

ANATOMICAL RESOURCES AT THE UNIVERSITY OF SYDNEY

Anatomical resources can be accessed outside of tutorial times at the following locations.

ONLINE RESOURCES

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| Course information including lecture downloads | http://www.anatomy.usyd.edu.au/teaching/macquarie/index.html Lecture downloads: <i>Username: hlth210</i> <i>Password: back</i> |
| Wilson Museum of Anatomy | http://wilson.anatomy.usyd.edu.au/museum/ <i>username: macquarie</i> <i>password: accesswilson</i> <i>(available only to students of Chiropractic and Anatomy - Macquarie University)</i> |
| Glossary of Anatomical Terms | http://www.anatomy.usyd.edu.au/glossary |
| Musculoskeletal atlas | http://eduserv.hscer.washington.edu/hubio553/modules.html |
| Grays anatomy online | http://www.yahooligans.com/reference/gray/index.html |

| RESOURCE | LOCATION |
|--|---|
| Prosections | Wilson Museum of Anatomy |
| X-rays | Wilson museum (full collection) |
| Skeletons (articulated) | Wilson Museum Burkitt-Ford, Medical library (+ disarticulated half skeleton) |
| Models | Medical library (full collection) Burkitt-Ford library (trunk and brain models only) |
| Textbooks of Anatomy and Histology | Burkitt-Ford, Fisher and Medical libraries |
| Netter CD – Interactive atlas of anatomy | Wilson Museum (installed on computers) |

LOCATION OF LIBRARIES AND ANATOMY MUSEUM

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|-------------------------------|---|
| J.T. Wilson Museum of Anatomy | Anderson Stuart Building, Rm W401, Opening hours: Mon-Fri, 8.30am – 5.30 pm (Enrolled students of anatomy only) |
| Medical library | Bosch building 1B – level 3 |
| Burkitt-Ford library | Edward Ford Building – level 2 |

WEEK 1. VERTEBRAL COLUMN – BONES AND JOINTS

General Objectives

To understand the general structure and organisation of the vertebral column

To understand, describe and identify the joints of the vertebral column

Part 1. Tutorial Learning Activities

IDENTIFICATION ACTIVITIES

Work in groups of 3 to 4, with an atlas to identify the following structures.

1. ISOLATED VERTEBRAE

Using isolated vertebrae in the boxes in your tutorial room, identify the following bones and their features.

Atlas (C1): anterior arch and anterior tubercle and facet for dens, posterior arch and posterior tubercle, groove for vertebral artery, lateral mass, transverse process, foramen transversarium, superior and inferior articular facets (compare the differences).

Axis (C2): body, dens, vertebral foramen, superior and inferior articular facets (compare the differences), pedicle, lamina, bifid spinous process, transverse process with foramen transversarium

Typical cervical vertebrae (C3-6): body (*small, wide*) with its uncinat process and inferior lip (anteriorly), vertebral foramen (*large triangular*), pedicle, lamina, spinous process (*short, bifid*), superior and inferior articular processes and facets, transverse process with anterior and posterior tubercles, costotransverse bar and foramen transversarium.

[C6 is often included with the typical cervical vertebrae, however the spinous process of C6 is usually longer and not bifid, and the anterior tubercle is larger than that of other cervical vertebrae (called the carotid tubercle).]

C7 (vertebra prominens): body, uncinat process, pedicle, lamina, spinous process (*long, not bifid*), superior and inferior articular processes and facets, transverse process with foramen transversarium.

Typical thoracic vertebra (T2-9): body (*heart-shaped*), costal facets on bodies (demifacets on bodies of typical thoracic vertebrae) for head of rib, vertebral foramen (*round*), pedicle, lamina, spinous process (*long and downward projecting*), transverse process, costal facet on transverse process for tubercle of corresponding rib, superior and inferior vertebral notches. Note that vertebrae above and below the typical thoracic vertebrae are transitional in shape and have more horizontal spinous processes.

If possible locate **T12 vertebrae**, and observe the thoracic orientation of the superior articular facet and the lumbar orientation of the inferior articular facet. This change in orientation of facets may occur anywhere between T11 and L1 and may be abrupt or gradual.

Typical lumbar vertebra: body (*large, wide*), vertebral foramen (*triangular*), pedicles, laminae, spinous process (*large, quadrangular*), superior articular process and facet, inferior articular process and facet, mamillary process, transverse process, accessory process, superior and inferior vertebral notches.

