Lecture 3

ARTHROLOGY

the Upper Limb

Lecture 3: Arthrology of the Upper Limb

Introduction

Arthrology is the study of joints and their functional relationships. The upper limb exhibits remarkable **mobility**, allowing diverse movements such as reaching, lifting, grasping, and fine manipulation. This flexibility is provided by a series of joints that connect the bones of the shoulder, arm, forearm, and hand in a coordinated kinetic chain.

Most of these joints are **synovial**, meaning they contain a cavity filled with synovial fluid, a capsule, and reinforcing ligaments — features that allow wide motion while maintaining stability.

1. General Classification of Upper Limb Joints

Type of Joint	Description	Examples in Upper Limb
Fibrous joints	Bones joined by fibrous tissue; minimal movement	Interosseous membrane between radius and ulna
Cartilaginous joints	Bones united by cartilage; slight movement	Sternocostal junctions
Synovial joints	Capsule, cavity, and synovial fluid; freely movable	Shoulder, elbow, wrist, etc.

The **upper limb** is dominated by **synovial joints**, ensuring the flexibility necessary for functional activities.

2. Joints of the Shoulder Girdle

The shoulder girdle connects the upper limb to the trunk. It includes the **sternoclavicular**, **acromioclavicular**, and **glenohumeral joints**.

Among them, the **glenohumeral joint** is the most important and mobile, so it will be described in detail.

A. Sternoclavicular Joint (Brief)

- **Type:** Synovial saddle joint (functionally ball-and-socket)
- **Articulating surfaces:** Sternal end of clavicle and manubrium of sternum
- **Function:** Acts as the only true bony link between upper limb and axial skeleton; allows elevation, depression, and rotation of the clavicle.

B. Acromioclavicular Joint (Brief)

- **Type:** Synovial plane joint
- **Articulating surfaces:** Lateral end of clavicle and acromion of scapula
- **Function:** Permits small gliding motions that accompany scapular movements.

3. Glenohumeral Joint (Shoulder Joint)

The **glenohumeral joint** is the most mobile joint in the human body. It connects the upper limb to the scapula and allows a wide range of complex movements. However, this high mobility comes at the expense of stability.

A. Type

- Synovial **ball-and-socket** joint.

B. Articulating Surfaces

- **Head of the humerus:** Large, hemispherical, covered with hyaline cartilage.
- **Glenoid cavity of the scapula:** Shallow concavity, deepened by a fibrocartilaginous rim called the **glenoid labrum**.

C. Joint Capsule

- Thin, loose, and attaches around the anatomical neck of the humerus and the margins of the glenoid cavity.
- The capsule is weakest inferiorly, explaining the frequency of **inferior dislocations**.

D. Ligaments

1. **Capsular ligaments:**
    - **Glenohumeral ligaments** (superior, middle, inferior): reinforce the anterior aspect.
    - **Coracohumeral ligament:** strengthens the superior part of the capsule.
2. **Accessory ligaments:**
    - **Transverse humeral ligament:** bridges the intertubercular groove, keeping the tendon of the biceps brachii in place.
    - **Coracoacromial ligament:** forms the coracoacromial arch — a strong protective roof preventing upward displacement of the humeral head.

E. Synovial Membrane

- Lines the inner surface of the capsule and forms bursae (e.g., subscapular bursa, subacromial bursa) to reduce friction during movement.

F. Muscular Reinforcement

The glenohumeral joint is stabilized dynamically by the **rotator cuff muscles**, whose tendons fuse with the capsule:

- **Supraspinatus** (superior)
- **Infraspinatus** and **Teres minor** (posterior)
- **Subscapularis** (anterior)

G. Movements

The shoulder joint allows movements in **three axes** and **six directions**:

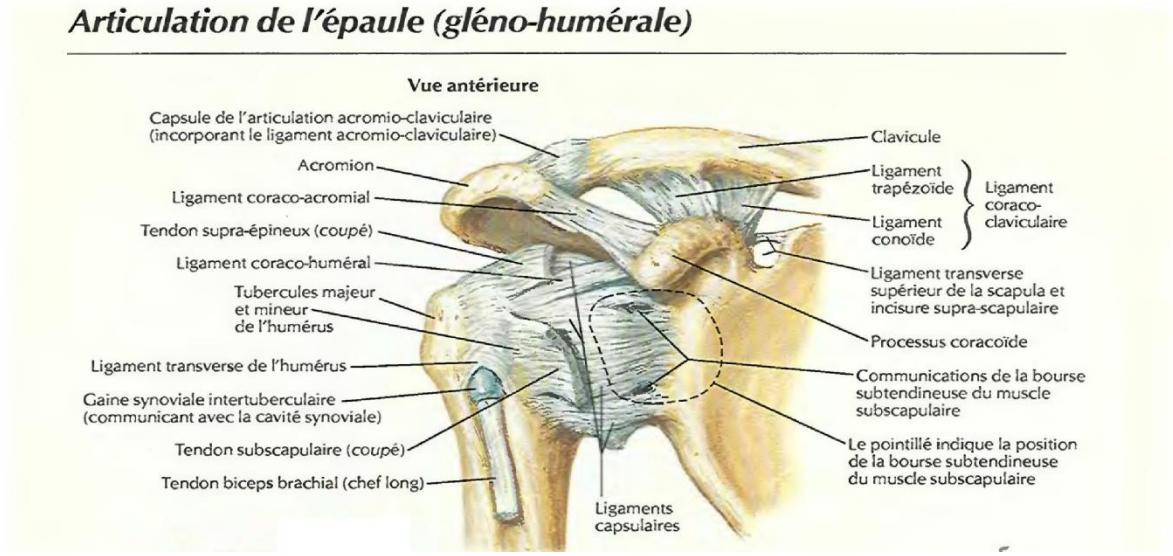
Movement	Main Muscles Involved
Flexion	Pectoralis major, Anterior deltoid, Coracobrachialis, Biceps brachii
Extension	Latissimus dorsi, Posterior deltoid, Teres major
Abduction	Supraspinatus (initiates), Deltoid (continues)
Adduction	Pectoralis major, Latissimus dorsi, Teres major
Medial rotation	Subscapularis, Pectoralis major
Lateral rotation	Infraspinatus, Teres minor

Circumduction is a combination of all the above movements.

I. Clinical Note

- The glenohumeral joint is **prone to dislocation**, most often **anteriorly**, due to the shallow glenoid cavity and weak inferior capsule.
- **Rotator cuff injuries** are common, especially supraspinatus tendon tears.
- **Bursitis** (inflammation of subacromial bursa) may cause shoulder pain and restricted movement.

Feature	Description
Joint type	Synovial ball-and-socket
Articulating surfaces	Humeral head and glenoid cavity
Main ligaments	Glenohumeral, coracohumeral, coracoacromial
Dynamic stabilizers	Rotator cuff muscles
Movements	Flexion, Extension, Abduction, Adduction, Rotation, Circumduction
Common injuries	Anterior dislocation, rotator cuff tear, bursitis



4. Elbow Joint

The elbow joint acts as a hinge between the arm and forearm, providing controlled flexion and extension.

A. Type : Synovial hinge joint.

B. Articulations

- Between **trochlea of humerus** and **trochlear notch of ulna**, and between **capitulum of humerus** and **head of radius** (both enclosed in one capsule).

C. Ligaments

- **Ulnar collateral ligament** (medial)
- **Radial collateral ligament** (lateral)
- **Annular ligament**: encircles the head of the radius

D. Movements

- **Flexion and extension** only.
    - *Flexors:* Brachialis, Biceps brachii, Brachioradialis
    - *Extensors:* Triceps brachii, Anconeus

E. Clinical Note

- **"Nursemaid's elbow"** (radial head subluxation) occurs when the annular ligament slips over the head of the radius — common in children.

