

## **Practical – Introduction to medical imaging, gross anatomy and organ systems 1 (skeletal, muscular, nervous, endocrine)**

### **Learning Objectives:**

Demonstrate the anatomical position and the anatomical planes, and use directional terms to describe anatomical relationships.

Identify the anatomical regions of the body, the body cavities, and their organ systems.

Identify skin, fascia, muscles, bones, neurovascular bundles, endocrine organs, and regions of the nervous system, on anatomical models, selected potted specimens, and medical imaging studies.

### **Specimens for stations:**

**Station 1:** torso model UA197, head section models UA198, 198/1; half head models HN AVN1, AVN2

**Station 2:** skeleton (model), torso models UA197/1, UA400; thorax models UA397, 397/1; light box, chest radiograph, 3 microscopes, slide 79 (lung)

**Station 3:** skeleton (model), torso model UA197/2; urinary/reproductive/posterior abdominal wall model UA411; 3 microscopes, slide 66 (stomach); 3 computers for virtual microscopy

**Station 4:** 2 skeletons (models); posterior body wall with spinal cord model UA ANS, ANS/1; upper limb models UA349/1, 349/2; lower limb models UA345/1, 345/2; potted specimen sections of leg and thigh UA75C, 76D, 87, 88; light boxes, shoulder, elbow, hand, foot, knee radiographs

**Station 5:** 2 skeletons (models), skull models (4), vertebral column model UASOS, cervical vertebra with spinal cord model UA235, 235/1, CNS posterior body wall models UA ANS, ANS/1

Note: A selection of radiological images (e.g., radiographs, computed tomography (CT), and magnetic resonance imaging (MRI)) will be available at each station.

### **Before you begin:**

You will find it useful to prepare before the practical class: read through the worksheet and attempt to answer as many of the questions as you can. You can then spend more time examining the resources provided at the practical.

We suggest you work in small groups of 2-4. It would be a good idea for at least one of your small group to bring the Marieb & Hoehn *Human Anatomy & Physiology* text and Weir et al *Imaging Atlas of Human Anatomy* to the practical. The practical is designed for self-directed learning; demonstrators are available to assist you if you have questions or would like to discuss topics further. Answer the questions on this worksheet and examine the resources available at each station. You do not hand in the worksheet at the end of the practical, and we do not provide a list of the answers. Discuss questions with your classmates and the demonstrators during the practical. You should use the worksheet to revise after the practical and in the lead-up to exams (written and applied).

You may start at any station (lab bench), and progress in order (e.g., station 4→5→1→2→3) about every 20 minutes. Please handle models with care, and if you disassemble them, reassemble them when finished, thank you.

At the practical, there will be some cadaveric material, specifically horizontal sections through the upper and lower limbs, preserved in plastic pots. Please treat these human remains with respect, thank you. This is part of your professionalism as a medical student, and is also a legal requirement under the Anatomical Examinations Act 2006, Tasmania, which is 'an Act to make provision for and in relation to anatomical examinations of the bodies of deceased persons, to ensure that such examinations are undertaken with due regard to the dignity of deceased persons.'

Both the regional and systemic approaches to the study of anatomy are valuable, and will be used in the MBBS course. Regional anatomy considers all structures and their relationships in a region of the body. The regions are the head, neck, thorax, abdomen, pelvis, perineum, upper limbs, lower limbs, and back. In contrast, systemic anatomy considers the structure of each individual organ system of the body, which may be located throughout the body, or in a few regions. Today, you'll be studying the skeletal, muscular, nervous and endocrine systems.

The basis for anatomical directional terminology is the anatomical position, which is standing, feet together, and upper limbs at the sides with palms facing forward. Demonstrate the anatomical position. The planes of section and directional terms relate to this position and apply regardless of what position a person assumes.

### **Station 1: Head and neck, magnetic resonance imaging (MRI) vs computed tomography (CT), types of joints**

The head section model illustrates two planes of section – which ones?

Which plane is perpendicular to the two planes of the head section model?

Examine the MRIs and CTs, and determine the plane of section of each.

Determine which of the images are MRIs, and which are CTs. The following can assist you in making this determination:

What colour (black, gray, or white) are the cortex and medulla of bone on CT?  
Why is this? Contrast this with the appearance of bone on MRI.

Compare skeletal muscle and fat on CT. Which is lighter - why? The relative brightness of muscle and fat on MRI can vary.

There are three major structural classifications of joints: fibrous, cartilaginous, and synovial. Which type unites most bones of the skull?

Observe the muscles of facial expression. These are unusual skeletal muscles, in that one of their attachments is to skin. What is their other attachment, and what do muscles usually attach to at both of their ends?

The articulations of the first cervical vertebra with the skull, and the joints between the cervical vertebrae, collectively allow much movement. Demonstrate the actions of flexion and extension, abduction and adduction (or lateral flexion), and lateral rotation of the head & neck. What types of joints (fibrous, cartilaginous, and/or synovial) are found between adjacent vertebrae?

