Systematic Anatomy
(For international students)

Department of Anatomy, Fudan University

Teaching contents

Introduction to anatomy
Introduction to locomotor system
General description of osteology and arthrology
Bones of the trunk

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Something before the class

◆ 16 weeks, Twice each week (8:55 to 11:35 on Mon & Fri)
◆ If you are absent please write the note to ask for leave in advance.
◆ Each lecture will be recorded by video camera, the students who are late for class have to enter the lab from back door. Don’t knock the front door during the lecture.
◆ Keep models & specimens in good condition during class.
◆ Keep clean. on duty, group by group.
◆ Words labeled red are important content.
◆ Each time, the monitor will record the persons who are late and absent for class.
◆ Twice exam. Mid-exam (in 8th week) (30%) – Final-exam (70%). Written exam and specimen identification.
What is anatomy?

- The word “anatomy” derived from the Greek, means “cut up”. means observe the cut opened cadaver in the naked eye.

- Human Anatomy is the science dealing with morphology and structures of normal or healthy human body (not patients).

- The main task of this subject is that students need to know the shapes & structure, the arrangements and relationship, the law of development and basic function of the organs in human body.

- It also is a visual subject: ideally, you need to see, touch and feel to get an idea of three dimensions.
Importance of human anatomy in clinic

◆ Anatomy is one of the most important basic courses in medical science.
◆ It is a bridge course from bench to bed.
◆ It is like the base of tall building, root of big tree.
◆ As long as you mastered the normal structure and to know how to tell what the abnormal is.
Human Anatomy

Systematic Anatomy (nine systems)
Learned in this semester

Regional Anatomy (nine regions)
Learned in next semester

Cadavers will be dissected by you.
The systems of the human body

Locomotor system

Skeleton  muscle

Attention please: skeleton means bones and their joints
Systems in human body

Alimentary (digestive) system
Respiratory system
Urinary system
Reproductive system

Male
Female
Divisions of the body (regionally)

- Head
- Neck
- Throax
- Abdomen
- Back
- Pelvic
- perineum
- Upper limbs
- Lower limbs
The classification of anatomy

- **Sectional anatomy**
- **X-ray anatomy**
- **Surface anatomy**
- **Children anatomy**

- Surgical anatomy; Clinical anatomy
- Nursing anatomy; Nervous anatomy
- Dance anatomy; Swimming anatomy etc.
Common language in study of anatomy

Anatomical position
Terms of the direction
Anatomical axis and planes
Anatomical position

- The body is upright
- Eyes looking forward
- Upper limbs hanging on each side of the body
- Palms facing forward
- Heels getting together
- Big toes facing forward

All descriptions of the human body and movement start in anatomical position. This anatomical position is adopted globally for anatomicomedical description.
Terms of the direction

- Superior (cranial, above) - closer to the head
- Inferior (caudal, below) - closer to the feet
- Anterior (ventral, front) - closer the front of the body
- Posterior (dorsal, back) - closer the back of the body
- Interior - nearer to the center
- Exterior - farther from the center
- Medial (center) - closer the imaginary midline
- Lateral - closer to the side of the body
Terms of the direction

- Plantar - the sole of the foot
- Palmar - the palm of the hand
- Proximal - closer to the trunk
- Distal - farther from the trunk
- Superficial - above another part
- Deep - below another part
- Ipsilateral - on the same side
- Contralateral - on the opposite side
Anatomical axis - Imaginary or virtual

Coronal axis - from left to right
Vertical axis - from head to feet
Sagittal axis - from ventral to dorsal
Anatomical planes

1 - Sagittal plane
Left & right parts.

1a - Median Sagittal plane
(equal two halves).

2 - Coronal planes
(or frontal plane).
Ant. & post. parts

3 - Horizontal plane (or transverse plane)
Sup. and inf. parts

Each of these three kinds of planes is at right angle to the other two planes.
Sagittal p  Horizental P  coronal p
How to learn anatomy?

