislocation + displaced greater tuberosity fr
- Loss of sensations over the lateral deltoid

Vascular injury Rarely

Pulse can be palpable (scapular collateral circulation)

Paresthesia + Enlarging mass → suspect!

> 50 y

Absence or asymmetry of radial pulse.

Distal limb viable: rich anastomoses

Presentation: Shoulder: - Pain - Swelling - Loss of fct (restricted mvt, arm supported with the other hand)
- ecchymosis (24-48 h after)

History

Elderly: medical history

Mechanism:

direct: trauma

indirect: seizure
electrical shock

Physical exam:

Insp: Swelling...

Palpation: Caution!

Associated injuries:

- ipsilateral scapular, rib fractures
- lung auscultation: PNO, hemoPNO
- young & Polytrauma

NeuroVx injuries

Axillary nerve injury:

Loss of sensations over the deltoid

Vascular injury:

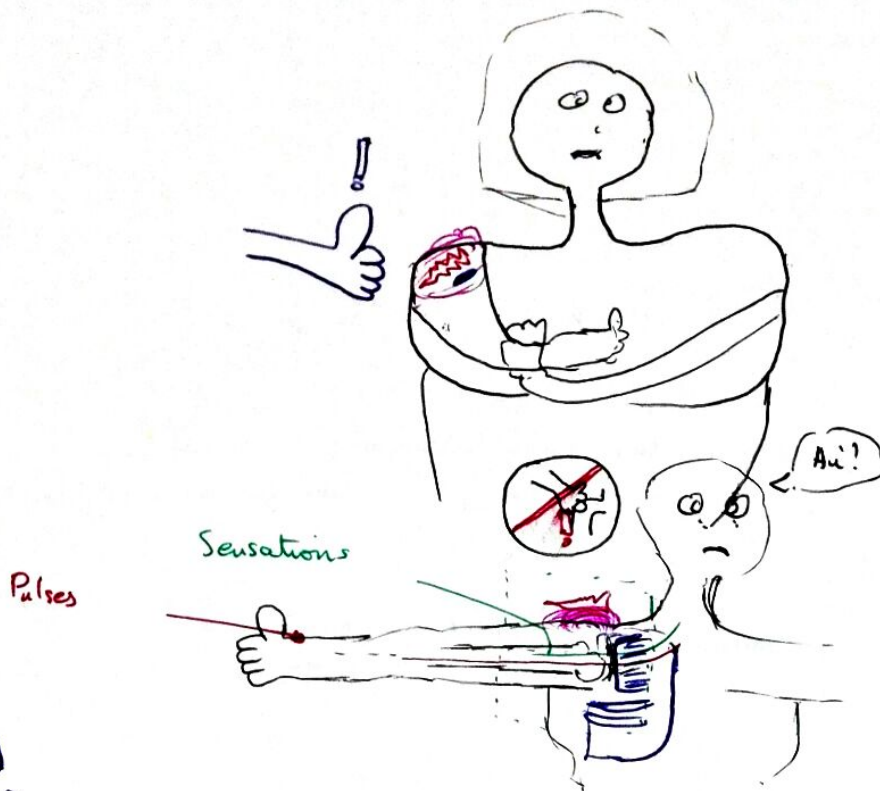
> 50 y +++

Absence or Asymmetric radial pulse

Paresthesia,

Enlarging mass

if suspected: angiotensin



History

Trauma

Indirect mechanism - seizures, electrical shock

Medical history

Sx/Sp: Pain
Swelling
Loss of function
Palpate!

Associated injuries

Scapula g.
Ribs } ipsi

Lung: PNO
hemoPNO
Polytrauma

Cpc

Neuro → Loss of sensation
lateral deltoid region

Va:

Pulse: absent/asymmetric
Enlarging mass
Paresthesia

↓
Angiogram

Imagings

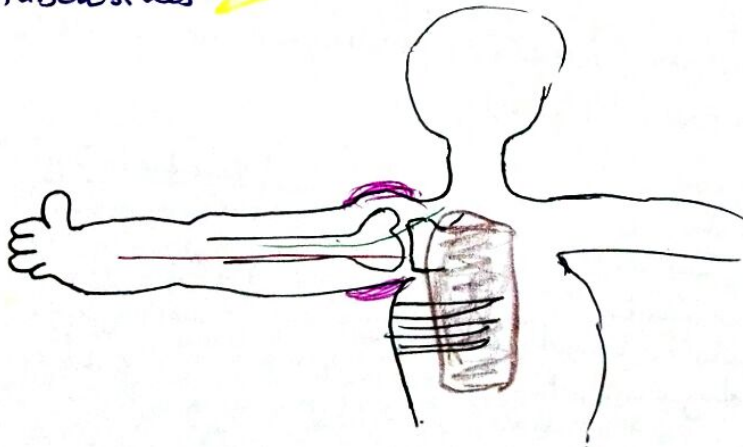
True AP - Y - Axillar

True AP → Glenohumeral ✓

Y → scapulo-humeral ✓

Axillar → Tuberosities ✓

CT scan:



Radiographic examination

AP + Lateral views

Neer's trauma series: true AP glenohumeral joint
Y view
Axillary view

98% accuracy can be achieved!

CT Scans: Complete scanous

Fracture-dislocations

Head splitting for

Impaction injuries

Associated glenoid fractures

Excessive comminution

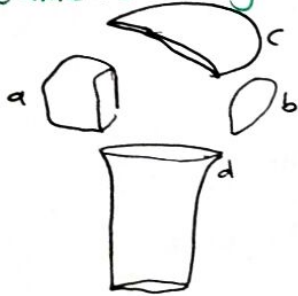
Other tests

Angiography: Absent/asymmetrical pulse

EMG: - subacute setting
- document progress of reinnervation

Classification

Codman's 4 segments



a - greater tuberosity

b - lesser tuberosity

c - anatomical head-neck: articular surface

d - surgical neck/humeral shaft

a - b - c → ossification centers giving rise to proximal humerus

Neer's classification

Plain radiographs

Displaced fracture if: $> 1\text{ cm}$ displacement
 $> 45^\circ$ angulation

Fracture type	Two Parts	Three parts	Four Parts
Segments involved	Surgical neck Greater tuberosity Lesser tuberosity Anatomic neck	Surgical neck + either greater tub. or lesser tub.	Anatomic & Surgical neck + both greater tub. and lesser tub.

Any fracture pattern can occur in combination with

Glenohumeral dislocation $\begin{cases} \text{Ant.} \\ \text{Post.} \end{cases}$

AO classification: Vascular supply to the articular segs

A → small

B → low

C → high

risk of AVN

Treatment

A. Non operative

Non displaced fx (85%)

Immobilization of the arm

Early range of motion exercises when pain permits

After 1 week

1 w → pendulum exercises
gentle isometric strengthening of biceps triceps

3-4 w → passive shoulder mobilisation added

4-5 w → overhead pulleys

6-8 w → stretching and strengthening

Excellent results

Patients with comorbidities → no surgery

Elderly → better results with operative management

Elderly, better with non OPI

B. Operative

Displaced fx (15%)

Absolute indications:

- Fracture - dislocation
- Head splitting Fx
- Fx with neuro-Va injuries

Results variable, dpts on factors

fx pattern
soft tissue injury
quality of surgical reduction
stability of fixation
post op rehabilitation
surgeon experience
patient age
bone quality
patient motivation & reliability

Two part surgical neck fractures

Shaft med } → Pectoralis major
 ant }
 sup → deltoid → fragments overlap + shortening of bone

Med. + Sup displacement → ↑ incidence of soft tissue interposition:

Long head of biceps interposition

↓
prevent reduction

↓
open stabilization

Results depend on AP displacement (66% displ is acceptable)
not on surgery

Percutaneous pin fixation

Closed reduction + percutaneous fixation

CI: Severe comminution
osteoporosis

Advantages: minimal invasive procedure
less mortality
preserves blood supply

Disadvantages: - pin migration
- loss of reduction
- pin site infection

ORIF

Indications

- Inadequate or failed closed reduction
- Displaced fractures
- severe comminution
- Poor bone quality
- Poly trauma

Fx approached: anteriorly
through extended deltopectoral
incision

Locking plates (osteoporosis + young)

T. buttress plate (can be used)

Intra medullary Ender's rods + intrafemoral
nails → humeral shaft so osteoporotic.

Two part isolated tuberosity

Greater tuberosity

Greater tuberosity fx +/- anterior dislocation shoulder

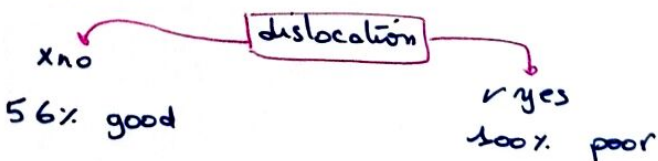
Closed reduction

• difficult: fragments $\rightarrow$ sup / rotator cuff m.

