Lecture 6

ARTHROLOGY
the Lower Limb

Lecture 6 : Arthrology of the Lower Limb

Introduction

The **arthrology of the lower limb** studies the **joints, ligaments, and articular structures** that unite its bones and permit both stability and controlled movement. Because the lower limb must **support the body's weight** while enabling **locomotion**, its joints are generally **stronger and more stable** than those of the upper limb, though less mobile.

The joints of the lower limb are classified into three main groups:

1. **Joints of the Pelvic Girdle**
2. **Joints of the Thigh and Leg**
3. **Joints of the Foot**

1. Joints of the Pelvic Girdle

The pelvic girdle connects the lower limb to the axial skeleton and consists of three principal articulations:

Joint	Type	Articulating Structures	Function / Notes
Sacroiliac Joint	Synovial (plane type)	Between the auricular surfaces of the sacrum and ilium	Transmits weight from the vertebral column to the lower limbs; reinforced by strong sacroiliac ligaments.
Pubic Symphysis	Secondary cartilaginous (symphysis)	Between the bodies of the two pubic bones, joined by a fibrocartilaginous disc	Allows limited movement; acts as a shock absorber during locomotion.
Hip Joint (Coxal Joint)	Synovial (ball and socket)	Between the head of the femur and the acetabulum of the hip bone	Permits flexion, extension, abduction, adduction, rotation, and circumduction.

2. The Hip Joint

The **hip joint** is a **ball-and-socket synovial joint** designed for stability and weight-bearing. It connects the lower limb to the pelvic girdle and supports the entire trunk in upright posture.

Articular Surfaces

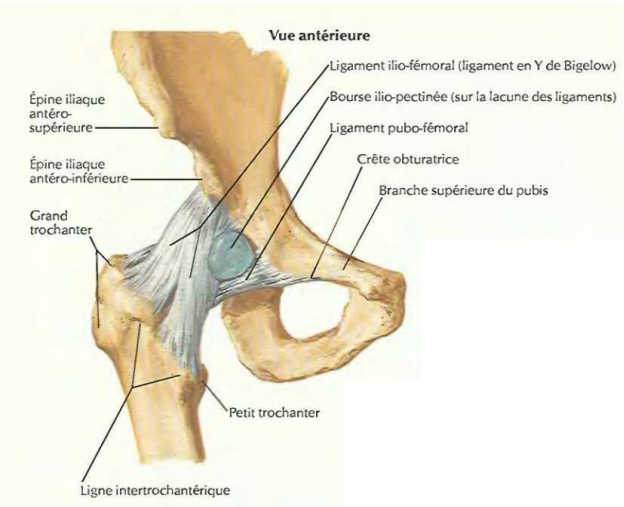
- **Head of the femur:** spherical, covered with hyaline cartilage except at the fovea capitis.
- **Acetabulum:** deep, cup-shaped cavity on the hip bone; deepened by the **acetabular labrum**, a fibrocartilaginous rim that increases stability.

