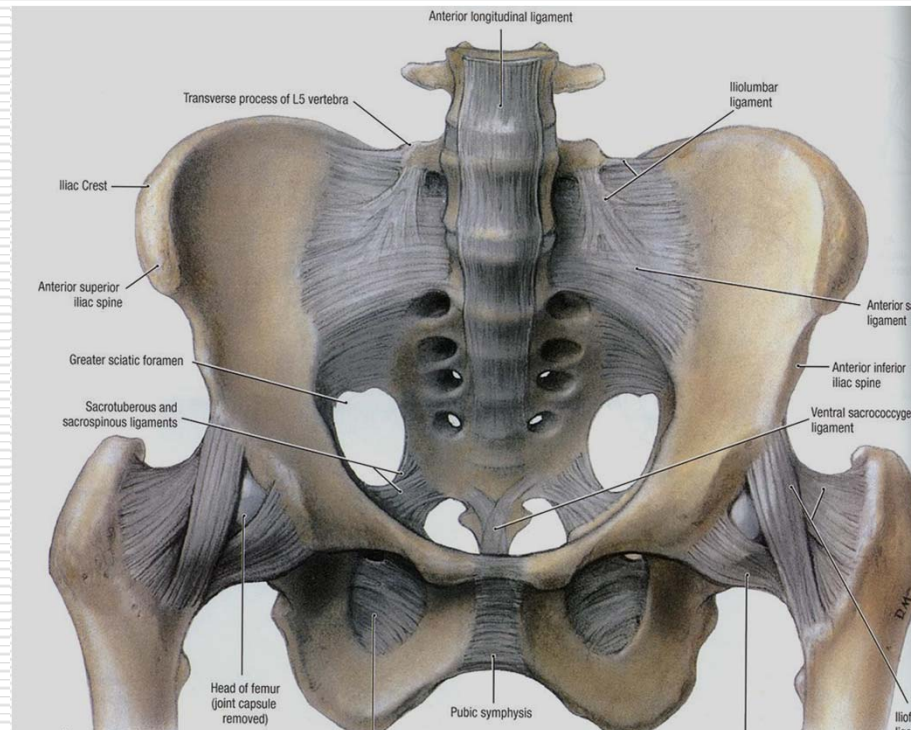


Bone Grafting and Reconstruction



Introduction

□ Historical background:

- Surgeons have gained their experience in reconstruction from the numerous wars
 - Civilian injuries produces the largest number and the most extensive tissue loss almost indistinguishable from ware injuries
-

Introduction

- It started in WW I and concentrated around reconstruction of the mandible but without antibiotic support
 - In WW II distant bone blocks were transplanted from the ilium, rib and tibia with routine use of antibiotic
 - No cancellous cellular marrow
-

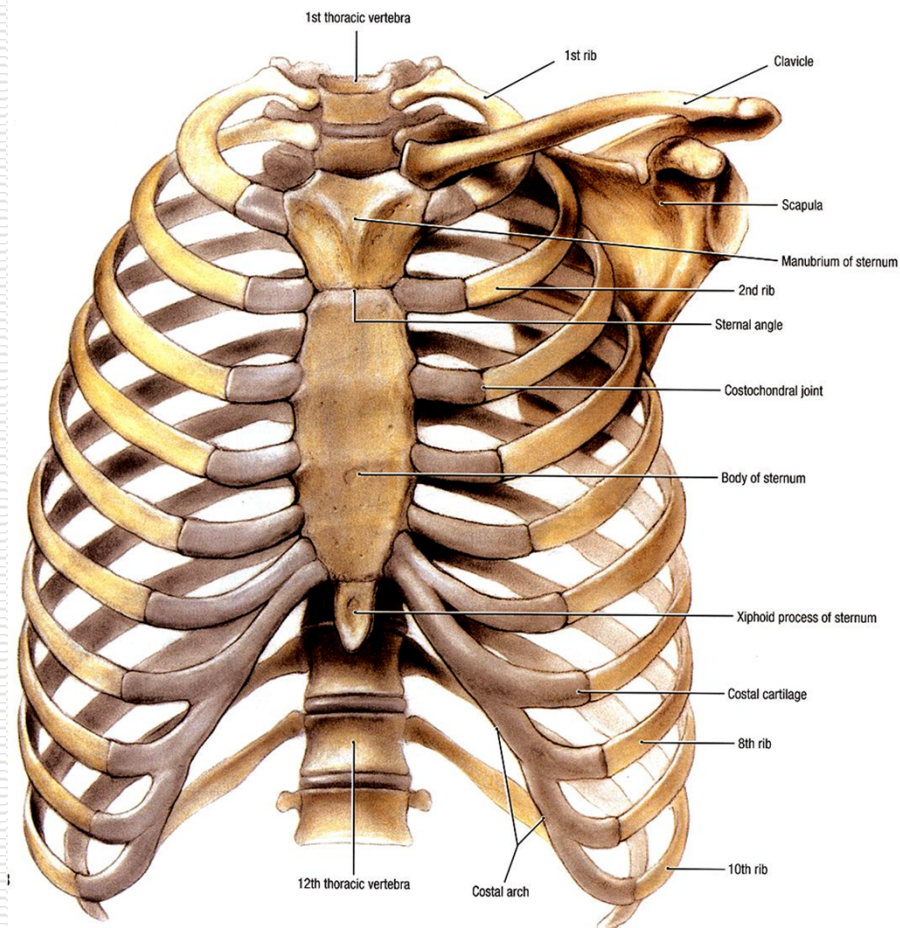
Introduction

- Mowlem in 1944, introduced the concept of “Iliac cancellous bone chips” beginning the evolution of predictable bony reconstruction of the jaw bone
 - Boyne brought about the “use of particulate bone and cancellous marrow” with metallic trays splinted to large acellular cortical bone
-

Biology of bone grafting

- Three biological mechanisms are involved:
 - **Osteogenesis:**
 - Is the production of new bone by proliferation, osteoid production and mineralization
 - **Osteoconduction:**
 - Is the production of new bone and migration of local osteocompetent cells along a conduit e.g. fibrin, blood vessel or even certain alloplast material like hydroxyapatite
 - Originate from the endostium or residual periostium of the host bone
 - **Osteoinduction:**
 - Is the formation of bone by stem cells transforming into osteocompetent cells by BMP
 - It induces the recipient tissue cells to form periostium and endostium
-