• difficulties:

- external rotation } limitation
- abduction }
- impingement difficulties

• results:



Open reduction

• Indication:

Displacement $\rightarrow$ sup. $\rightarrow$ ≥ 5 mm
 $\rightarrow$ post. $\rightarrow$ ≥ 10 mm

Axillary lateral view:

- post. displacement $\rightarrow$ Greater tuberosity
- ant. dislocation $\rightarrow$ articular surface

• Approaches:

* deltopectoral $\rightarrow$ if long inf. spike on the G. tub

* superior deltoid splitting $\rightarrow$ preferred

• Deltopectoral approach

* Long inf spike on G. tub. $\rightarrow$ exposure of the infermost portion with a superior approach could damage the axillary nerve



* Post. exposure facilitated by arm abduction $\rightarrow$ deltoid retraction

Lesser tuberosity

Lesser tuberosity fx +++/ post. shoulder dislocation

Rare

L. tub. fx

+
dislocation

no

rare

yes

often

fx defect is rare

loss of int. rotation

ORIF

Large fragment blocking medial rotation

Deltopectoral interval + interfragmentary sutures

Three part fractures → Open reduction → fixation

+ Greater tuberosity

articular sgt → internal rotation
by subscapularis
adequate blood supply
through the lesser tuberosity

+ Lesser tuberosity

art. sgt → external rotation
m. attached to G. tub.
intact blood supply
through the G. tuberosity

Blood supply preservation

Sgt reassembled

Rotator cuff repaired

ORIF

↓
Good Results

Four Part fractures

Orthopaedic challenge

Decision made based on: age

Comorbidities

Commminution

head split

fracture-dislocation

activity level of the patient

Elderly: fixation or replacement?

Prosthetic replacement

- 4 part displaced fx
- 4 part fx - dislocation
- impression fx involving articular surface involving >40% of head
- head splitting fx
- (if accurate reduction not possible and possibility of avascular necrosis)

Tuberosities - retained
- reassembled beneath the prosthetic head

Good fcr results depend on → tuberosities union to the proximal humeral shaft
Rotator cuff healing

Extra-articulaires

F# de l'extrémité Proximale de l'humérus

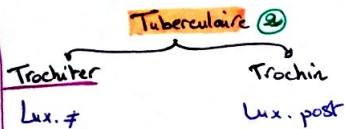
Classification de Duparc

Articulaires

→ Nécrose de la tête !

• Olivier

- A. Parcellaire
- B. Totale non déplacée
- C. Totale déplacée
- D. + Lux. antéro-interne



Sous tuberculaire

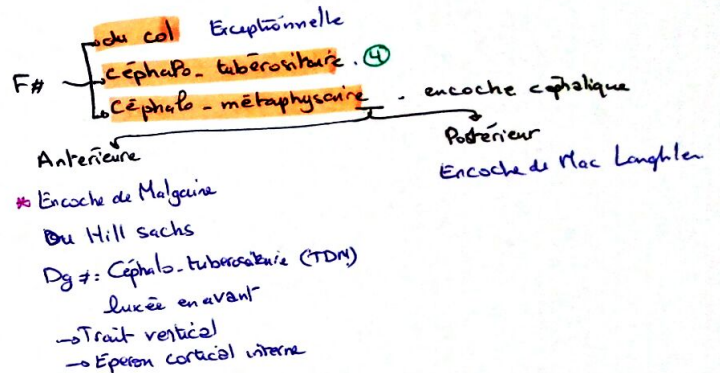


Col chir. ; $\frac{2}{3}$ des FESH

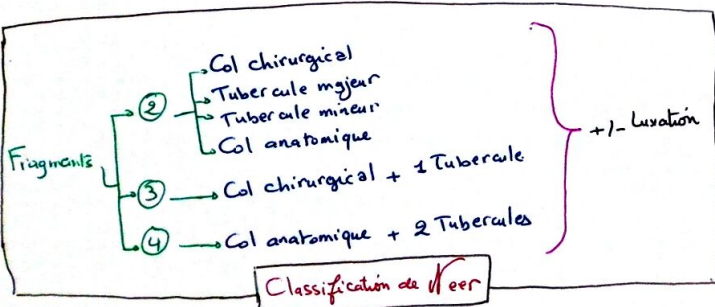
Très fréquente
Irreductible / incarcerated

Déplacée
Engrenée

Haute
Basse



! Clinique : • Ecchymose Brachio-Céphalique 💡



Se. chiffres ②, ③, ④ → Fragments de Weer !

#N682