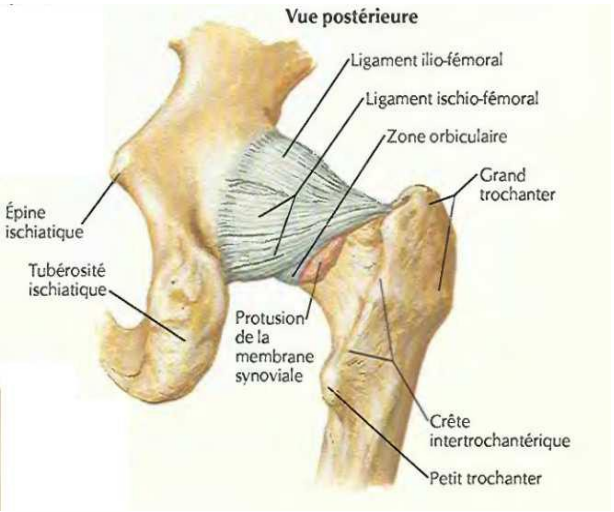
Capsule and Ligaments

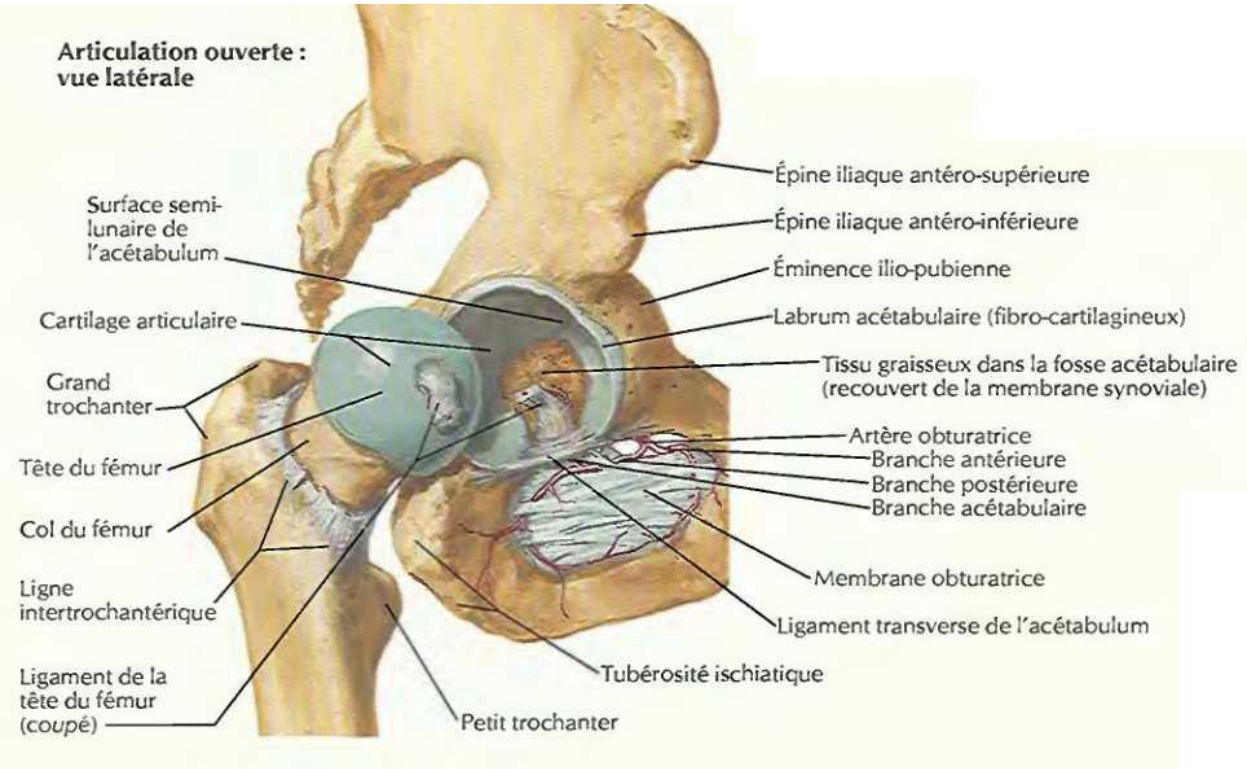
Ligament	Position / Attachment	Function
Iliofemoral ligament	From anterior inferior iliac spine to intertrochanteric line	Prevents hyperextension; strongest ligament in the body.
Pubofemoral ligament	From pubic part of acetabular rim to inferior neck of femur	Limits overabduction and extension.
Ischiofemoral ligament	From ischial part of acetabulum to greater trochanter	Limits internal rotation and adduction.
Ligamentum teres (of head of femur)	Within the joint cavity; attaches femoral head to acetabular notch	Contains artery to head of femur; minor stabilizing role.