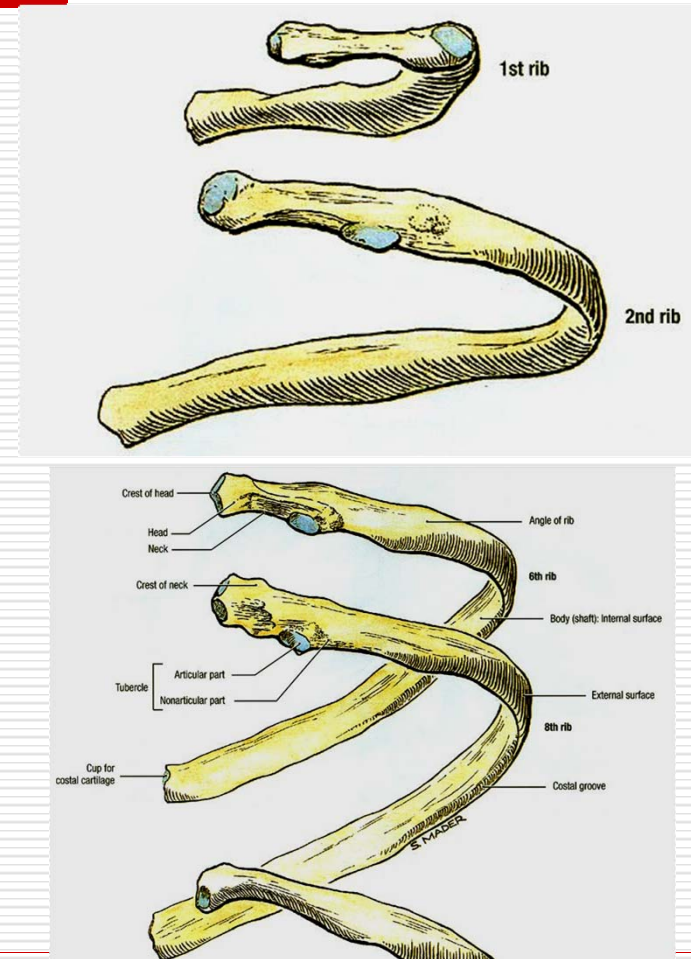
The Rib



Surgical anatomy

The Rib

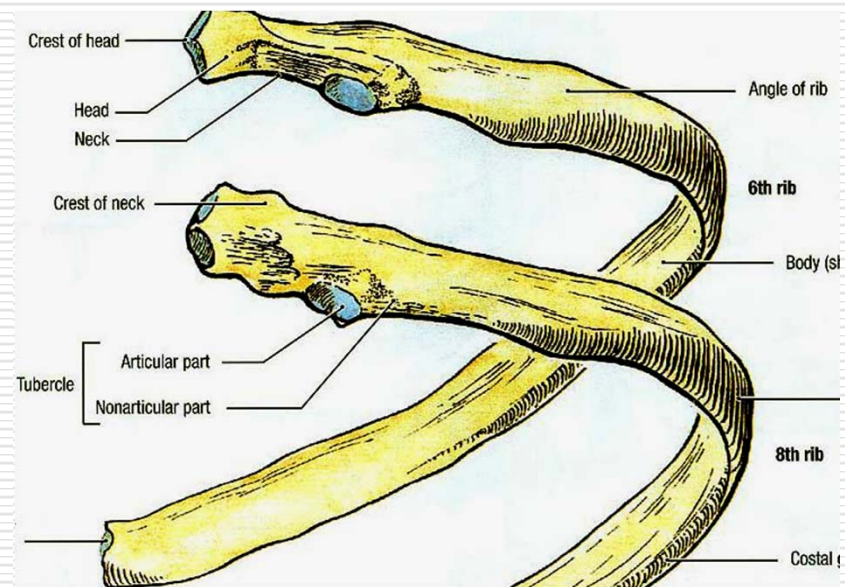
- The first, eleventh and twelfth ribs are atypical
- A typical rib has a head, a neck and a shaft.
 - The shaft slopes down and laterally to an angle and then curve forward
 - The upper border is blunt and lateral to the angle the lower border form a sharp ridge sheltering a costal groove
 - This feature identify right from left ribs



Surgical anatomy

The Rib

- Typical rib:
 - The head:
 - Bevelled by two articular facets that slope away from a dividing ridge.
 - The lower one is vertical and articulate with the upper border of its own vertebra
 - The upper facets faces up and articulate with the lower border of the vertebra above
 - Each form a synovial joint separated by a ligament attached to the ridge



Surgical anatomy

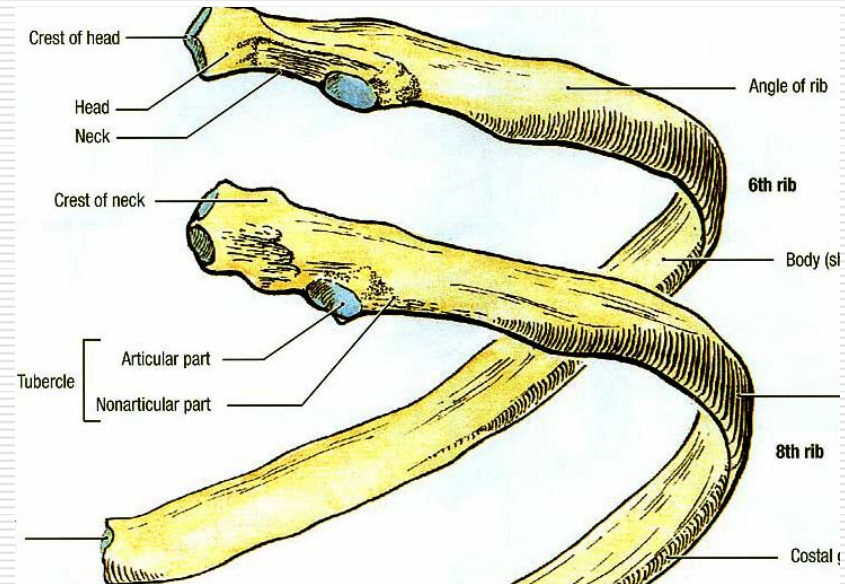
The Rib

■ The neck:

- Is flattened with its upper border curving into a thin, prominent ridge, the crest

■ The tubercle:

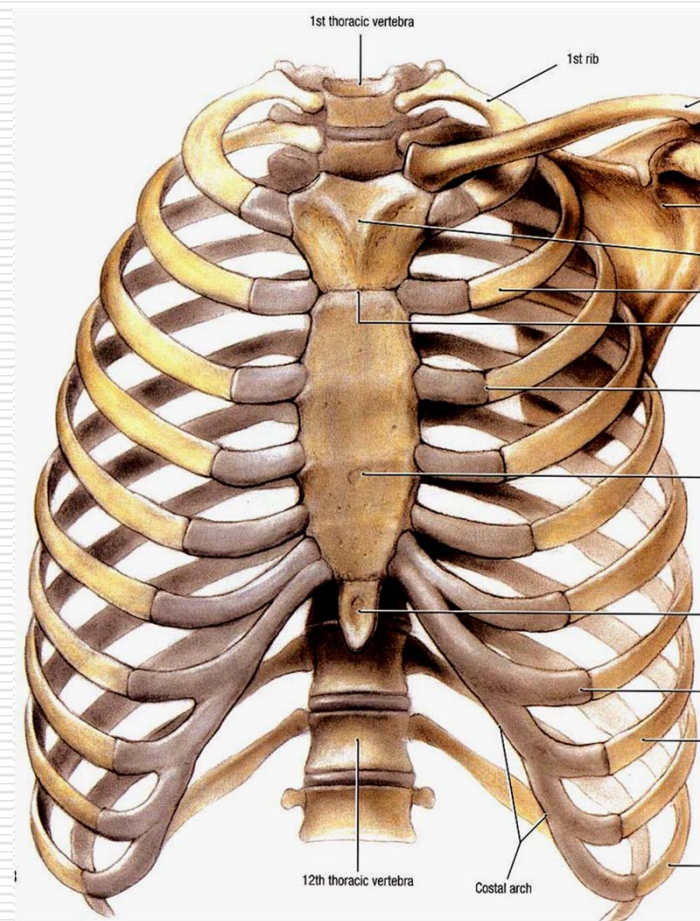
- Shows two small facets lying medial and lateral
- The medial one is covered with hyaline cartilage and form synovial joint with the transverse process of its vertebra
- The lateral facet is smooth surfaced and receive the costotransverse ligament



Surgical anatomy

The Rib

- **Costal cartilages:**
 - They form a primary cartilaginous joints at the extremities of all twelve ribs
 - The first is short and articulate with the manubrium and the clavicle
 - They increase in length below and the seventh has the longest.
 - They are bend from a downward slope with the rib to upward slope toward the sternum



Surgical anatomy

The Rib

□ Rib harvesting:

- Indicated for costochondral graft to restore pseudoarticulation of the TMJ, or to replace a missing part of the anterior mandible to reconstruct a functional articulation
 - The rib is usually 5th or 6th typical one
 - Incision is placed in the infra-mammary crease, to hide the scar
-

Surgical anatomy

The Rib

- Right rib is always preferred because:
 - It could be contoured to fit either side of the mandible or facial bones
 - Postoperative pain is less likely to be confused with cardiogenic pain
 - The 6th rib is where the distal origin of the pectoralis major muscle, dissection transect the muscle minimally
 - Sharp dissection is carried through full thickness of skin, subcutaneous tissues and the muscle, to expose the rib periostium, the chest wall cortex
-

Surgical anatomy

The Rib

- The periosteum is incised from 1 cm onto the rib cartilage to the full desired length, the anterior border of the latissimus dorsi muscle, about 12 cm.
 - Reflected carefully from the chest wall cortex around the inferior and superior rib edges to the pleural cortex periosteum, using a maxillofacial surgery periosteal elevator rather than Doyen rib stripper
-

Surgical anatomy

The Rib

- This is to avoid creating pleural tear, because of the irregularities and bony projection to which periosteum and lung pleura are firmly attached, leading to pneumothorax
 - A releasing incision made at right angle to the rib incision carried to the rib edges help in reflecting the perichondrium and gaining access to the cartilage
-

Surgical anatomy

The Rib

- The cartilage is separated first by scalpel blade and the proximal part is cut with a saw or rib cutter after lifting the rib and carefully separating any adherent periosteal membrane from the pleural cortex
 - The closure is layered, periostium, subcutaneous tissue, dermis and lastly skin
 - Drain is not necessary
-