- Reading the textbook (before & after class)
- Learn the important vocabulary by heart
- Observe model, specimen & pictures or atlas carefully
- Each guy is a living specimen or model; Such as: Joint movement, pupil, cornea, bone marking etc.
- Repetition: Read it, Hear it, See it, Say it, Draw it; then do it again.
- The cadaver also is your teacher without language.
- Use of web resource fully (google-photo, video)
- Observe cadaver; Active and brave, not afraid of odd.
- Group discussion, no pains, no gains
Recommended related books and atlas

1. Netter's Atlas of Human Anatomy
2. Clinically Oriented Anatomy
3. Grant's Dissector
4. Gray's Anatomy: The Anatomical Basis of Clinical Practice
5. Grant's Atlas of Anatomy
Better atlas of anatomy (bilingual)
Locomotor System
Introduction-constitution

Osteology-bones
As framework
Arthrology-joints
As axis
Myology-muscles
As motivation

These functions are regulated by nervous system. Muscular markings can provide the reference for the clinical practice, such as incision, acupuncture and forensic medicine.
General Introduction to the bone

- Bone – 206 in adult, more than 206 in infancy, 1/5 body weight in adult, 1/7 in newborn.
- Each bone is a living organ, with hardness and elasticity, metabolism, growth & development, healing.
- After injured - repair and reconstruction.
- Many factors can affect the development of the bone, such as age, heritage, nutrient, exercise and etc.
Classification of bones

According to position

Cranial bones
Bones of the trunk
Axial skeleton
Bones of the limbs
Appendicular skeleton

Yellow ones
pink ones
Classification of bone according to shape

1. Long
2. Short
3. Flat
4. Irregular
5. Sesamoid
Long bone

Located in limbs
1 body, 2 ends (epiphysis)

- Epiphysis
- Articular surface (Articular cartilage)
- Metaphysis
- Diaphysis (shaft)
- Medullary cavity
- Epiphyseal cartilage
- Epiphyseal line (after in adult)
Epiphyseal line

In adult

Epiphyseal cartilage in child at 7 year old
Classification of bone

**Short bones:**
cube-shaped seen in wrist and ankle

**Flat bones:**
Thin, lamella, such as rib, skull, scapula etc

**Irregular bones:**
irregular or mixed shape, e.g. vertebrae, pneumatic bones

**Sesamoid bones:**
developed within tendon
# Meanings of bone markings

<table>
<thead>
<tr>
<th>Bone marking</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Linear elevation</strong></td>
<td></td>
</tr>
<tr>
<td>line</td>
<td>Sup.nuchal line of the occipital bone</td>
</tr>
<tr>
<td>Ridge</td>
<td>The medial and lat. supracondylar ridges of the humerus</td>
</tr>
<tr>
<td>crest</td>
<td>The iliac crest of the hip bone</td>
</tr>
<tr>
<td><strong>Rounded elevation</strong></td>
<td></td>
</tr>
<tr>
<td>tubercle</td>
<td>Pubic tubercle</td>
</tr>
<tr>
<td>protuberance</td>
<td>External occipital protuberance</td>
</tr>
<tr>
<td>tuberosity</td>
<td>Greater &amp; lesser tuberosities of the humerus</td>
</tr>
<tr>
<td>malleous</td>
<td>Med.malleolus of the tibia, lat.malleolus of the fibula</td>
</tr>
<tr>
<td>trochanter</td>
<td>Greater and lesser trochanters of the femur</td>
</tr>
</tbody>
</table>
## Meanings of bone markings

<table>
<thead>
<tr>
<th>Bone marking</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sharp elevation</strong></td>
<td></td>
</tr>
<tr>
<td>Spine of spinous process</td>
<td>Ischial spine, spine of vertebra</td>
</tr>
<tr>
<td>Styloid process</td>
<td>Styloid process of temporal bone</td>
</tr>
<tr>
<td><strong>Expanded ends for articulation</strong></td>
<td></td>
</tr>
<tr>
<td>Head</td>
<td>Head of humerus, head of femur</td>
</tr>
<tr>
<td>Condyle</td>
<td>Med. and lat. condyles of femur</td>
</tr>
<tr>
<td>Epicondyle (a prominence situated just above condyle)</td>
<td>Medial and lateral epicondyles of femur</td>
</tr>
<tr>
<td><strong>Small flat area for articulation</strong></td>
<td></td>
</tr>
<tr>
<td>Facet</td>
<td>Facet on head of rib for articulation with vertebral body</td>
</tr>
</tbody>
</table>
### Meanings of bone markings