Movements and Muscles

Movement	Main Muscles Involved
Flexion	Iliopsoas, rectus femoris, sartorius
Extension	Gluteus maximus, hamstrings
Abduction	Gluteus medius and minimus
Adduction	Adductor longus, brevis, magnus
Medial rotation	Tensor fasciae latae, gluteus medius
Lateral rotation	Piriformis, obturator internus, gluteus maximus


Vue antérieure
Ligament ilio-fémoral (ligament en Y de Bigelow)
Épine iliaque antéro-supérieure
Bourse ilio-pectinée (sur la lacune des ligaments)
Ligament pubo-fémoral
Épine iliaque antéro-inférieure
Crête obturatrice
Branche supérieure du pubis
Grand trochanter
Petit trochanter
Ligne intertrochantérique


Vue postérieure
Ligament ilio-fémoral
Ligament ischio-fémoral
Zone orbiculaire
Grand trochanter
Épine ischiatique
Tubérosité ischiatique
Protusion de la membrane synoviale
Crête intertrochantérique
Petit trochanter


Articulation ouverte : vue latérale
Épine iliaque antéro-supérieure
Surface semi-lunaire de l'acétabulum
Épine iliaque antéro-inférieure
Éminence ilio-pubienne
Cartilage articulaire
Labrum acétabulaire (fibro-cartilagineux)
Tissu graisseux dans la fosse acétabulaire (recouvert de la membrane synoviale)
Grand trochanter
Artère obturatrice
Branche antérieure
Branche postérieure
Branche acétabulaire
Tête du fémur
Col du fémur
Membrane obturatrice
Ligne intertrochantérique
Ligament transverse de l'acétabulum
Tubérosité ischiatique
Ligament de la tête du fémur (coupé)
Petit trochanter

3. Joints of the Thigh and Leg

Joint	Type	Articulating Structures	Function / Notes
Knee Joint	Synovial (modified hinge)	Between femur, tibia, and patella	Allows flexion, extension, slight rotation; stabilized by cruciate and collateral ligaments.
Superior Tibiofibular Joint	Synovial (plane)	Head of fibula with lateral condyle of tibia	Permits gliding movement.
Inferior Tibiofibular Joint	Fibrous (syndesmosis)	Distal ends of tibia and fibula	Maintains stability of the ankle mortise.

4. The Knee Joint

The **knee joint** is the **largest and most complex** synovial joint. It supports large mechanical loads while permitting **flexion**, **extension**, and **slight rotation** when flexed.

Articular Surfaces

- **Femoral condyles** (medial and lateral)
- **Tibial condyles (plateaus)**
- **Posterior surface of the patella**