On median sections (model and MRI) identify the following parts of the brain:

Cerebral hemisphere

Thalamus and hypothalamus

Brainstem, including midbrain, pons, and medulla

Cerebellum

Circle the correct term: The thalamus is [cranial / caudal] to the medulla. The terms cranial, cephalic, and rostral mean approximately the same as superior, while caudal is approximately the same as inferior.

Which of the above listed regions of the brain directly regulates the function of the anterior pituitary gland? Identify the pituitary gland. What is the pituitary gland's anatomical relationship to this part of the brain?

The thyroid and parathyroid glands are located in the neck. Circle the correct term: The parathyroid glands are imbedded in the [anterior / posterior] surface of the thyroid gland. Which hormones do these organs produce?

Circle the correct anatomical term:

The thyroid gland is mostly [superficial / deep] to the trachea.

The trachea is [anterior / posterior] to the oesophagus.

How do the terms dorsal and ventral usually relate to anterior and posterior? There are some exceptions to this, however.

## **Station 2: Thorax, thoracic cavity and associated organ systems**

The ventral body cavity has two divisions: the thoracic cavity and the abdominopelvic cavity. Circle the correct term: The thoracic cavity is [superior / inferior] to the abdominopelvic cavity. Which skeletal muscle separates these two cavities?

The thoracic cavity is dominated by major structures of two organ systems, the respiratory and cardiovascular. On the torso or thorax models and medical images, identify the lungs and heart. Which other organ systems of the body are located, in part, in the thoracic cavity?

Examine the medical images and determine whether each is a radiograph, MRI or CT (there is information about what to look for to distinguish CT from MRI in Station 1). For the CTs and MRIs, determine the plane of section of each. What is the viewing convention for these images? That is, is the left side of the image the patient's right or left side?

The thoracic wall, surrounding the thoracic cavity, is comprised of parts of several organ systems – which ones? Identify the ribs, sternum, and thoracic vertebrae (part of the vertebral column = spine) on the skeleton and medical images.

Circle the correct term in the following statements:

The ribs are [medial / lateral] to the vertebral bodies.

The heart is [superficial / deep] and [anterior / posterior] to the sternum.

The oesophagus is [anterior / posterior] to the heart.

Each lung is surrounded by, but not actually inside, a pleural cavity. The pleural cavity contains a small volume of serous fluid, which allows the lungs and surrounding structures to move smoothly against each other. The surface of the

lung and the inner surface of the thoracic wall (and also the diaphragm and mediastinum) are lined by serous membranes called pleura. Pleura on the lung surface is called visceral pleura, while that on 'wall' structures is called parietal pleura. On slide 79 of the lung, identify the visceral pleura. Which specific tissue types comprise a serous membrane?

The heart is surrounded by, but not actually inside, the pericardial cavity. The pericardial cavity contains a small volume of serous fluid. The external surface of the heart is the visceral pericardium (also called epicardium), and the fibrous pericardium that surrounds the heart is lined on its inner surface by parietal pericardium. The visceral pericardium and parietal pericardium are both serous membranes. See the A4 print of the histology of the heart, with visceral pericardium visible. Note that the visceral pericardium has the same tissue layers as the pleura, and the peritoneum (see station 3).

### **Station 3: Abdomen, pelvis, perineum, abdominopelvic cavity and associated organ systems**

The abdominopelvic cavity may be subdivided into the abdominal cavity and pelvic cavity, at the level of the 'pelvic brim,' which is part of the bony pelvis. The abdominal cavity is partly surrounded by the inferior ribs, and the superior part of the hip bone. The pelvic cavity is largely surrounded by the hip bone and sacrum. The hip bone and sacrum contribute to the pelvic brim, which is a 'circle' of bones separated by three joints. Identify the pelvic brim on the skeleton.

The perineum is the inferior-most part of the trunk, located between the thighs. It includes the external genitalia, anal canal and surrounding tissues. The perineum is inferior to the pelvis, separated from it by skeletal muscles collectively called the pelvic diaphragm.

Which organ systems of the body are located predominantly within the abdominopelvic cavity? We will identify the various organs of these systems at the next practical. Remove these organs from the torso model until you can see the posterior abdominal wall and associated organs.

Which other organ systems of the body are located, in part, in the abdominal cavity?

Which endocrine organ is located in the abdominopelvic cavity? Identify it on the model. List the hormones or groups of hormones produced by this organ.

Which other organs in the abdominopelvic cavity contain endocrine tissues or cells?  
List one hormone produced by each of these organs.

The abdominopelvic cavity contains the peritoneal cavity, which contains a thin film of serous fluid. The abdominal wall is lined by parietal peritoneum, and many organs have visceral peritoneum on their surface. Both the parietal peritoneum and visceral peritoneum are serous membranes. Identify the visceral peritoneum on the external surface of the stomach on slide 66. Note that it is similar to the visceral pleura and visceral pericardium, which are also serous membranes (see station 2).