L5 vertebra is wedge-shaped, relatively broad, spinous process is relatively small, transverse processes is stout (transverse processes originates from the full length of each pedicle and pass posteriorly and superiorly). This will be covered more in week 5.

Sacrum: promontory, ala, superior articular process and facet, pelvic sacral foramina (4 pairs), lateral mass, apex of sacrum, facet for coccyx, sacral canal, sacral hiatus, cornua of sacrum, dorsal sacral foramina, median sacral crest, intermediate sacral crest, lateral sacral crest. What parts of a vertebra do each of the sacral crests represent? Where are the posterior sacral foramina located with respect to these crests?

Coccyx: apex, base, transverse process, cornua

QUESTION 1

Fill in your answer in the space provided

(The answers will be reviewed by your tutor at the end of the class).

- a) What features are common to all cervical vertebrae?

- b) What features are common to all thoracic vertebrae?

- c) Is it possible to identify a vertebra (C, T or L) from the orientation of its articular facets alone?

- d) Give one method for determining superior from inferior on:
 - a typical cervical vertebrae
 - a typical thoracic vertebrae
 - a lumbar vertebrae
 - the atlas (C1)

2. ARTICULATED SPINE

i) On the flexible spine:

Identify the **curvatures** (cervical, thoracic, lumbar, sacral) and state which of these are primary and secondary curvatures. Note the orientation of the sacral base. The posterior orientation of the superior articular facet of the sacrum prevents forward slippage of L5 vertebra.

Identify the **intervertebral foramina** in the cervical, thoracic and lumbar regions. Note their size.

Identify the **atlantooccipital, atlantoaxial** (median and lateral) **joints**, **intervertebral discs** and **zygapophyseal joints** (from C2/3 to L5/S1). Note the **orientation of the articular facets**

in each region and determine the movements that occur. Use the flexible spine to test these movements.

QUESTION 2

a) What movement(s) would *decrease* the size of an intervertebral foramen?

b) Lumbar intervertebral foramina are best seen on a lateral X-ray, however cervical intervertebral foramina are best seen using an oblique X-ray (not on a lateral X-ray). Why is this? Describe the angle you would use to show the cervical IVF on X-ray.

c) Which movements are:

- (i) “coupled” in the cervical spine
- (ii) favoured in the thoracic spine
- (iii) restricted in the lumbar spine

3) PROSECTIONS

On head and neck prosections, in the midsagittal plane:

Identify **foramen magnum**, anterior and posterior **arches of the atlas**, **dens**, **body** and **spinous process of C2**, **bodies**, **laminae** and **spinous processes** of C3 -7 and T1. Observe the increase in vertebral body size from cervical to thoracic regions.

Identify the **median atlantoaxial joint** (between dens and anterior arch of C1) and identify and number the **intervertebral discs**. *In some scoliotic spines **zygapophyseal joints** may be visible.

On the hip and lower limb prosections, in the midsagittal plane:

Identify the **lumbar vertebrae**, **sacrum** and **coccyx**. Identify the **promontory** of the sacrum, **sacral canal** and **remnant disc material** between the fused sacral vertebral bodies.

On isolated intervertebral discs (in buckets in tutorial room)

Identify the **annulus fibrosus** and **nucleus pulposus**. Are these discs from the lumbar, thoracic or cervical region? Determine anterior from posterior. Note that these discs are from older individuals and are more fibrous than in the young.

QUESTION 3

a) Classify the following joints as either i) synovial ii) cartilaginous or iii) fibrous:

atlantooccipital joint

atlantoaxial joint

intervertebral disc

zygapophyseal joint

sacrococcygeal joint

sacroiliac joint

symphysis pubis

b) Discs are often numbered according to the vertebrae they are between (*e.g.*, C2/3), however sometimes a single number is given. In this case, are discs numbered according to the vertebra above or below?

4. TUTOR REVIEW OF QUESTIONS

At the end of the tutorial, tutors will review the answers to the questions above. Use this time to review any areas of difficulty you have.