<table>
<thead>
<tr>
<th>Bone marking</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fossa</strong></td>
<td>Olecranon fossa of humerus. Acetabular fossa of hip bone</td>
</tr>
<tr>
<td><strong>Depressions</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Notch</strong></td>
<td>Greater sciatic notch of hip bone</td>
</tr>
<tr>
<td><strong>Groove or sulcus</strong></td>
<td>Bicipital groove of humerus</td>
</tr>
<tr>
<td><strong>Openings</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Fissure</strong></td>
<td>Superior orbital fissure</td>
</tr>
<tr>
<td><strong>Canal</strong></td>
<td>Carotid foramen of the maxilla</td>
</tr>
<tr>
<td><strong>Meatus</strong></td>
<td>Exteranl acoustic meatus of temporal bone</td>
</tr>
</tbody>
</table>
Structure of bone-summary

**Substance**
- Compact bone: hard & dense
- Spongy bone

**Membrane**
- Periosteum
- Endosteum

**Bone marrow**
- Red bone marrow; cavity. hemopoiesis (blood making)
- Yellow bone marrow: rich in fat

**Blood vessel** (nutrient artery, nutrient foramen),
**Nerve**: sensory etc
Structure of bone

1-Articular cartilage
2-Epiphyseal line
3-Spongy bone (trabeculae)
4-Compact bone
5-Periosteum
6-Medullary cavity
7-Bone marrow (yellow)
8-Nutrient vessel

Fresh bone

Dry bone
Arterial supply of the bone

Three types
Nutrient artery (shaft)
Metaphyseal artery
Epiphyseal artery

Different arteries interconnect

If the bone lose the blood supply, the necrosis will occur.
Chemical component and physical character of bone

Inorganic: calcium, phosphate etc.
Make bone with hardness & rigidity

Organic: collagen, protein polysaccharides
Make bone with elasticity & toughness

In child: organic : inorganic = 5:5
In adult: organic : inorganic = 3:7 just right
In the old: organic : inorganic = 2:8

As the age increases:
Organic decrease; but inorganic increase, hardness increase.
In child: less fracture & easy to deform
In the old: easily fracture

Decalcified bone - remove inorganic- soft.
Burned bone - remove organic- brittle.
Femur – fracture and fixation

Dislocation

Fracture

After one fixation operation
Function of the bone

◆ Support  framework of the body
◆ Protection - brain, spinal cord, vital internal organs
◆ Movement
◆ Hemopoiesis (Blood cell formation)
  red bone marrow
◆ Storage of fat - yellow bone marrow
◆ Mineral and fat reservoir - Ca, P, K, etc
Arthrology (Joint)

General description of arthrology
Classification of joints

Articulating bones joined by

Synarthrosis (Immovable joints)

- Synostosis (骨性连结)
- Suture (缝连结)
- Syndesmosis (韧带连结)
- Gomphosis (嵌合)

Cartilaginous joint

- Synchondroses (软骨连结)
- Synphysis (骨愈合)

Diarthrosis (Freely movable joints)

- Synovial joints
  - Uniaxial joints
  - Biaxial joints
  - Multiaxial joints
## Classification of joints

<table>
<thead>
<tr>
<th>Classification</th>
<th>Structure</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fibrous joints</td>
<td>Articulating bones joined by fibrous connective tissue</td>
<td>● Sutures of the skull</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● Tibia –fibula and radial ulna joints</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● Teeth in socket</td>
</tr>
<tr>
<td>Cartilaginous joints</td>
<td>Articulating bones joined by fibrocartilage or hyaline cartilage</td>
<td>● Intervertebral joints</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● Pubic symphysis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● Sacroiliac joint</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● Epiphyseal plates</td>
</tr>
<tr>
<td>Synovial joints</td>
<td>Joint capsule containing synovial membrane and synovial fluid</td>
<td>● All freely moveable joints; most of the joints of the limbs</td>
</tr>
</tbody>
</table>