Surgical anatomy

The Rib

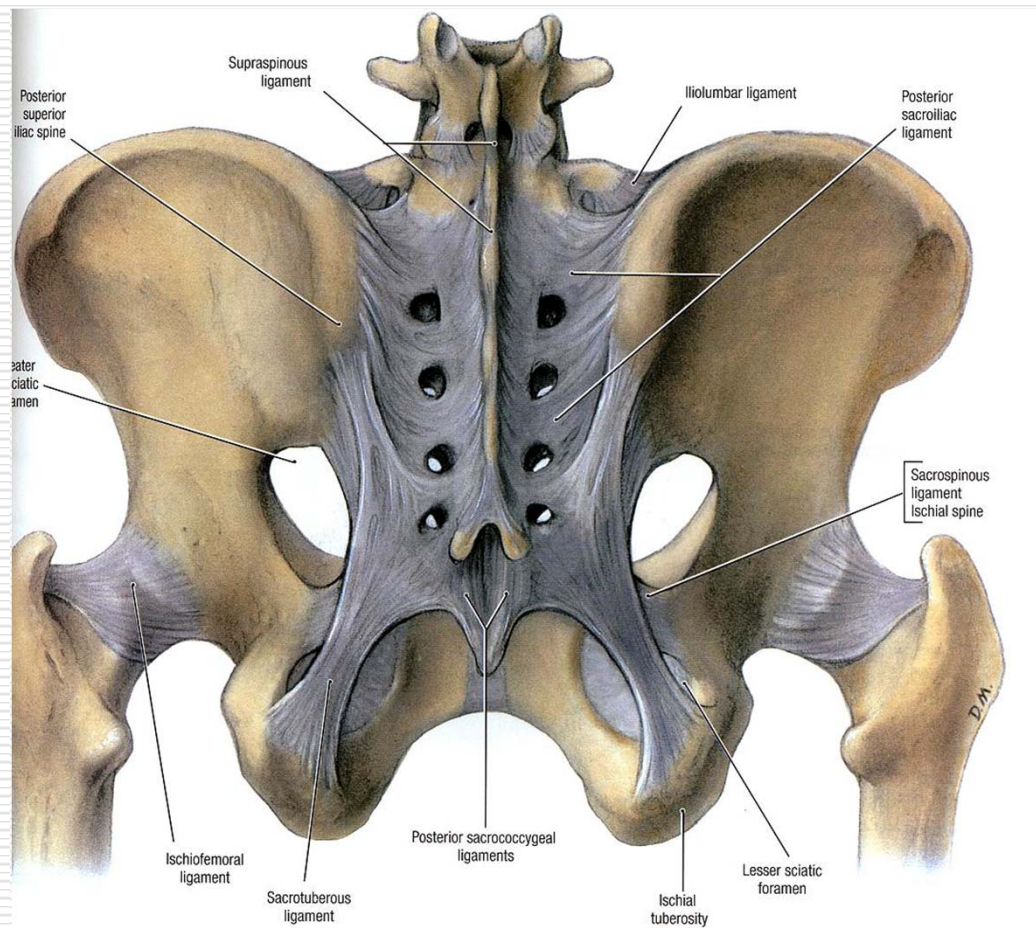
- The length of the cartilage is related to the growth of the graft not to the prevention of bony ankylosis
 - Disadvantages:
 - Longer length create a longer lever arm, promoting separation (2-3 mm)
 - Associated with overgrowth
 - Incorporation of the perichondrium or periosteum sleeve, in the graft does not enhance survival or stability of the graft
 - In children the cartilage is easily separated from bone, sleeve reduce the chance of separation
 - In adult the cartilage is firmly incorporated to bone
 - Increases the probability of pneumothorax
-

Surgical anatomy

The Rib

- It is recommended, a 2 – 3 mm of cartilage length without adherent periostium of perichondrium for both costochondral growth grafts in children and articulation graft in adult
-

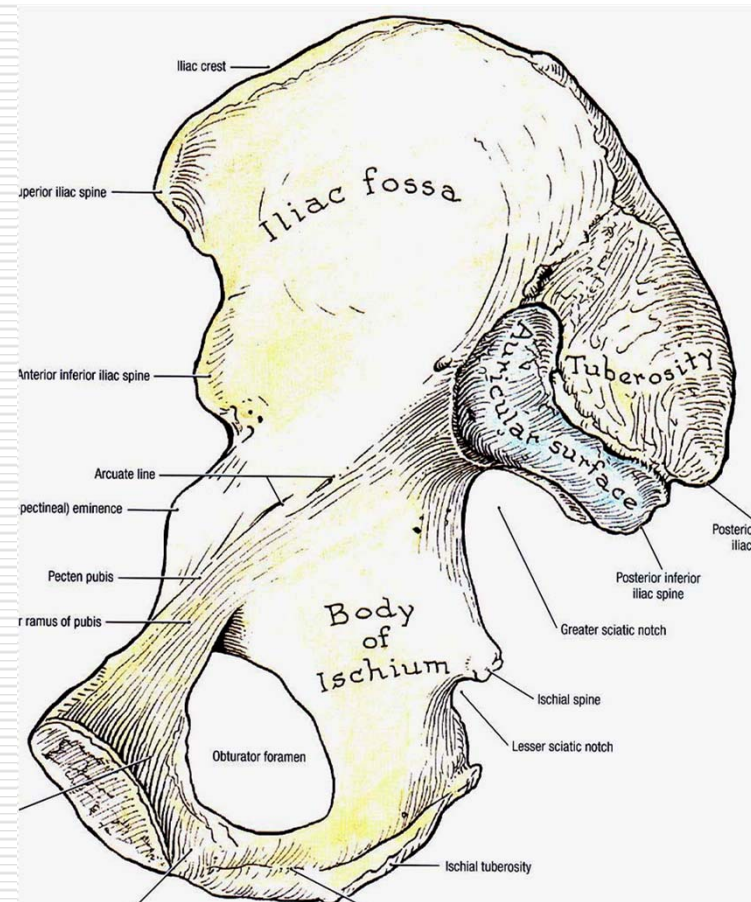
The Iliac crest



Surgical Anatomy:

Iliac crest

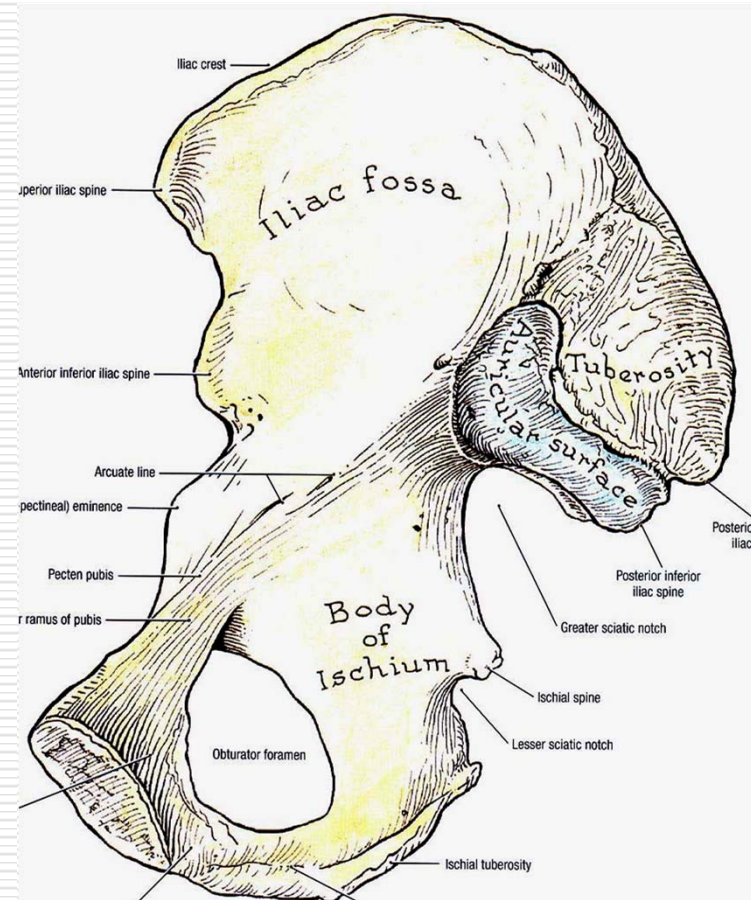
- Hip Bone:
 - Made of three bones fused in a Y-shaped epiphysis involving the *acetabulum*, (hip joint socket), a concave hemisphere,
 - **Pubis** and **ischium** form incomplete bony wall for pelvic cavity, their outer surface gives attachment to the thigh muscles
 - The **ilium** forms a brim between the hip joint and the joint with the sacrum