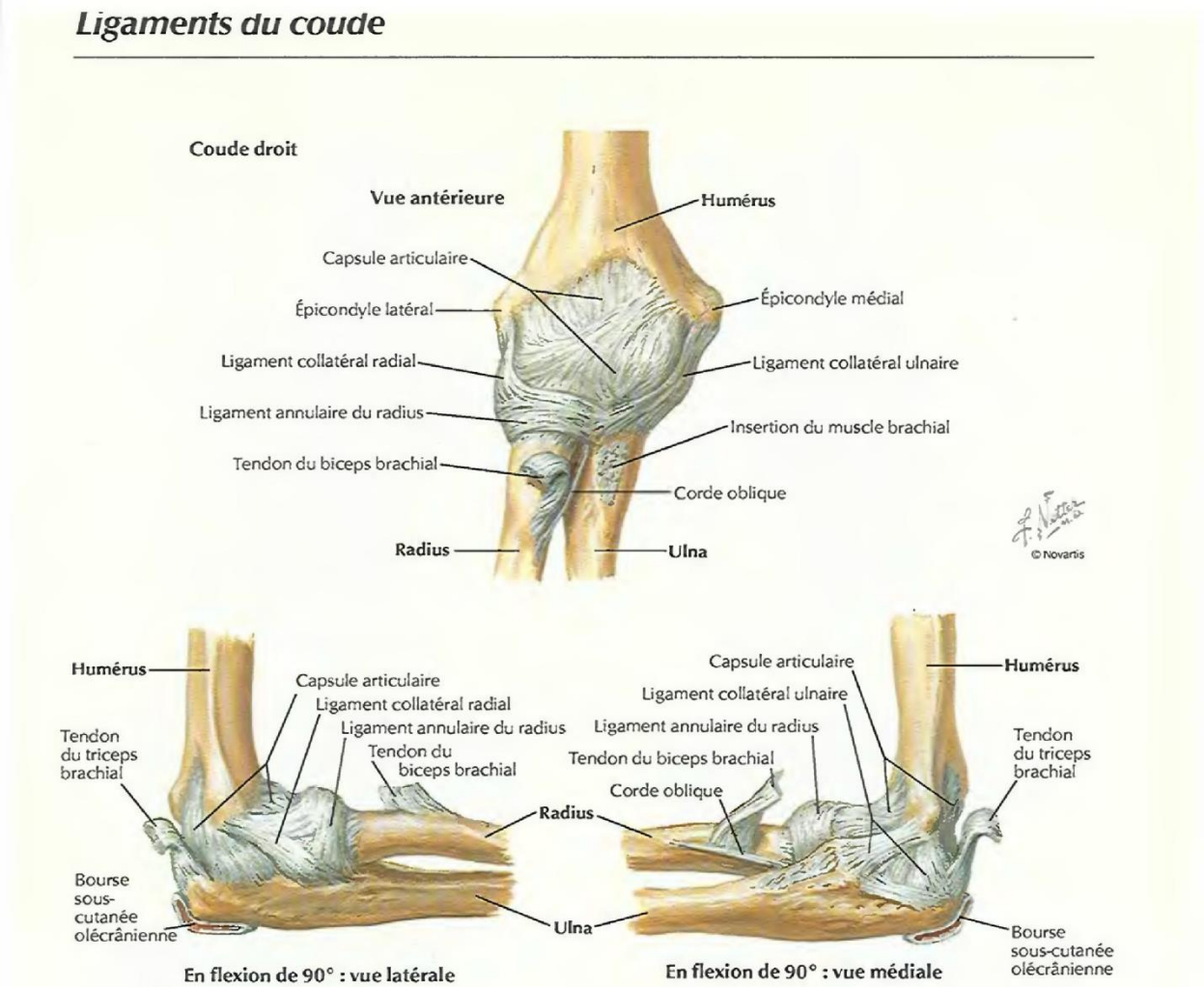
Feature	**Description**
Joint type	Synovial hinge
Movements	Flexion, Extension
Ligaments	Ulnar and radial collaterals, annular ligament
Common injuries	Dislocation, ligament sprain, nursemaid's elbow

5. Radioulnar Joints

The **proximal** and **distal radioulnar joints** permit **pronation** and **supination** of the forearm.

Joint	Type	Main Ligament	Movement
Proximal radioulnar	Pivot	Annular ligament	Rotation of radius around ulna
Distal radioulnar	Pivot	Triangular fibrocartilage (TFCC)	Rotation of distal radius

- **Interosseous membrane:** binds both bones and transmits forces during hand actions.
- **Muscles for pronation:** Pronator teres, Pronator quadratus
- **Muscles for supination:** Supinator, Biceps brachii



6. Wrist (Radiocarpal) Joint

- **Type:** Synovial ellipsoid (condyloid) joint
- **Articulations:** Distal radius and articular disc with proximal carpal bones (scaphoid, lunate, triquetrum)
- **Movements:** Flexion, extension, abduction (radial deviation), adduction (ulnar deviation), and circumduction
- **Ligaments:** Palmar, dorsal, ulnar, and radial collateral ligaments

The wrist joint provides stability and smooth transition of movements from forearm to hand.

7. Joints of the Hand (Brief Overview)

The hand contains numerous joints that collectively allow precise movements and dexterity.

Region	Joints Included
Intercarpal joints	Between carpal bones (gliding)
Carpometacarpal (CMC) joints	Between carpal and metacarpal bones
Metacarpophalangeal (MCP) joints	Between metacarpals and proximal phalanges
Interphalangeal (IP) joints	Between phalanges (proximal and distal)

Note: The **CMC joint of the thumb** is a **saddle joint**, enabling opposition — a unique and essential movement for grasping.

Summary Table: Principal Joints of the Upper Limb

Region	Joint	Type	Main Movements
Shoulder girdle	Sternoclavicular	Saddle	Elevation, rotation
Shoulder girdle	Acromioclavicular	Plane	Gliding
Shoulder	Glenohumeral	Ball-and-socket	Flexion, extension, abduction, rotation
Arm	Elbow	Hinge	Flexion, extension
Forearm	Radioulnar (proximal/distal)	Pivot	Pronation, supination
Wrist	Radiocarpal	Ellipsoid	Flexion, extension, deviation
Hand	CMC, MCP, IP	Various	Fine movements, grip

Conclusion

The arthrology of the upper limb reveals a perfect balance between **mobility** and **stability**. The **glenohumeral joint** ensures maximum range of motion, while the **elbow** and **radioulnar joints** refine forearm actions. The **wrist and hand joints**, though smaller, offer exceptional dexterity and precision — essential for all manual activities. Understanding the structural and functional aspects of these joints is crucial for anatomy, biomechanics, and clinical applications in sports and rehabilitation.