Learn it by yourself
Synarthrosis - Fibrous joint

Fibrous joint - united by fibrous CT

Feature:
- Without cavity
- A little or no movement

Sutures

Gomphoses

Syndesmoses

Interverebral disc
Interspinal lig
Synarthrosis - Cartilaginous joints

The bones are united by cartilage

Synchondrosis
By hyaline cartilage

Symphysis by fibrous cartilage

Metaphyseal cartilage

Symphysis pubis
Synarthrosis - synostosis

In the aged, the bones are united by the ossification of the fibrous joint or synchondroses between them. e.g., the synostoses between the ilium, ischium and pubis of the hip bones.
Diarthrosis — synovial joints

Essential structures

◆ Articular surface:
  Articular cartilage

◆ Articular capsule
  Fibrous membrane
  Synovial membrane

◆ Articular cavity
  Synovial fluid
  Negative pressure

It is the most important type of all the joints.
Accessory structures of synovial joints

◆ Ligaments (lig.)
  Extracapsular lig.
  Intracapsular lig.

◆ Articular disc (meniscus)
Accessory structures of synovial joints

1. Articular labrum
2. Synovial fold
3. Synovial bursa

Shoulder joint (cut open)

Draw a picture
Classification of synovial joints

◆ Uniaxial joints （单轴关节）
  Hinge joints (屈戌关节或滑车关节)
  Trochoid (pivot) joints (车轴关节)

◆ Biaxial joints （双轴关节）
  Ellipsoid joints
  Saddle joints

◆ Multiaxial joints （多轴关节）
  Ball-and-socket joints （球窝关节）
  Plane joints （平面关节）
The types of the synovial joints

- Plane joints
- Trochoid joint (Pivot joint)
- Sellar joint (shaddle joint)
- Ellipsoid joint
- Ball and socket joint
Terms of joint movements

1. Coronal axis flexion and extension
2. Sagittal axis adduction and abduction
3. Vertical axis – rotation
   - Medial rotation (Pronation)
   - Lateral rotation (Supination)
   - Inversion & eversion
4. Three axis-Circumduction
5. Translation
Structural classification of joints and examples, all synovial joints are freely movable

Learn it by yourself

<table>
<thead>
<tr>
<th>Movements at synovial joints</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexion</td>
<td>Decreasing the angle between two bones</td>
</tr>
<tr>
<td>Extension</td>
<td>Increasing the angle between two bones</td>
</tr>
<tr>
<td>Abduction</td>
<td>Movement away from the midline of the body</td>
</tr>
<tr>
<td>Adduction</td>
<td>Movement toward the midline</td>
</tr>
<tr>
<td>Rotation</td>
<td>Movement of a bone around its own axis</td>
</tr>
<tr>
<td>Pronation</td>
<td>Rotation of the forearm that results in the palm directed backward</td>
</tr>
<tr>
<td>Supination</td>
<td>The opposite rotation to pronation</td>
</tr>
<tr>
<td>Circumduction</td>
<td>Circular, cone-like movement of a body segment</td>
</tr>
</tbody>
</table>
Learn it by yourself

Flexion

Extension
Learn it by yourself

Abduction
abduction
circumduction
Pronation
supination
eversion
inversion
Petrusion
Protrusion
Elevation
Depression
The bones of the human body

According to position

1 Cranial bones  29
2 Bones of trunk  51
Axial bones

3 Bones of upper limbs  64
4 Bones of lower limbs  62
Appendicular bones
In adult

Vertebrae 26
  Cervical 7
  Thoracic 12
  Lumbar 5
  Sacrum 1
  Coccyx 1

Sternum 1

Rib 24

In children
  Sacrum 5
  Coccyx 4
General feature of a typical vertebra

1 body, 1 arch and 7 processes

1 Vertebral body – ant. wall
1 Vertebral arch – post. wall
7 Process – 2 Upper articular processes
2 Lower articular processes
2 Transverse processes
1 Spinous process