Articular Capsule

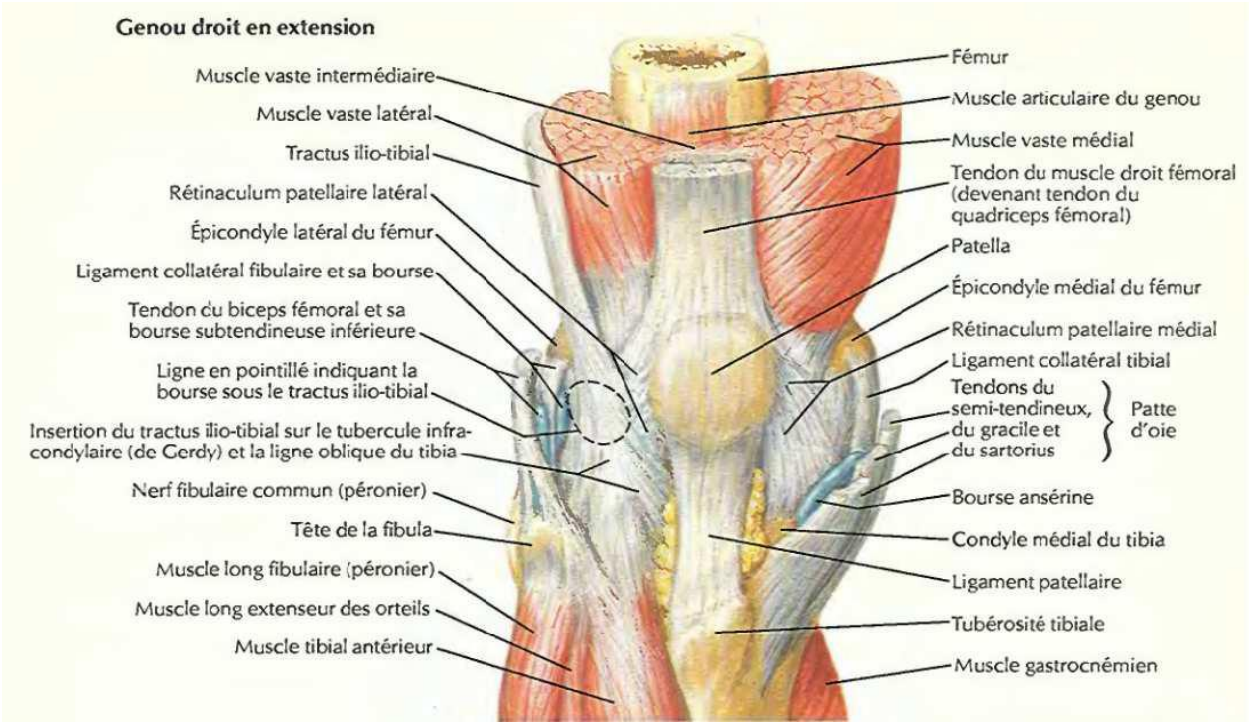
- Strong but thin anteriorly (replaced by the quadriceps tendon, patella, and patellar ligament).
- Reinforced by expansions from the quadriceps and hamstring tendons.