Surgical Anatomy:

Iliac crest

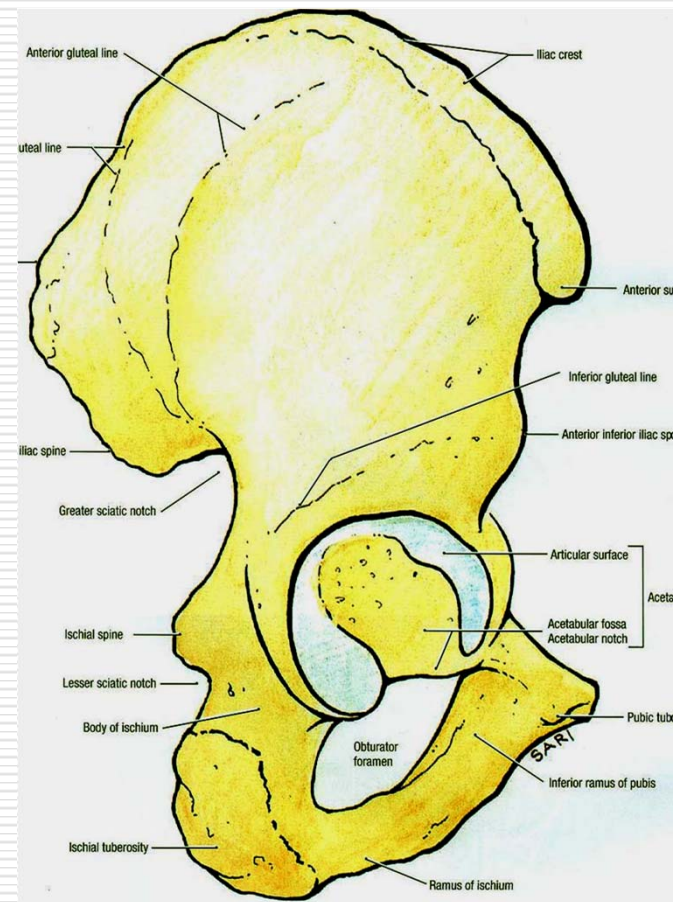
- The anterior 2/3 is thin bone forming the iliac fossa, posterior abdominal wall
- The posterior 1/3 is thick bone and carries the articular surface for the sacrum
- The ilium is nearly at right angle to the other two bones



Surgical Anatomy:

Iliac crest

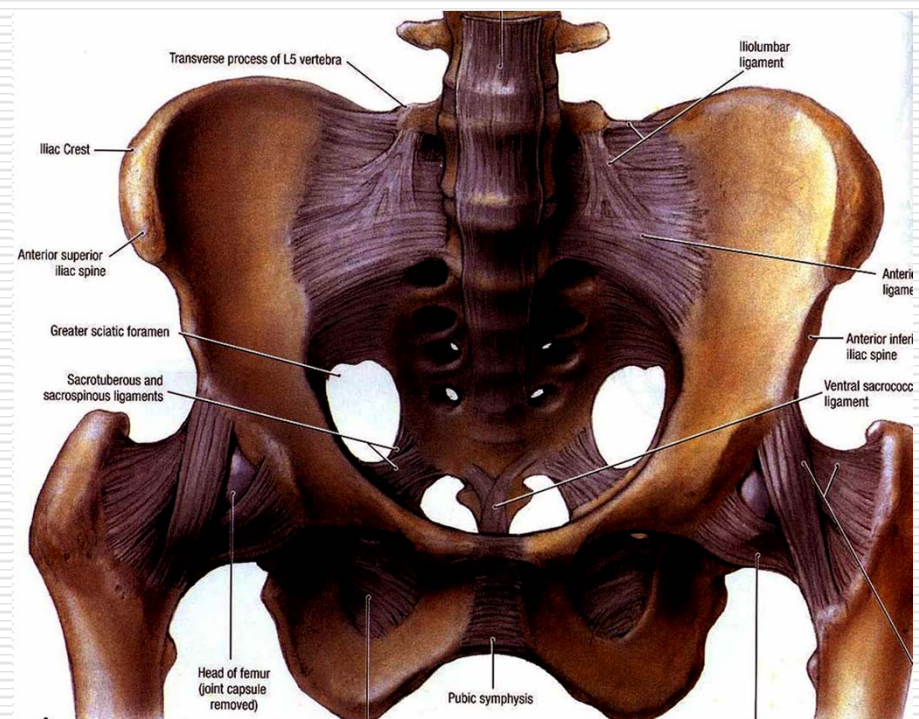
- The outer surface rises wedge-shaped along an anterior border to the anterior superior iliac spine
- Behind the acetabulum, it passes up as a thick bar of weight-bearing bone and curve back to the posterior superior iliac spine
- It is the attachment of the muscles of the buttock, Gluteus minimus, medius and maximus



Surgical Anatomy:

Iliac crest

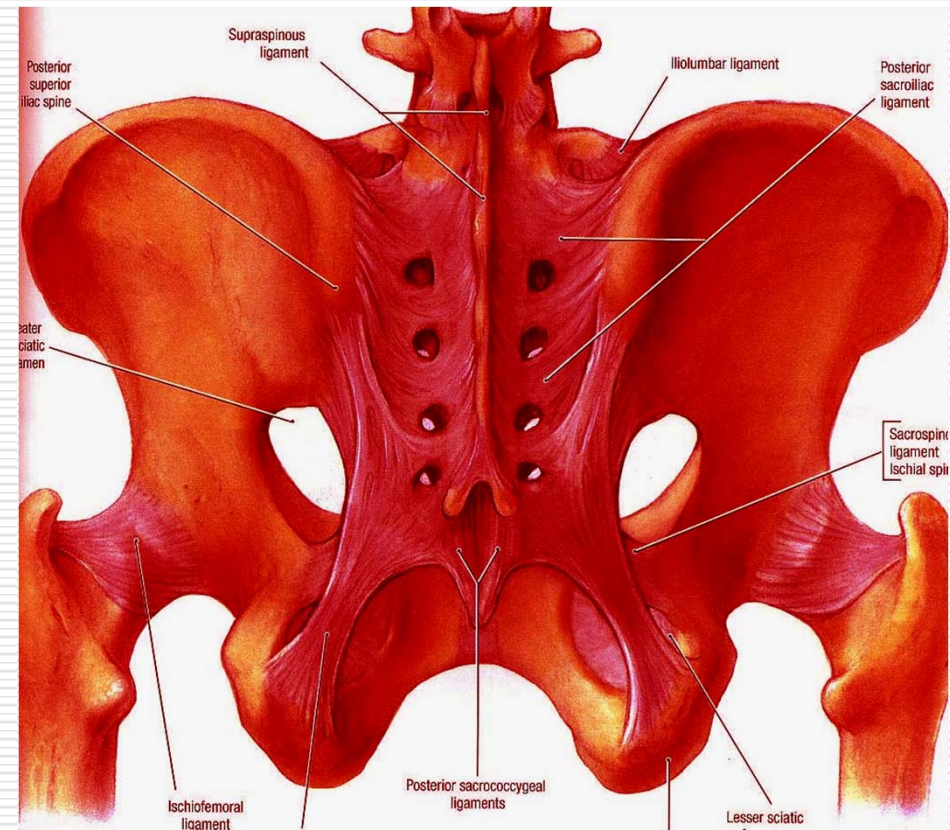
- The upper border between the anterior and posterior superior iliac spines, the iliac crest, has a bold upward convexity and curve from front backward in a sinuous bend
- The anterior part is curved outwards and its external rim has a more prominent convexity behind the anterior superior iliac crest spine, the iliac tubercle



Surgical Anatomy:

Iliac crest

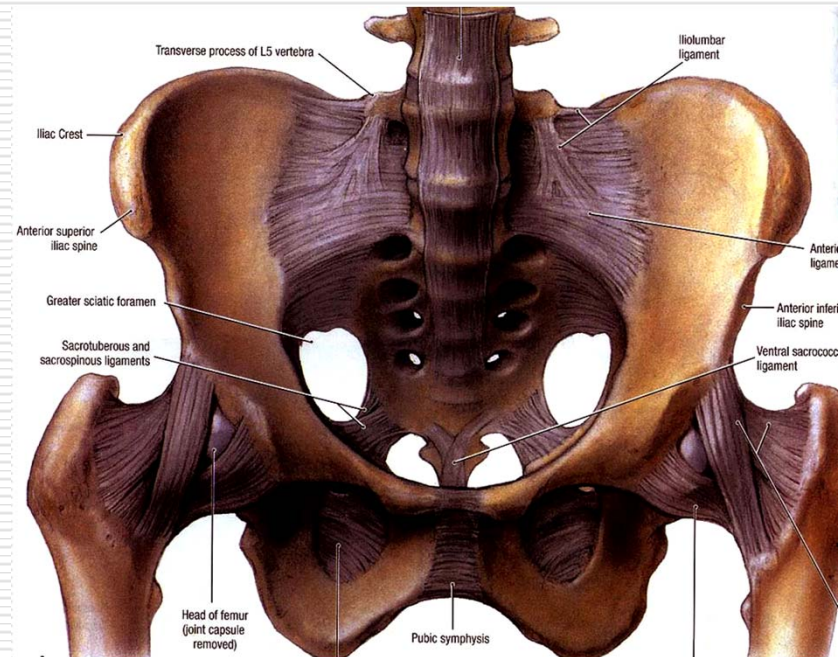
- The gluteal surface:
 - Convex in front, concave behind, conforming to the curvature of the iliac crest
- The anterior border:
 - Shows a gentle S-shaped bend
 - Sartorius muscle is attached a finger breadth below the anterior spine
- The posterior part of the crest is thicker than the rest



Surgical Anatomy:

Iliac crest

- The inner surface:
 - The iliac fossa, shows a gentle concavity and is paper thin in it's deepest part
 - The lower 2/3 is bare bone
 - The iliacus muscle and fascia are attached to the inner lip of the crest over the whole area



Surgical Anatomy: Iliac crest

□ Bone harvesting:

- The lateral approach to the anterior ilium affect the gait the most
 - The medial anterior approach involve the large iliacus muscle which is not necessary for normal gait but large medial haematoma might produce gait disturbances
-

Surgical Anatomy: *Iliac crest*

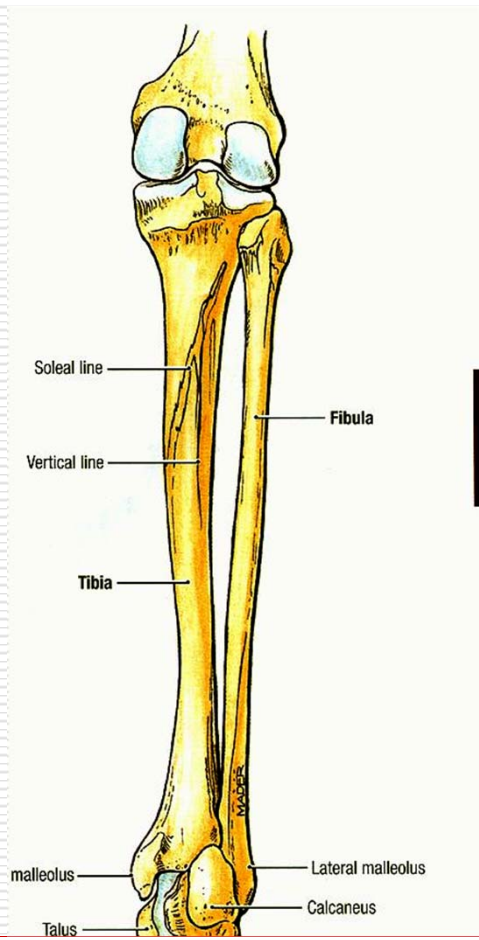
□ Surgical access:

- Incision should be placed 1 cm posterior to the anterior superior spine and extend to the iliac tubercle
 - It should be placed lateral to the bony prominence to prevent irritation by tight cloths or belt
 - Proceed down to bone medial to the muscles, tensor fascia lata and gluteus medius and lateral to the iliacus and the external abdominal muscles
-

Surgical Anatomy: *Iliac crest*

- Cancellous bone is available in the anterior ilium within the upper 2 – 3 cm and between the tubercle and the anterior superior spine, *Iliac crest graft*.
 - “Trap door” is one of the most common osteotomy used for anterior ilium harvest
 - During closure, strict attention should be followed in order to reorient and reposition the muscles in their original positions
 - A drain is required to because of the dead space and should be placed within the bony cavity
-

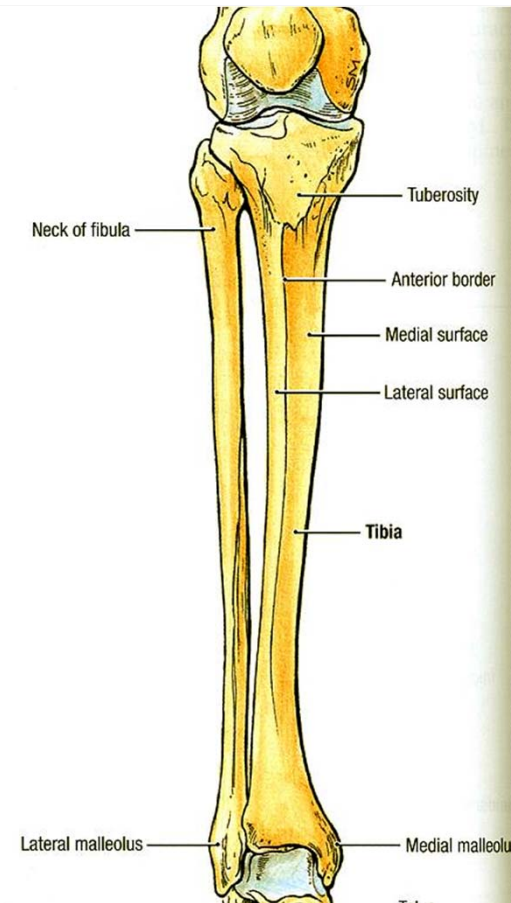
The tibia



Surgical Anatomy:

The tibia

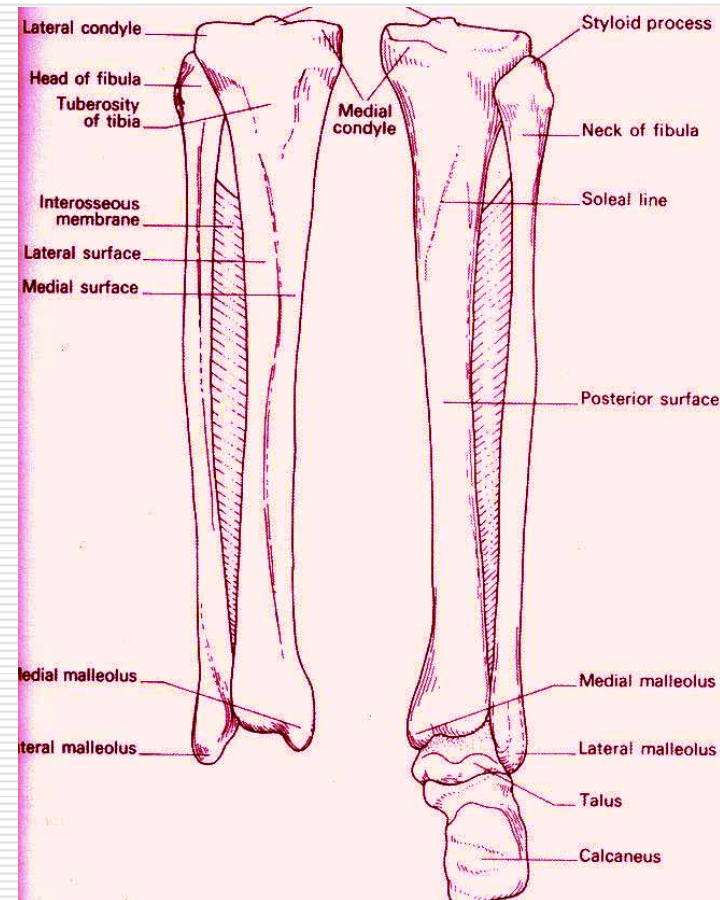
- Is the largest and medial bone of the lower leg, has a large upper end and a smaller lower one
- The shaft is vertical and triangular in cross-section
- Its anterior and posterior borders with the medial surface between them are *subcutaneous*



Surgical Anatomy:

The tibia

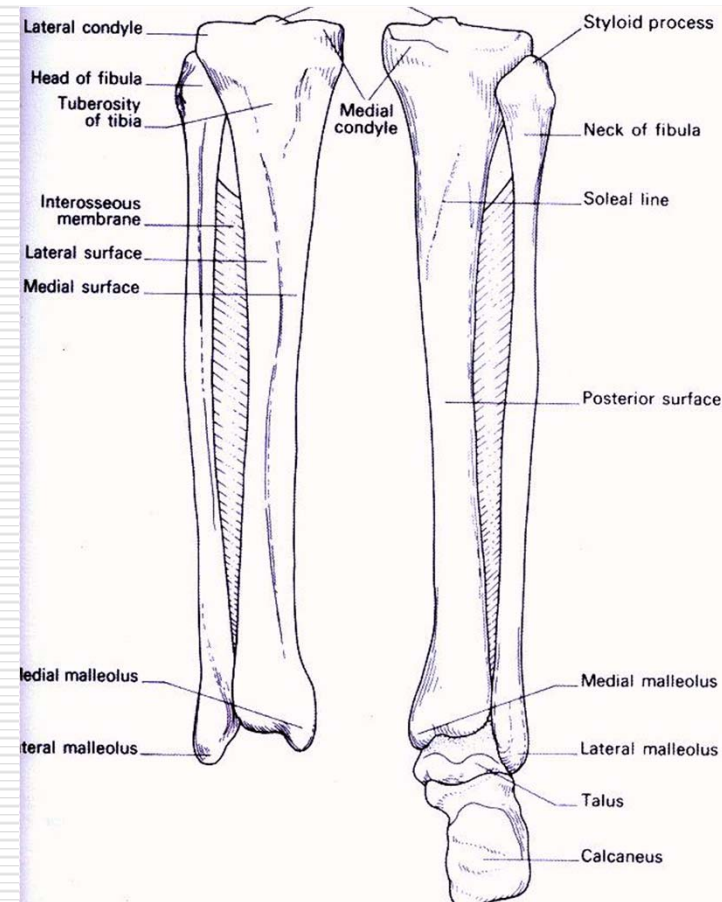
- The anterior border is sharp above and blunt below where it continues with medial malleolus
- The posterior border is blunt and runs down into the posterior border of the medial malleolus
- On the fibular side it has a sharp interosseous border



