Lecture 2

OSTEOLOGY
the Upper Limb

Lecture 2: Osteology of the Upper Limb

Introduction

The upper limb is designed primarily for **mobility and dexterity**, allowing a wide range of precise and coordinated movements such as reaching, grasping, lifting, and manipulating objects. Its skeletal framework is light but strong, providing both flexibility and mechanical leverage. The **osteology of the upper limb** refers to the study of its bones, which are connected through joints and supported by muscles, tendons, and ligaments. These bones are organized into four main regions: the **shoulder girdle**, **arm**, **forearm**, and **hand**.

1. General Organization of the Upper Limb Skeleton

The upper limb is divided into four anatomical regions:

Region	Main Bones	Description
Shoulder Girdle (Pectoral Girdle)	Clavicle, Scapula	Attaches the upper limb to the axial skeleton and provides attachment points for muscles.
Arm (Brachium)	Humerus	Extends from the shoulder to the elbow.
Forearm (Antebrachium)	Radius, Ulna	Extends from the elbow to the wrist.
Hand (Manus)	Carpal bones, Metacarpals, Phalanges	Forms the wrist, palm, and fingers.

2. The Shoulder Girdle

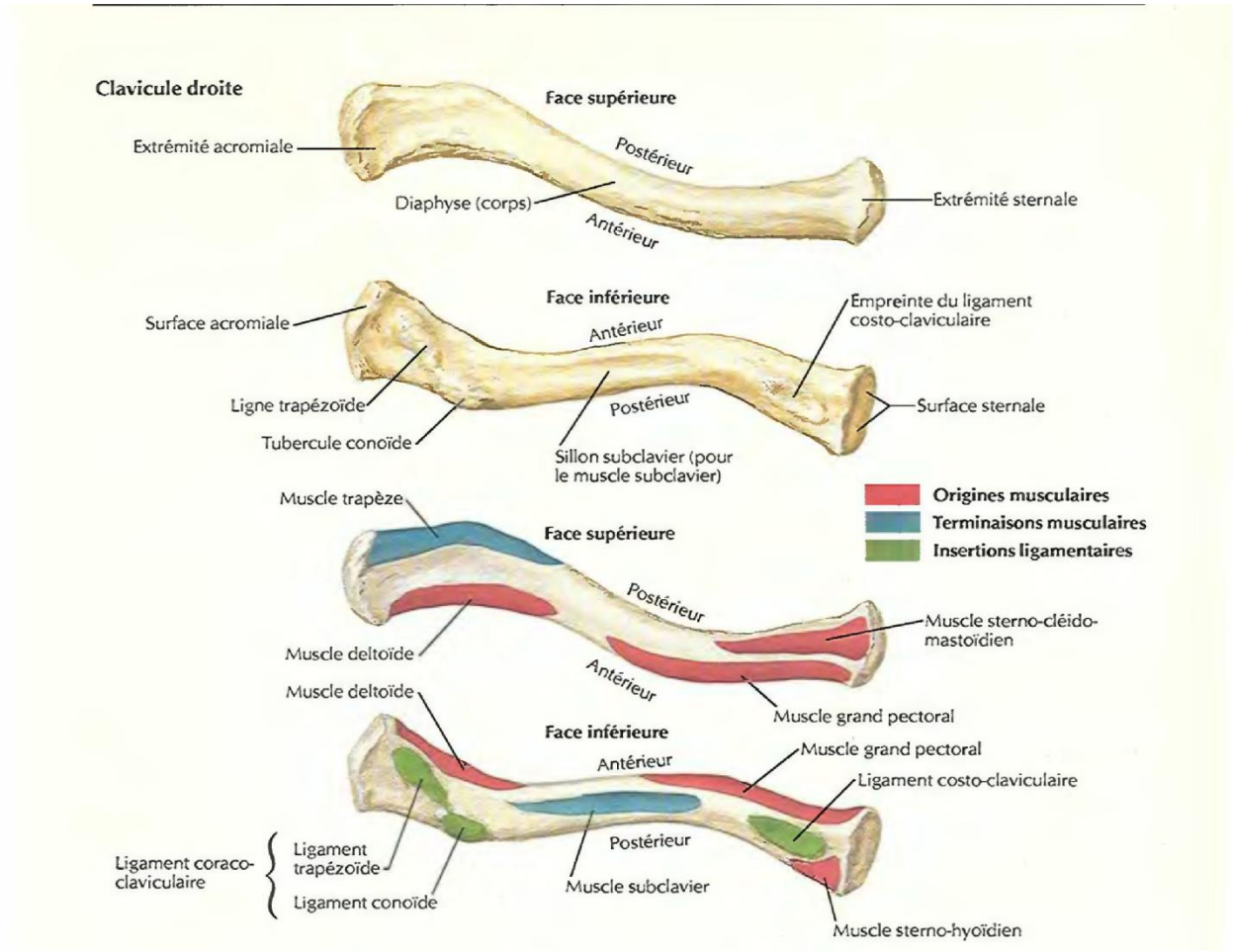
The **shoulder girdle** connects the upper limb to the axial skeleton and provides a wide range of motion for the arm. It consists of the **clavicle** and the **scapula**.