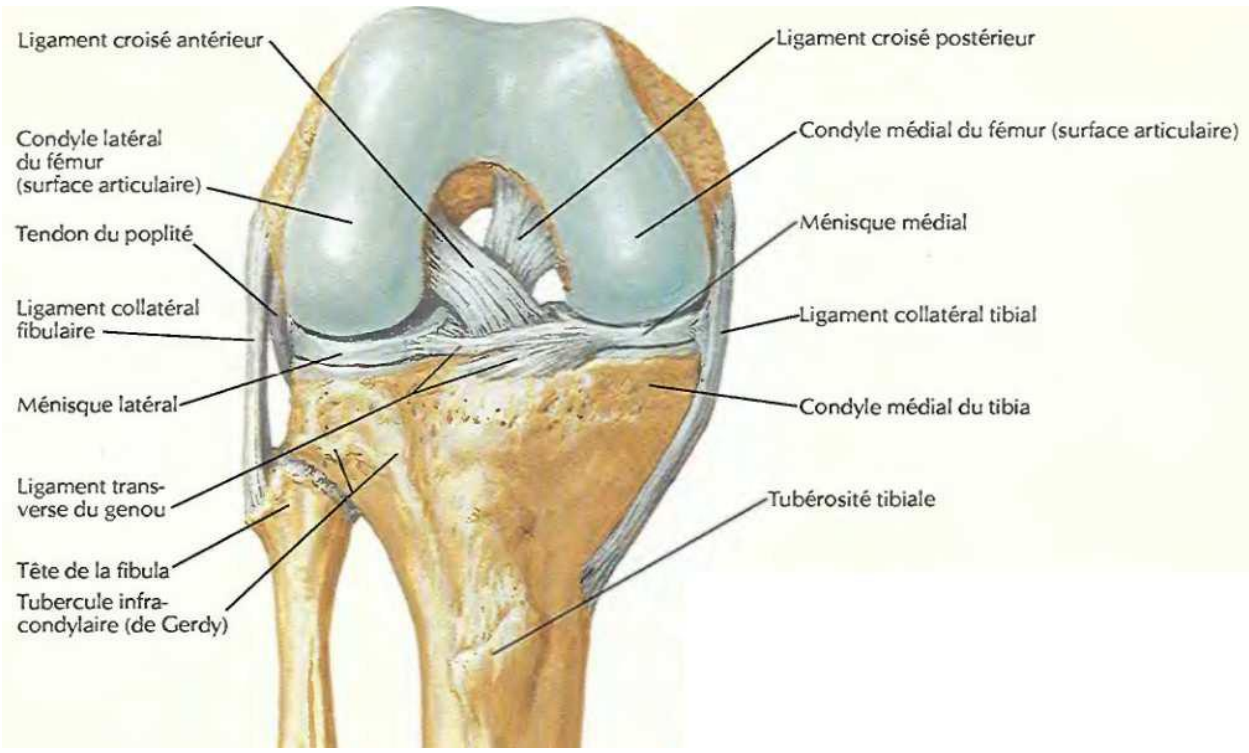
Ligaments of the Knee

Ligament	Position	Function
Patellar ligament	From patella to tibial tuberosity	Continuation of quadriceps tendon; stabilizes anteriorly.
MCL (Tibial collateral)	Medial epicondyle of femur to medial tibia	Prevents valgus stress; attached to medial meniscus.
LCL (Fibular collateral)	Lateral epicondyle to head of fibula	Prevents varus stress; separate from meniscus.
ACL (Anterior cruciate)	Anterior tibia → lateral femoral condyle	Prevents anterior tibial displacement; limits hyperextension.
PCL (Posterior cruciate)	Posterior tibia → medial femoral condyle	Prevents posterior tibial displacement; stronger than ACL.
Oblique popliteal	Posterior capsule from semimembranosus	Reinforces posterior wall.
Arcuate popliteal	Posterolateral corner of joint	Strengthens posterior-lateral capsule.

Intra-Articular Structures

Structure	Description / Function
Menisci (medial & lateral)	Crescent-shaped fibrocartilages that deepen tibial surfaces, improve congruence, and absorb shock.
Infrapatellar fat pad	Cushions joint during motion.
Synovial membrane	Produces synovial fluid; lines non-articular parts of capsule.


Genou droit en extension
Muscle vaste intermédiaire
Muscle vaste latéral
Tractus ilio-tibial
Rétinaculum patellaire latéral
Épicondyle latéral du fémur
Ligament collatéral fibulaire et sa bourse
Tendon du biceps fémoral et sa bourse subtendineuse inférieure
Ligne en pointillé indiquant la bourse sous le tractus ilio-tibial
Insertion du tractus ilio-tibial sur le tubercule infra-condylaire (de Gerdy) et la ligne oblique du tibia
Nerf fibulaire commun (péronier)
Tête de la fibula
Muscle long fibulaire (péronier)
Muscle long extenseur des orteils
Muscle tibial antérieur
Fémur
Muscle articulaire du genou
Muscle vaste médial
Tendon du muscle droit fémoral (devenant tendon du quadriceps fémoral)
Patella
Épicondyle médial du fémur
Rétinaculum patellaire médial
Ligament collatéral tibial
Tendons du semi-tendineux, du gracile et du sartorius
Patte d'oie
Bourse ansérine
Condyle médial du tibia
Ligament patellaire
Tubérosité tibiale
Muscle gastrocnémien


Ligament croisé antérieur
Condyle latéral du fémur (surface articulaire)
Tendon du poplité
Ligament collatéral fibulaire
Ménisque latéral
Ligament transverse du genou
Tête de la fibula
Tubercule infra-condylaire (de Gerdy)
Ligament croisé postérieur
Condyle médial du fémur (surface articulaire)
Ménisque médial
Ligament collatéral tibial
Condyle médial du tibia
Tubérosité tibiale

5. The Ankle Joint (Talocrural Joint)

The **ankle joint** is a **synovial hinge joint** connecting the **leg and foot**, allowing **dorsiflexion** and **plantar flexion**.

Articulating Surfaces

- **Inferior surface of tibia and medial malleolus**
- **Lateral malleolus of fibula**
- **Trochlea of the talus**
  → Together they form a **mortise-and-tenon** configuration that gives the joint high stability.

Capsule and Ligaments

Articular Capsule : Thin anteriorly and posteriorly; strengthened by strong medial and lateral ligaments.