#### **Station 4: The limbs**

As you answer the following questions, identify the bones and joints on a skeleton and medical imaging studies, and the skin, connective tissues, muscle compartments, and neurovascular bundles on the models, medical images, and potted specimen sections. The potted specimen sections are human remains, so please treat them with respect, thank you, as discussed on page 2 of this worksheet.

Examine the horizontal sections of the lower limb (potted specimens and MRIs). Starting superficially, the outermost layer of the limbs is the skin. Deep to the skin is tissue comprised primarily of adipose tissue. What are the various names for this layer? What other structures are visible within this layer macroscopically?

Deep to the layers referred to above is the deep fascia, which is comprised of dense irregular connective tissue. This surrounds the muscles and bones in the limbs.

The lower limb is commonly referred to as the leg, but in the study of anatomy the leg refers to the part of the lower limb between the knee and ankle joints. Name and identify the two bones of the leg.

In the limbs, proximal means closer to the point of attachment to the trunk, and distal means further away. Circle the correct terms: The ankle is [superior / inferior] and [proximal / distal] to the knee.

The region between the knee and hip joints is called the thigh. What is the bone of the thigh, and with which bones does it articulate?

The upper limb is commonly referred to as the arm, but in the study of anatomy the arm refers to the part of the upper limb between the shoulder and elbow joints. What is the bone of the arm?

What is the region between the elbow and wrist joints called? Name and identify the two bones in this region.

A group of muscles with similar functions (actions) has one or more neurovascular bundles supplying it, comprised of a nerve, an artery, one or more veins, and lymphatic vessels (usually lymphatic vessels can't be seen macroscopically). Identify some neurovascular bundles in the potted specimens, models (which typically don't show the veins), and MRIs, and distinguish nerves from blood vessels on the specimens (how can these structures be distinguished from each other?).

Observe the cortex (outer layer) and medullary cavity (inner layer) of the diaphysis of bones in the potted specimens and MRIs. What does the medullary cavity contain?

The foot is comprised of several sets of bones: tarsals, metatarsals, and phalanges. How many of each are there (count them on a skeleton and on radiographs)? Observe the numerous joints between the bones of the foot.

The hand is comprised of several sets of bones: carpals, metacarpals, and phalanges. How many of each are there (count them on the skeleton and radiographs)? Observe the numerous joints between the bones of the hand.

Bones may be classified by shape as long, short, flat, or irregular. Which shape/s is/are the bones of the hand?

Circle the correct term in the following statements: (remember the anatomical position)

The thumb is [medial / lateral] to the little finger.

The palmar surface of the hand is the [anterior / posterior] and [dorsal / ventral] surface.

The tarsal bones are [proximal / distal] and [anterior / posterior] to the phalanges of the foot.

Identify the other two bones of the upper limb, the clavicle and scapula. With which two bones does the clavicle articulate?

### **Station 5: Back and vertebral canal; cranial cavity**

The dorsal body cavity is comprised of the cranial cavity and vertebral canal. The cranial cavity is located within the skull. What does the cranial cavity contain? Examine the radiograph, CTs and MRIs of the head, and determine the plane of section for the CTs and MRIs.

Examine a model skull and observe that it has numerous foramina (holes), which allow cranial nerves to exit the cranial cavity and blood vessels to enter or leave. The really big hole at the base (inferior) part of the skull is called the foramen magnum (which means 'big hole'); what goes through there?

Each vertebra has a vertebral foramen located between the vertebral body and the rest of the vertebra (vertebral arch and processes). Collectively, the vertebral foramina stacked up in the vertebral column create the vertebral canal, surrounded by nearly all the vertebrae. What does the vertebral canal contain?

Circle the correct term: The brain is [rostral / caudal] and [superior / inferior] to the spinal cord.

The vertebral column is comprised of approximately 33 vertebrae, some of which are fused. Complete the table on the next page to answer the following questions: What are the five regions of the vertebral column? How many vertebrae are in each region? In which regions are the vertebrae separate, and in which are they fused? Which articulate with other (non-spine) bones, e.g., skull, ribs, hip bone?



Name of vertebral column region	Number of vertebrae	Separate or fused?	Articulate with non-spine bones (which)?

Identify these regions of the vertebral column on the skeleton or vertebral column model, and on the radiographs, CT, and MRI.

Observe the intervertebral foramina between adjacent vertebrae in the articulated spine. What exits through these holes? Note that the holes are oriented differently in the sacrum.

Identify the spinal cord and proximal portions of the spinal nerves in the CNS / body wall model. Observe that the spinal cord is much shorter than the vertebral column. At which region of the vertebral column does the spinal cord end inferiorly?

While the ventral body cavities are lined by a serous membrane (refer to stations 2 and 3), the dorsal body cavity has three layers of connective tissue covering the brain and spinal cord. What are these layers called? Between two of these layers (which two?) is cerebrospinal fluid (CSF), which allows the central nervous system essentially to float within the dorsal body cavity.

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