2.1. Clavicle

- **Shape:** S-shaped long bone situated horizontally at the root of the neck.
- **Position:** Subcutaneous throughout its length, acting as a strut that holds the scapula laterally.
- **Features:**
    - **Sternal end:** Articulates with the manubrium of the sternum.
    - **Acromial end:** Articulates with the acromion of the scapula.
    - **Inferior surface:** Has the conoid tubercle and trapezoid line for ligament attachments.

Functions:

- Connects the upper limb to the trunk.
- Acts as a support to keep the limb away from the thorax.
- Transmits mechanical forces from the upper limb to the axial skeleton.



2.2. Scapula

- **Shape:** Flat triangular bone located on the posterior thoracic wall between the 2nd and 7th ribs.
- **Surfaces and Borders:**
    - **Anterior (costal) surface:** Contains the *subscapular fossa*.
    - **Posterior surface:** Divided by the *spine of the scapula* into *supraspinous* and *infraspinous fossae*.
    - **Lateral angle:** Bears the *glenoid cavity* for articulation with the head of the humerus.

Important Processes:

- **Acromion:** Extends laterally to form the highest point of the shoulder.
- **Coracoid process:** Projects forward for muscle and ligament attachment.
- **Glenoid cavity:** Receives the head of the humerus, forming the shoulder joint.

Function:

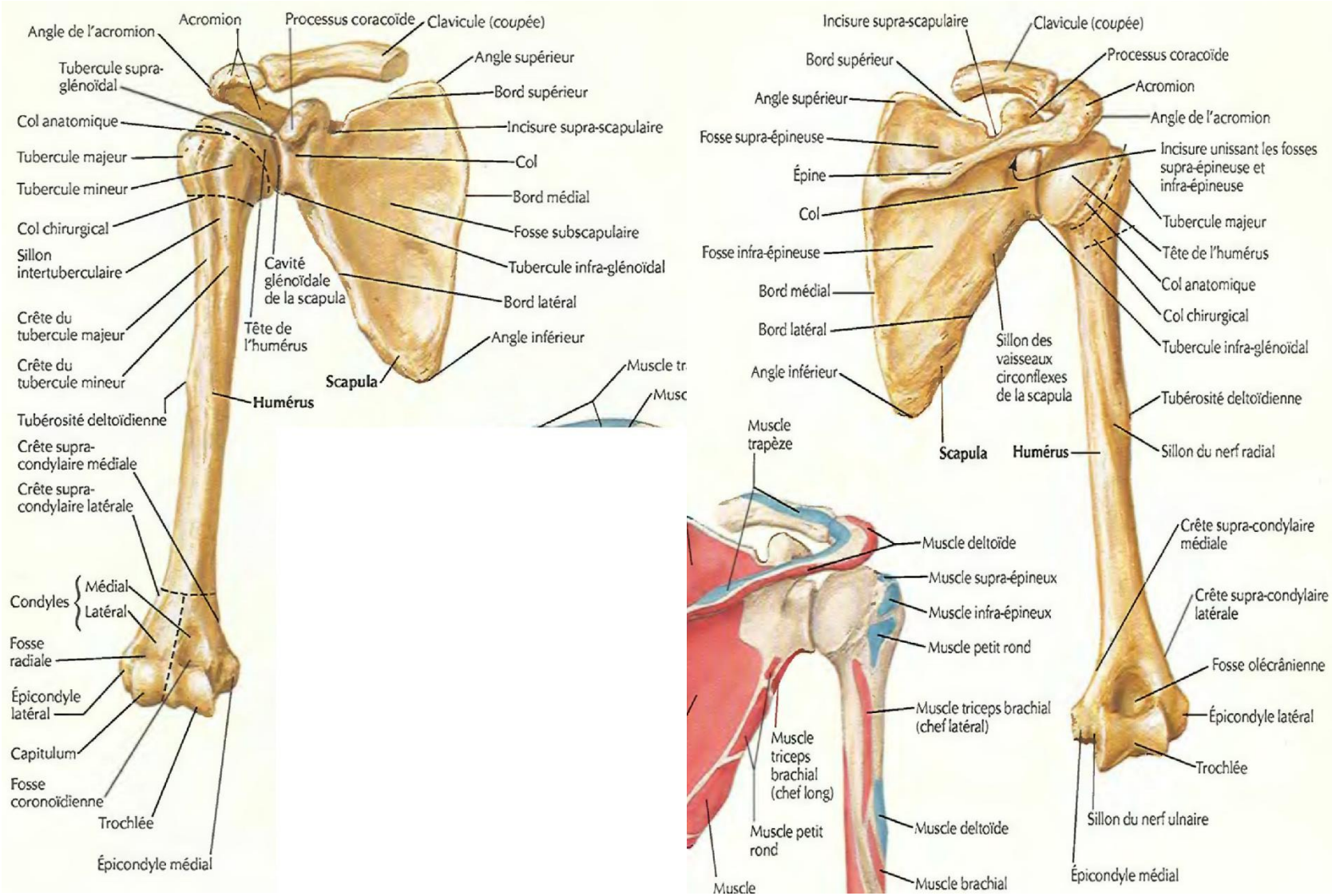
Provides attachment for muscles that move and stabilize the shoulder joint, maintaining alignment of the humeral head during arm movements.

3. The Arm (Brachium)

Humerus

The **humerus** is the largest and longest bone of the upper limb, forming the skeleton of the arm.

- **Proximal End:**
    - **Head:** Articulates with the glenoid cavity of the scapula.
    - **Anatomical neck:** Separates the head from the tubercles.
    - **Greater and lesser tubercles:** Serve as attachment sites for rotator cuff muscles.
    - **Intertubercular sulcus (bicipital groove):** Lodges the tendon of the long head of biceps brachii.
- **Shaft:**
    - **Deltoid tuberosity:** Insertion point for the deltoid muscle.
    - **Radial (spiral) groove:** Accommodates the radial nerve and deep brachial artery.
- **Distal End:**
    - **Capitulum:** Articulates with the head of the radius.
    - **Trochlea:** Articulates with the ulna.
    - **Medial and lateral epicondyles:** Serve for muscle attachments and ligament anchoring.