Medial (Deltoid) Ligament

Part	Attachment	Function
Tibionavicular	Medial malleolus → navicular	Resists eversion and abduction
Tibiocalcaneal	Medial malleolus → sustentaculum tali	Supports medial arch
Posterior tibiotalar	Medial malleolus → talus posteriorly	Limits dorsiflexion
Anterior tibiotalar	Medial malleolus → talus anteriorly	Limits plantar flexion

Lateral Ligament Complex

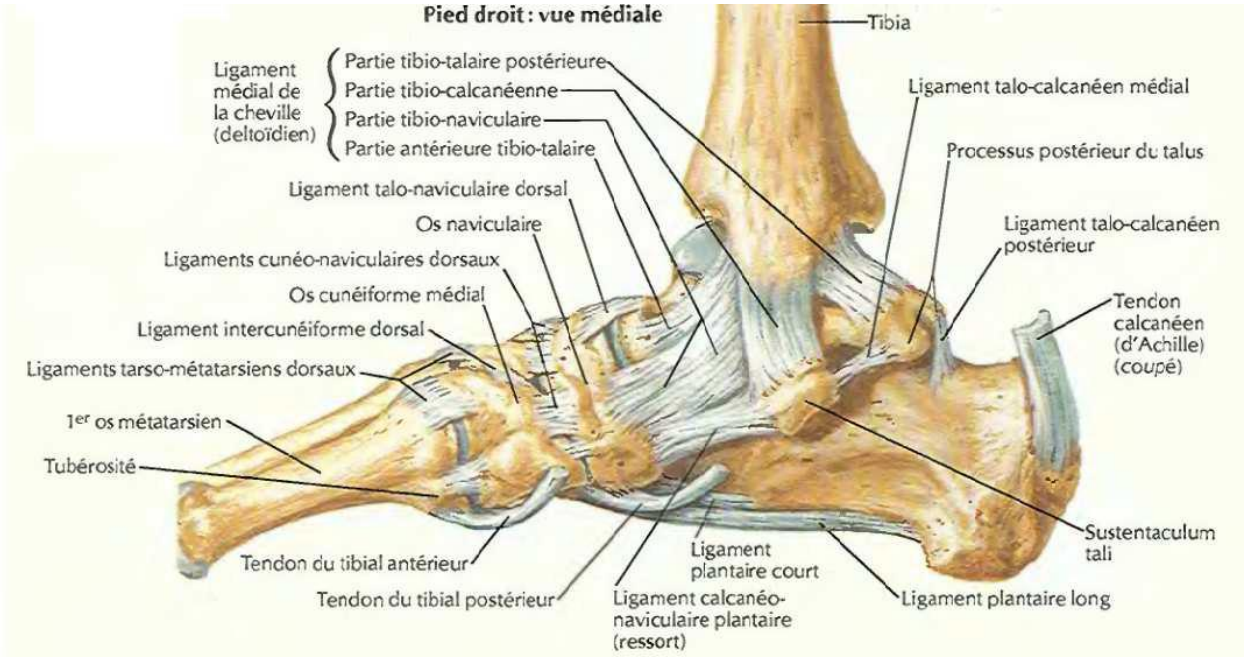
Ligament	Attachment	Function / Clinical Note
ATFL (Anterior talofibular)	Lateral malleolus → talus (anterior)	Most commonly injured in inversion sprains.
CFL (Calcaneofibular)	Lateral malleolus → calcaneus	Resists inversion when ankle is neutral.
PTFL (Posterior talofibular)	Lateral malleolus → talus (posterior)	Stabilizes posterior aspect.