Surgical Anatomy:

The tibia

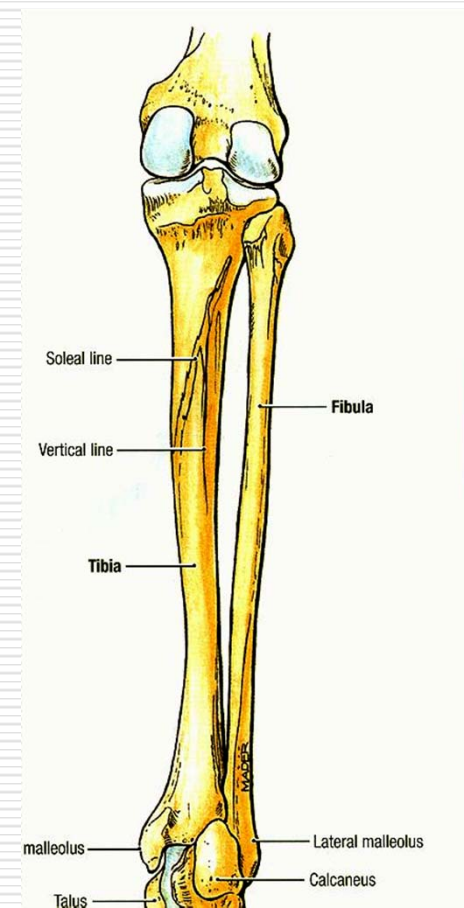
- The upper end:
 - Expand widely with prominent tuberosity projecting anteriorly from its lower part
 - The surface bone is a very thin compact-type which is fragile around the margins



Surgical Anatomy:

The tibia

- The superior articular surface or plateau shows a pair of condylar concavity to articulate with meniscus and the condyle of the femur
- Between the condylar surfaces, the plateau is elevated into intercondylar eminence and grooved by the medial and lateral tubercles

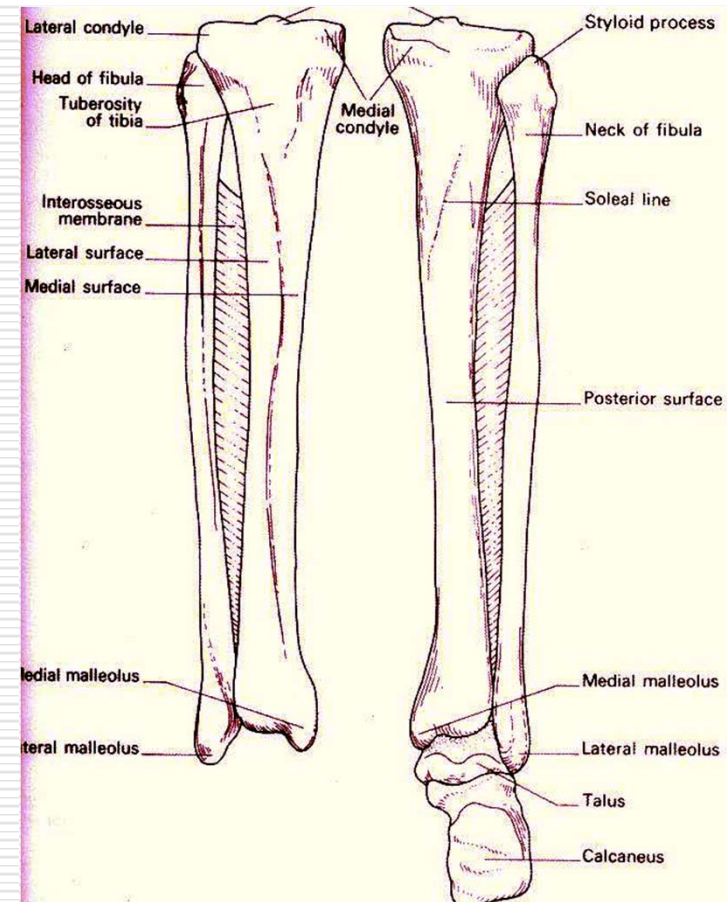


Surgical Anatomy:

The tibia

- The lower end:
 - Is rectangular in section
 - Medially, it is subcutaneous, anteriorly, it is bare bone
 - Laterally, the surface is triangular and articulate with the fibula

- *The extensive subcutaneous surface of the tibia makes it an accessible donor site for bone grafts*



Surgical Anatomy: *The tibia*

Bone harvesting:

- The tibial plateau is an excellent reservoir for cancellous bone
 - It can provide up to 40 cc of bone without affecting the structural support of the tibia
 - Indication:
 - Small bony defects
 - **Non-union,**
 - **Osteotomy defects**
 - **Dentoalveolar defects**
 - **Sinus lift procedure**
-

Surgical Anatomy: *The tibia*

- Surgical access:
 - Could be done under local anaesthesia and conscious sedation
 - Incision over the lateral tubercle best accomplished by flexing the leg at the knee joint
 - It is 6 – 10 mm from the skin and dissection is made through the thin subcutaneous tissue
 - Sharp dissection to reflect the tensor fascia lata band and make 1 cm opening into the cortex and the cancellous bone could be harvested lateral and inferior to the midline to avoid damage to the knee
-