Lumbar Vertebrae

Superior v

55 lateral
General features of typical vertebrae

1 - Pedicle of vertebral arch
2 - Sup & inf. vertebral notch
3 - Lamina of vertebral arch
4 - Vertebral foramen
   Vertebral canal
5 - Intervertebral foramen
Characteristics in cervical vertebrae

1-Transverse foramen: vertebral artery
2-Spinous processes: short & bifid small
3-Vertebral body:
4-Vertebral foramen: triangular
5-Transverse processes: short & bifid
6-Articular processes: horizontal

1
2
3
4
5
6

vertebral artery

3-6th cervical vertebrae

superior

lateral

57
Special cervical vertebrae-C1, C2, C7

C1 – Atlas; No Body & spinous process, ant. & post. arches two lateral masses, groove for vertebral artery (1)

C2 - Axis; Distinguished by dens, which articulates with dental fovea of anterior arch of atlas.

C7 - Vertebra prominens: contains long and non-bifid spinous process, it is visible with neck flexed, used as clinical landmark.
Characteristics in thoracic vertebrae

1- Superior & inferior costal fovea
2- Transverse costal fovea
3- Articular processes: coronal position (sup. & inf.)
4- Spinous processes: long, downward obliquely
5- Vertebrae Body: heart-shape
6- Vertebral foramen: Smaller, round
Lumbar vertebrae

Larger size

1-Spinous processes: horizontally
2-Articular processes: sagittal
3-Vertebral body:
larger, kidney-shape
4-Vertebral foramen:
larger & triangular
5-Transverse processes: long
Posterior surface
1 - Median sacral crest
2 - Post. sacral foramina
   (4 pairs),
3 - Sacral hiatus
4 - Sacral cornu
Lateral part
5 - Auricular surface
6 - Sacral tuberosity

Posterior view

Sacrum and coccyx
5 Sacral vertebrae fuse, Apex-downward, Base-upward

Anterior surface
1-Promontory,
2- Ant. sacral foramina (4pairs)
Sternum

Manubrium

Body of sternum

Xiphoid process

Three portions

Clavicular notch

Jugular notch

Costal cartilage of 1st rib

Manubrium

Sternal angle

(manubriosternal joint)

Transverse ridges

Body of sternum

Xiphisternal joint

Xiphoid process
Sternal angle is an important landmark indicating the order of Rib in clinic, which connects 2nd costal cartilage laterally, and lies opposite lower border of T4 posteriorly.
General features
Ribs 1 ~ 7 - true ribs
Ribs 8~10 - false ribs
Ribs 11~12 - floating ribs
The structure of the ribs

- Costal angle
- Costal groove
- Articular facet of costal head
- Costal tubercle
- Costal neck
- Costal head
- Shaft of rib

Costal cartilage

Bony Framework of Thorax
Anterior view

1st rib
2nd rib
7th rib

Copy Right-Hongqi ZHANG-Department of Anatomy-Fudan University
The knowledge you have to master today

- The systems of human body
- Anatomical position
- Terms of the directions
- Anatomical axis and planes
- Institution and function of locomotor system
- Classification & structure of bones
- The essential structure & movement of synovial joint
- Name, location & number of the bone of the trunk
- The difference of different vertebral bone
- The features of the sternum
- The features of the ribs
The content of next lecture