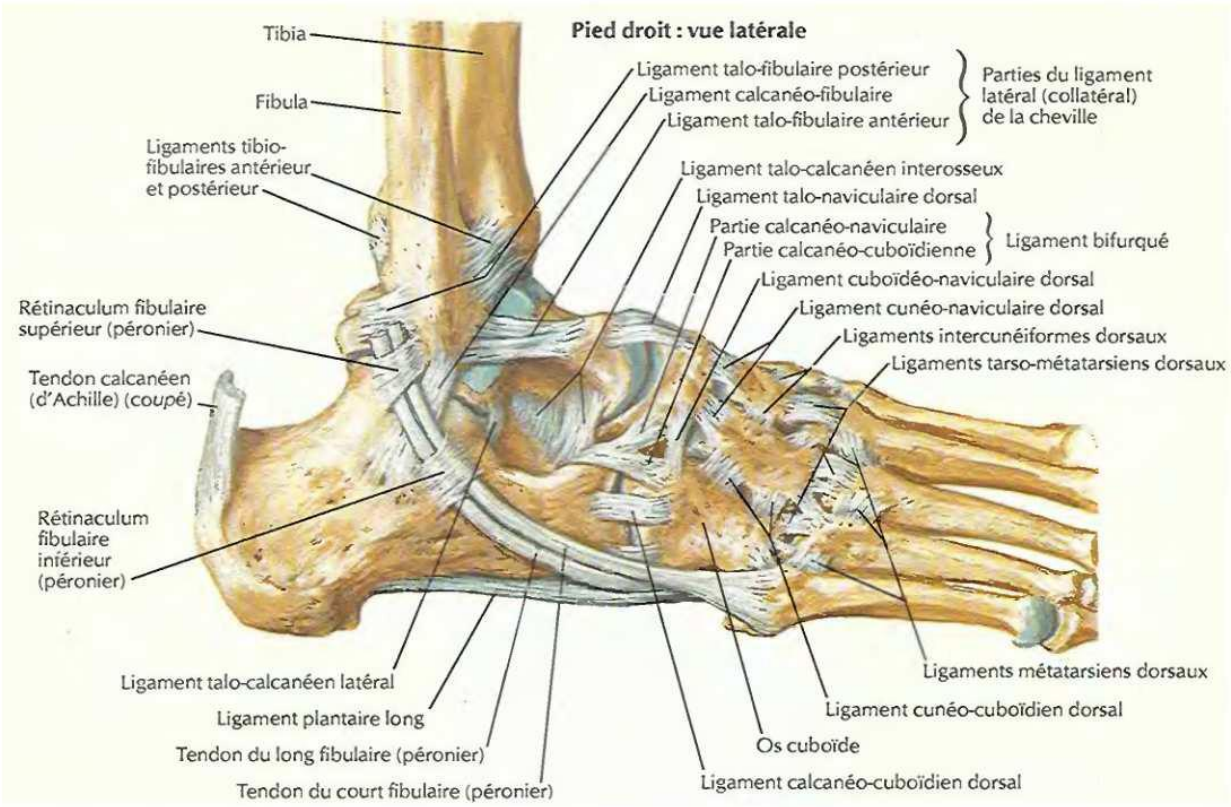
Movements

Movement	Muscles Involved	Notes
Dorsiflexion	Tibialis anterior, extensor digitorum longus, extensor hallucis longus, fibularis tertius	Limited by posterior ligaments; more stable position.
Plantar flexion	Gastrocnemius, soleus, plantaris, tibialis posterior, flexor digitorum longus, flexor hallucis longus, fibularis longus & brevis	Greater range; limited by anterior ligaments.

Clinical Note:

- The joint is most stable in **dorsiflexion**, when the talus fits tightly between malleoli.
- **Inversion injuries** are common, damaging the **ATFL** and **CFL**.
- **Eversion injuries** are rare due to the strength of the deltoid ligament.





Conclusion

The **arthrology of the lower limb** reveals an elegant compromise between **stability and mobility**.

The **hip** supports the trunk, the **knee** provides a powerful hinge for locomotion, and the **ankle and foot joints** adapt to ground irregularities while maintaining balance and shock absorption.

Together, these articulations ensure **efficient bipedal movement**, **energy conservation**, and **postural equilibrium**, making the lower limb a biomechanical masterpiece of human anatomy.