Angle de l'acromion
Acromion
Processus coracoïde
Clavicule (coupée)
Tubercule supra-glénoïdal
Angle supérieur
Bord supérieur
Col anatomique
Incisure supra-scapulaire
Tubercule majeur
Col
Tubercule mineur
Bord médial
Col chirurgical
Fosse subscapulaire
Sillon intertuberculaire
Tubercule infra-glénoïdal
Cavité glénoïdale de la scapula
Bord latéral
Crête du tubercule majeur
Tête de l'humérus
Angle inférieur
Crête du tubercule mineur
Scapula
Humérus
Tubérosité deltoïdienne
Crête supra-condylaire médiale
Crête supra-condylaire latérale
Condyles
Médial
Latéral
Fosse radiale
Épicondyle latéral
Capitulum
Fosse coronoïdienne
Trochlée
Épicondyle médial
Incisure supra-scapulaire
Clavicule (coupée)
Bord supérieur
Processus coracoïde
Angle supérieur
Acromion
Angle de l'acromion
Fosse supra-épineuse
Incisure unissant les fosses supra-épineuse et infra-épineuse
Épine
Col
Tubercule majeur
Tête de l'humérus
Fosse infra-épineuse
Col anatomique
Bord médial
Col chirurgical
Bord latéral
Tubercule infra-glénoïdal
Sillon des vaisseaux circonflexes de la scapula
Angle inférieur
Tubérosité deltoïdienne
Muscle trapèze
Scapula
Humérus
Sillon du nerf radial
Muscle deltoïde
Crête supra-condylaire médiale
Muscle supra-épineux
Crête supra-condylaire latérale
Muscle infra-épineux
Muscle petit rond
Fosse olécrânienne
Muscle triceps brachial (chef latéral)
Épicondyle latéral
Muscle triceps brachial (chef long)
Trochlée
Muscle petit rond
Muscle deltoïde
Sillon du nerf ulnaire
Muscle brachial
Épicondyle médial

4. The Forearm (Antebrachium)

The **forearm** extends from the **elbow** to the **wrist** and forms the link between the arm and the hand. It plays a vital role in positioning the hand and performing movements such as **pronation**, **supination**, **grasping**, and **manipulation**.
It consists of **two parallel long bones**, the **radius** and the **ulna**, which are connected by the **interosseous membrane**.

General Arrangement

Feature	Radius	Ulna
Position	Lateral (thumb side)	Medial (little finger side)
Length	Shorter	Longer
Wrist Articulation	Directly articulates with carpal bones	Does not articulate with carpal bones
Main Role	Responsible for hand movements	Provides stability and forms elbow hinge

A. The Ulna

The **ulna** is the **medial** and **longer** bone of the forearm. It mainly participates in the **elbow joint**, providing stability for forearm movements.

Part	Description	Function
Proximal End	- **Olecranon process:** Prominent projection forming the point of the elbow. - **Coronoid process:** Anterior projection fitting into the coronoid fossa of the humerus during flexion. - **Trochlear notch:** Articulates with the trochlea of the humerus. - **Radial notch:** Articulates with the head of the radius.	Forms the hinge of the elbow joint and provides leverage for triceps.
Shaft	Triangular in cross-section, with an interosseous border facing the radius.	Serves for muscle attachment and stability.
Distal End	Small head with **styloid process** projecting downward.	Articulates with the radius and provides ligament attachment for the wrist.

B. The Radius

The **radius** is the **lateral** and **shorter** bone of the forearm. It is the main bone involved in **wrist movements** because it articulates directly with the carpal bones.

Part	Description	Function
Proximal End	- **Head:** Disc-shaped; articulates with the capitulum of the humerus and the radial notch of the ulna. - **Neck:** Narrow part below the head. - **Radial tuberosity:** Rough area for insertion of biceps brachii tendon.	Allows rotation at the elbow and transmits biceps force.
Shaft	Slightly curved, with interosseous border facing the ulna.	Provides attachment for pronator and supinator muscles.
Distal End	Broad, articulates with the scaphoid and lunate bones; has a lateral **styloid process**.	Forms the main articulation for the wrist joint.

C. The Interosseous Membrane

The **interosseous membrane** is a strong fibrous sheet connecting the interosseous borders of the radius and ulna.

Functions:

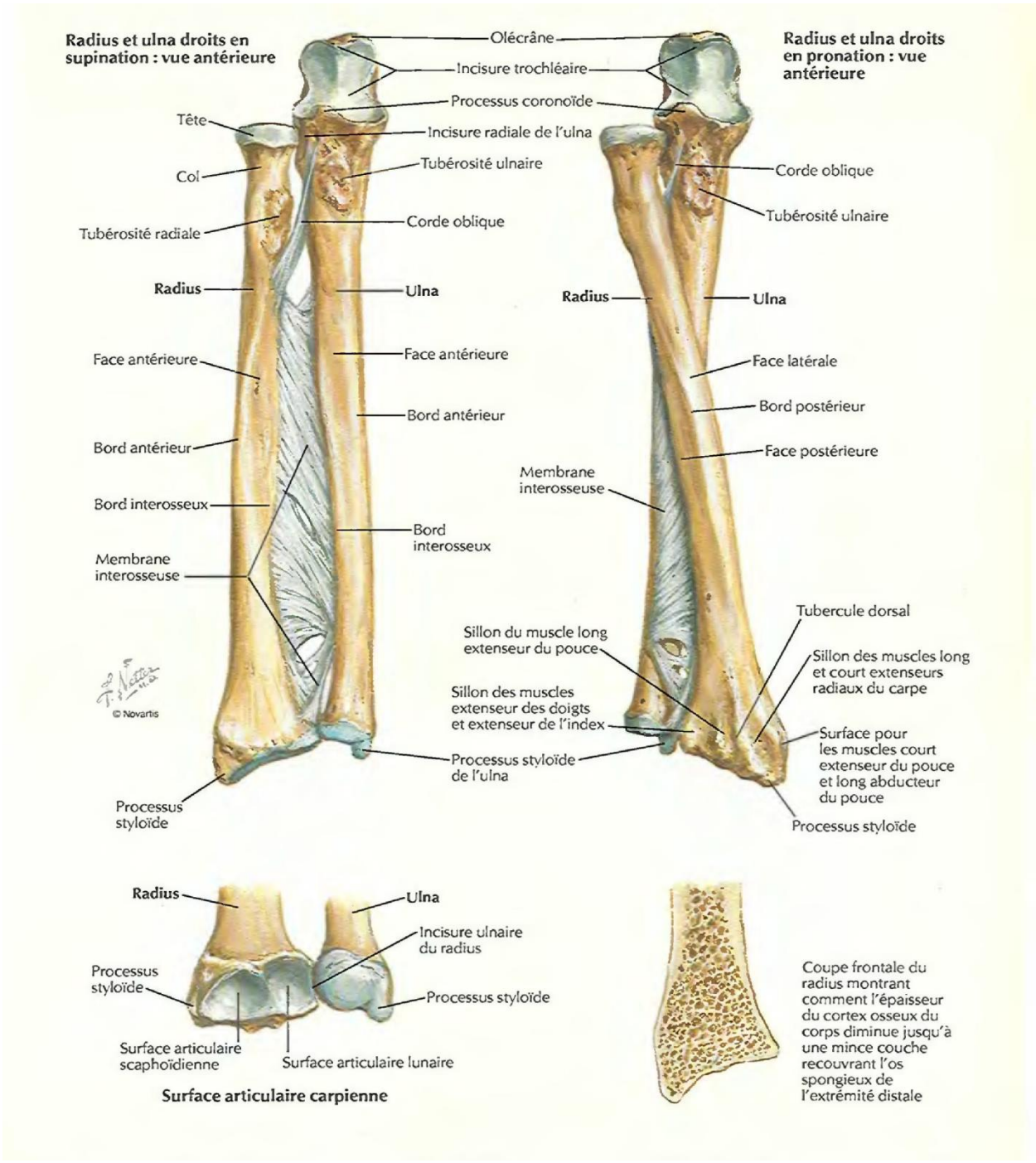
- Maintains the relative position of both bones.
- Serves as an attachment surface for deep forearm muscles.
- Transmits forces from the hand through the radius to the ulna and then to the humerus.

D. Functional Movements of the Forearm

Movement	Description	Muscles Involved	Bones' Relationship
Supination	Palm faces upward or forward.	Biceps brachii, Supinator	Radius and ulna are parallel.
Pronation	Palm faces downward or backward.	Pronator teres, Pronator quadratus	Radius crosses over the ulna.

Summary of the Forearm

- The **ulna** provides **stability** and forms the hinge of the elbow.
- The **radius** provides **mobility** and is essential for wrist and hand movements.
- The **interosseous membrane** coordinates their actions, ensuring stability and efficient transmission of forces.
- Together, they give the upper limb its **functional versatility** and fine control.