- The articulations of trunk bone
- Cranial bone and their articulation

Please preview it carefully!
See you next time!
The following is contents (learn by yourself).
<table>
<thead>
<tr>
<th>System</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integumentary system</td>
<td>External support and protection of body; helps maintain body temperature.</td>
</tr>
<tr>
<td>Respiratory system</td>
<td>Rids the blood of carbon dioxide and supplies the blood with oxygen; helps maintain the pH of the blood</td>
</tr>
<tr>
<td>Cardiovascular system</td>
<td>Transport of nutrients to body cells and transport of wastes away from cells</td>
</tr>
<tr>
<td>Skeletal system</td>
<td>Internal support and protection; body movement; production of blood cells</td>
</tr>
<tr>
<td>Lymphatic system/immunity</td>
<td>Drainage of tissue fluid; purifies tissue fluid and keeps it free of pathogens</td>
</tr>
<tr>
<td>Muscular system</td>
<td>body movement, production of heat that maintains body temperature</td>
</tr>
<tr>
<td>Nervous system</td>
<td>regulatory centers for control of all body systems; learning and memory</td>
</tr>
<tr>
<td>Digestive system</td>
<td>breakdown of food and absorption of nutrients into blood</td>
</tr>
<tr>
<td>Urinary system</td>
<td>maintenance of volume and chemical composition of blood</td>
</tr>
<tr>
<td>Endocrine system</td>
<td>secretion of hormones for chemical regulation of all body systems</td>
</tr>
<tr>
<td>Reproductive system</td>
<td>production of sperm and egg; transfer of sperm to female system where development occurs</td>
</tr>
<tr>
<td>Term</td>
<td>Definition (refer to)</td>
</tr>
<tr>
<td>------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Antebrachial</td>
<td>Forearm</td>
</tr>
<tr>
<td>Antecubital</td>
<td>Front of elbow</td>
</tr>
<tr>
<td>Axillary</td>
<td>Armpit</td>
</tr>
<tr>
<td>Brachial</td>
<td>Upper arm</td>
</tr>
<tr>
<td>Cranial</td>
<td>Head</td>
</tr>
<tr>
<td>Cutaneous</td>
<td>Skin</td>
</tr>
<tr>
<td>Deltoid</td>
<td>Shoulder</td>
</tr>
<tr>
<td>Femoral</td>
<td>Thigh</td>
</tr>
<tr>
<td>Frontal</td>
<td>Forehead</td>
</tr>
<tr>
<td>Gastric</td>
<td>Stomach</td>
</tr>
<tr>
<td>Gluteal</td>
<td>Buttocks</td>
</tr>
<tr>
<td>Inguinal</td>
<td>Groin</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumbar</td>
<td>Small of back</td>
</tr>
<tr>
<td>Hepatic</td>
<td>Liver</td>
</tr>
<tr>
<td>Iliac</td>
<td>Hip</td>
</tr>
<tr>
<td>Mammary</td>
<td>Breast</td>
</tr>
<tr>
<td>Nasal</td>
<td>Nose</td>
</tr>
<tr>
<td>Occipital</td>
<td>Back of head</td>
</tr>
<tr>
<td>Orbital</td>
<td>Eye</td>
</tr>
<tr>
<td>Parietal</td>
<td>Crown of head</td>
</tr>
<tr>
<td>Patellar</td>
<td>Kneecap</td>
</tr>
<tr>
<td>Pectoral</td>
<td>Chest</td>
</tr>
<tr>
<td>Pedal</td>
<td>Foot</td>
</tr>
<tr>
<td>Perineal</td>
<td>Pelvic floor</td>
</tr>
<tr>
<td>Plantar</td>
<td>Sole of foot</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Popliteal</td>
<td>Back of knee</td>
</tr>
<tr>
<td>Pulmonary</td>
<td>Lung</td>
</tr>
<tr>
<td>Renal</td>
<td>Kidney</td>
</tr>
<tr>
<td>Sacral</td>
<td>Base of spine</td>
</tr>
<tr>
<td>Temporal</td>
<td>Side of head</td>
</tr>
<tr>
<td>Umbilical</td>
<td>Navel</td>
</tr>
<tr>
<td>Volar (palmar)</td>
<td>Palm</td>
</tr>
<tr>
<td>Scapular</td>
<td>Shoulder blade</td>
</tr>
<tr>
<td>Sternal</td>
<td>Breastbone</td>
</tr>
</tbody>
</table>