Part 2 Self-Directed Learning Activities

Vertebrae

DISCUSS

- i) the normal and abnormal curvatures of the vertebral column
- ii) the line of weight transmission
- iii) stability and movements of vertebral column
- iv) the primary and secondary centres of ossification of a typical vertebra

COMPARE AND CONTRAST

- i) typical vertebrae: cervical (C3-C6), thoracic (T2-T9) and lumbar (L2-L4)
- ii) contribution of costal elements to cervical, lumbar and sacral vertebrae
- iii) the terms body and vertebral arch to the terms centrum and neural arch

Joints**CLASSIFY**

- i) the following joints: atlantooccipital, atlantoaxial, intervertebral discs, zygapophyseal joints, sacroiliac and sacrococcygeal joints; symphysis pubis

NAME

- i) the joints that determine the range of movement between vertebrae
 ii) the joints that determine the direction of movement between vertebrae
 iii) the weight bearing parts of a cervical vertebra

STATE

- i) the orientation of the superior articular facets in the cervical, thoracic and lumbar regions
 ii) the movements that occur in each region of the vertebral column
 iii) the movements that occur at the atlanto-occipital and atlantoaxial joints
 iv) the innervation of zygapophysial joints
 v) the parts of an intervertebral disc and the function of each part
 vi) the highest intersegmental level at which uncovertebral joints are present

DESCRIBE

- i) the structure of the end plate, nucleus pulposus, annulus fibrosus
 ii) the direction of movement of the nucleus pulposus in flexion and extension
 iii) the structure of a zygapophyseal joint

Media

| | |
|-------------|---|
| Bones | skull isolated vertebrae ribs |
| Prosections | midsagittal head and neck, trunk isolated intervertebral discs mid-sagittal head and neck – superficial and deep superficial lower limb prosections, hip joint prosections |

WEEK 2. VERTEBRAL COLUMN – LIGAMENTS AND MUSCLES

General Objectives

To understand the general arrangement and functions of the ligaments of the vertebral column

To understand the arrangement, action and innervation of the muscles of the vertebral column

Part 1. Tutorial Learning Activities

IDENTIFICATION ACTIVITIES

Work in groups of 3 to 4, with an atlas to identify the following structures.

1. LIGAMENTS

On midsagittal head and neck prosections:

Identify the **transverse ligament of the atlas** (posterior to dens), **anterior and posterior longitudinal ligaments**, **ligamentum flavum** and, if present, **ligamentum nuchae**

On the medial aspect of the hip joint and lower limb prosections:

Identify the anterior and posterior **longitudinal ligaments**, **ligamentum flavum** and the **interspinous** and **supraspinous ligaments**.

Please see Wilson Museum pots for other ligaments (these pots may be used in examinations):
(Those in italics are not online; the part in brackets indicates the location in the museum. For example **B532** indicates cabinet **B**, section **5**, shelf **3** (from top), **2nd** bottle from left on shelf)

| Ligaments | Wilson bottle and location |
|---|---|
| Apical and alar ligaments of dens, Tectorial membrane | 561 (B532), 560 (B531) 560 (B531) |
| Ligamentum nuchae | 448 (<i>B622</i>) |
| Anterior longitudinal ligament - in neck - in thorax - in lumbar spine | 560 anterior (B351) 103 anterior (J311) 217 anterior (H211) 104 anterior (J312) |
| Posterior longitudinal ligament | 104 medial (J312) |
| Ligamentum flavum | 104 medial (J312) |
| Interspinous ligament | 104 medial (J312) + 103 left (J311) |
| Supraspinous ligament | 103 posterior (J311) 217 posterior (H211) 104 medial (J312) |

QUESTION 1

a. In what region(s) of the spine is the ligamentum nuchae located

b. In what region(s) of the spine are the ligamenta flava located?

c. In what region(s) of the spine are the supraspinous ligaments located?

2. BACK MUSCLES

i) EXTRINSIC BACK MUSCLES

On the back prosections, identify the extrinsic back muscles, which lie superficial to the true back muscles:

Identify **trapezius**, **latissimus dorsi** and deep to these, **rhomboids minor**, **rhomboids major** and **levator scapulae** (*these muscles act on the upper limb*).

Deep to these, identify: **serratus posterior superior and inferior** (*these muscles move the ribs*)

ii) INTRINSIC (TRUE) BACK MUSCLES

On back prosections identify:

a) Layer 1 (most superficial)

Identify **splenius capitis and cervicis** in the cervical region.

b) Layer 2 (intermediate)

Identify **erector spinae muscle** in the lumbar region dividing into three columns of muscles (spinalis, longissimus, iliocostalis).