Radius et ulna droits en supination : vue antérieure
Olécrâne
Incisure trochléaire
Processus coronoïde
Tête
Incisure radiale de l'ulna
Col
Tubérosité ulnaire
Tubérosité radiale
Corde oblique
Radius
Ulna
Face antérieure
Face antérieure
Bord antérieur
Bord antérieur
Bord interosseux
Membrane interosseuse
Bord interosseux
Processus styloïde
Processus styloïde de l'ulna
Processus styloïde
© Novartis
Radius et ulna droits en pronation : vue antérieure
Corde oblique
Tubérosité ulnaire
Radius
Ulna
Face latérale
Bord postérieur
Face postérieure
Membrane interosseuse
Tubercule dorsal
Sillon du muscle long extenseur du pouce
Sillon des muscles long et court extenseurs radiaux du carpe
Sillon des muscles extenseur des doigts et extenseur de l'index
Surface pour les muscles court extenseur du pouce et long abducteur du pouce
Processus styloïde
Radius
Ulna
Incisure ulnaire du radius
Processus styloïde
Processus styloïde
Surface articulaire scaphoïdienne
Surface articulaire lunaire
Surface articulaire carpienne
Coupe frontale du radius montrant comment l'épaisseur du cortex osseux du corps diminue jusqu'à une mince couche recouvrant l'os spongieux de l'extrémité distale

5. The Hand (Manus)

The hand is the most specialized part of the upper limb. It is adapted for grasping, sensation, and precise manipulation.

Region	Bones	Description
Carpus (Wrist)	8 carpal bones arranged in two rows.	Provides flexibility and movement at the wrist.
Metacarpus (Palm)	5 metacarpal bones (I–V).	Form the skeleton of the palm.
Phalanges (Fingers)	14 bones (3 per finger, 2 for the thumb).	Provide fine mobility and dexterity.

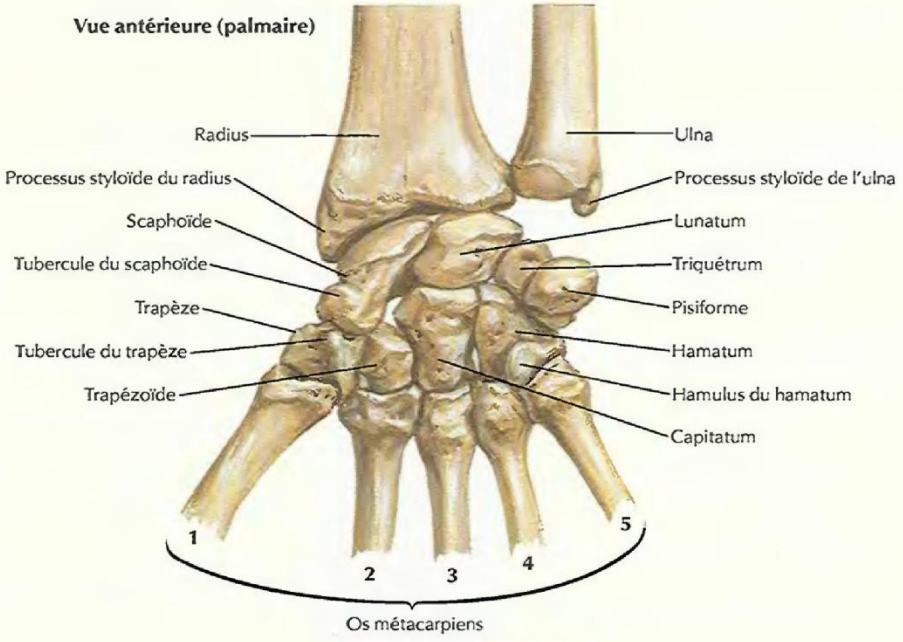
Arrangement of Carpal Bones

Proximal Row (lateral → medial)	Distal Row (lateral → medial)
Scaphoid	Trapezium
Lunate	Trapezoid
Triquetrum	Capitate
Pisiform	Hamate

Mnemonic: *"Some Lovers Try Positions That They Can't Handle."*

Together, these features make the human upper limb one of the most **adaptable and functional systems** in the body, enabling skilled movements essential for daily activities and tool use.

Os du carpe



Os du poignet et de la main