Identify the parts of each of the following muscles: **iliocostalis** (lumborum, thoracis and cervicis), **longissimus** (thoracis, cervicis and capitis), **spinalis thoracis** (do not be concerned with identifying the other parts of spinalis).

c) Layer 3 (deep layer)

Identify the transversospinalis group and its three layers: **semispinalis**, **multifidus**, **rotatores**. Identify **semispinalis thoracis, cervicis and capitis**.

d) Minor layer

Identify **levatores costarum**, and if possible **interspinalis** and **intertransversus** muscles

e) Suboccipital Muscles

Identify the suboccipital muscles: **rectus capitis posterior minor**, **rectus capitis posterior major**, **obliquus capitis inferior** and **obliquus capitis superior**.

Identify the **suboccipital triangle**. Its **borders** are rectus capitis posterior major, obliquus capitis inferior and obliquus capitis superior. In the **floor** of the triangle, identify the **posterior arch of the atlas**, **vertebral artery** and the **posterior ramus of C1**.

iii) LATERAL VERTEBRAL MUSCLES OF NECK

On back prosections and deep thorax prosections

Identify **scalenus anterior**, **scalenus medius** and **scalenus posterior** muscles

QUESTION 2

a) Between which two scalene muscles does the brachial plexus emerge?

b) What other structure emerges between these muscles?

c) What might be the effect of spasm of these muscles?

d) Scalene muscles attach to the transverse processes of cervical vertebrae. Indicate which tubercle of the transverse process the following muscles attach:

Scalenus anterior

Scalenus medius

Scalenus posterior

Does this now make sense with respect to the emergence of the brachial plexus?

iv) PREVERTEBRAL MUSCLES OF NECK

On back prosections and specialised neck prosections:

Identify **longus colli**, **longus capitis**, **rectus capitis anterior** and **rectus capitis lateralis**.

QUESTION 3

a) Indicate the ramus (anterior or posterior) that supplies the following muscle groups:

Extrinsic back muscles

Intrinsic (True) back muscles

Lateral vertebral muscles

Prevertebral muscles

Please see Wilson Museum pots for other muscles:

| Muscle | Wilson bottle and location |
|---------------------------------------|-----------------------------------|
| Splenius capitis and cervicis | 448 (B622) |
| Suboccipital muscles | 151 (Y511) |
| Levatores costarum | 223 posterior (H212) |
| Multifidus (layers reflected on left) | 749 (X122) |
| Prevertebral muscles | 567 (A332) |

v) FASCIAE OF THE BACK

In the thoracic and lumbar regions of the back prosections identify the thoracolumbar fascia. Latissimus dorsi and the two deepest muscles of the anterolateral abdominal wall attach to the thoracolumbar fascia.

3. TUTOR REVIEW OF QUESTIONS

At the end of the tutorial tutors will review the answers to the questions above. Use this time to review any areas of difficulty you have.

Part 2 Self-Directed Learning Activities**Ligaments****DESCRIBE AND DISCUSS**

- i) attachments and functions of ligaments of the vertebral column, particularly the ligamentum nuchae, ligamentum flava, anterior and posterior longitudinal ligaments, interspinous and supraspinous ligaments and the transverse ligament of the atlas

Muscles**SUMMARISE**

- i) features of the intrinsic muscles of the back: names of major groups and their parts, innervation, position, actions, postural functions
- ii) prevertebral and postvertebral muscles, their general attachments, actions and innervation
- iii) extent of the thoracolumbar fascia, the three parts of the thoracolumbar fascia in the lumbar region and the muscles attached to the fascia (lat. dorsi, Tv abd, Int obl)
- iv) specific attachments of suboccipital muscles, rectus capitis anterior and lateralis, the inferior attachment of each scalene muscle, the attachments of psoas major and iliacus.
- v) the boundaries and structures in the floor of the suboccipital triangle

DEMONSTRATE

- i) the area in which deep (intrinsic) back muscles are situated

Media

| | |
|-------------|--|
| Models | Trunk, flexible spine |
| Bones: | isolated vertebrae |
| Prosections | back prosections, suboccipital prosections Superficial head and neck Deep thorax |

