Surgical Orthopaedic Anatomy Course

2014
Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>2</td>
</tr>
<tr>
<td>Course Objectives</td>
<td>2</td>
</tr>
<tr>
<td>Delegate Attributes</td>
<td>2</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>2</td>
</tr>
<tr>
<td>Course Structure</td>
<td>2</td>
</tr>
<tr>
<td>AOA Accreditation</td>
<td>3</td>
</tr>
<tr>
<td>Program Outline</td>
<td>4</td>
</tr>
<tr>
<td>Course Contacts</td>
<td>5</td>
</tr>
<tr>
<td>Anatomy Presentations and Surgical Demonstritations</td>
<td>6</td>
</tr>
<tr>
<td>Assessment</td>
<td>6</td>
</tr>
<tr>
<td>Attendance</td>
<td>6</td>
</tr>
<tr>
<td>Case Studies</td>
<td>6</td>
</tr>
<tr>
<td>Examinations</td>
<td>6</td>
</tr>
<tr>
<td>Special Consideration</td>
<td>7</td>
</tr>
<tr>
<td>Supplementary Exams</td>
<td>7</td>
</tr>
<tr>
<td>Revision Week</td>
<td>8</td>
</tr>
<tr>
<td>Resources</td>
<td>8</td>
</tr>
<tr>
<td>QUT Code of Conduct</td>
<td>8</td>
</tr>
<tr>
<td>Case Study Format</td>
<td>9</td>
</tr>
<tr>
<td>Module 1 – Shoulder</td>
<td>10</td>
</tr>
<tr>
<td>Module 2 – Elbow</td>
<td>14</td>
</tr>
<tr>
<td>Module 3 – Wrist</td>
<td>18</td>
</tr>
<tr>
<td>Module 7 – Back and Spine</td>
<td>22</td>
</tr>
<tr>
<td>Module 4 – Hip</td>
<td>27</td>
</tr>
<tr>
<td>Module 5 – Knee</td>
<td>32</td>
</tr>
<tr>
<td>Module 6 – Ankle/Foot</td>
<td>37</td>
</tr>
</tbody>
</table>
Introduction

The QUT Medical Engineering Research Facility (MERF) has designed a comprehensive 12 week Surgical Orthopaedic Anatomy Course that enables delegates to further enhance their knowledge of anatomy education in relation to orthopaedic practice. This course creates an in-depth immersion into specific joint regions of the body through osteology, arthrology, clinical anatomy, surface anatomy, surgical approaches and clinical case studies. This course involves weekly anatomical demonstrations with cadaveric prosected specimens as well as surgical approaches and dissection using cadaveric material demonstrated by current leading orthopaedic surgeons. In addition, delegates will be given the opportunity to participate in a human movement gait lab.

This course is supported by the Australian Orthopaedic Association and is conducted by professional university staff from the Anatomical & Surgical Skill Laboratory at MERF, QUT.

Course Objectives

The objectives of this course are to:

1. Provide comprehensive surgically-relevant anatomy education for orthopaedic trainees.
2. Provide specialist surgical training using cadaveric material in the Anatomical & Surgical Skill Laboratory.
3. Provide opportunities for delegates to facilitate and enhance learning experience through forums and workshops.

Delegate Attributes

At the conclusion of this course, delegates will have covered:

1. Specific knowledge of surface anatomy, osteology and surgical anatomy in an orthopaedic anatomy context as it refers to major joints of the body.
2. Knowledge and relevant understanding of specific surgical approaches to common injury/disease etiology in various regions of the body, including indications, structural risks, complications and contraindications.
3. Knowledge of a variety of case studies with clinical relevance to surgical anatomy knowledge.

Prerequisites

Minimum undergraduate anatomy knowledge required as per Medical Degree/ Anatomical Sciences Degree – a minimum of 1 unit of anatomy at university level.

Delegates are required to undertake Self-Directed Learning to revise adjacent anatomical structures and pathways related to the specific joint modules. Assumed knowledge will not be directly assessed.

Course Structure

- Certificate course
- Duration: 10 weeks
- 7 Anatomy Demonstrations
- 7 Surgical Presentations
- 1 Revision Presentation
- Revision Week
- Exam week
**AOA Accreditation**

The AOA has determined **3 credit points** will be awarded for this Certificate course.

**Program Outline**

<table>
<thead>
<tr>
<th>Week/Date</th>
<th>Module</th>
<th>Topic</th>
<th>Proposed Surgeon</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20.08.14</td>
<td>1</td>
<td>Shoulder</td>
<td>Dr Mark Ross</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Introduction Session prior to the start of the Anatomical Demonstration.</strong></td>
</tr>
<tr>
<td>2</td>
<td>27.08.14</td>
<td>2</td>
<td>Elbow</td>
<td>Dr Darren Marchant</td>
</tr>
<tr>
<td>3</td>
<td>3.09.14</td>
<td>3</td>
<td>Back/Spine</td>
<td>Dr Paul Licina</td>
</tr>
<tr>
<td>4</td>
<td>10.09.14</td>
<td>4</td>
<td>Wrist/Hand</td>
<td>Dr Greg Couzens</td>
</tr>
<tr>
<td>5</td>
<td>17.09.14</td>
<td></td>
<td>Revision</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Revision of the Upper limb and spine anatomy</strong></td>
</tr>
<tr>
<td>6</td>
<td>7.10.14</td>
<td>5</td>
<td>Hip</td>
<td>Dr Michael Ottley</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dr Rohan Brunello</td>
</tr>
<tr>
<td>7</td>
<td>15.10.14</td>
<td>6</td>
<td>Knee</td>
<td>Dr Tony Ganko</td>
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<tr>
<td>8</td>
<td>22.10.14</td>
<td>7</td>
<td>Ankle/Foot</td>
<td>Dr Jeff Peereboom</td>
</tr>
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<td>9</td>
<td>29.10.14</td>
<td></td>
<td>Revision</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Revision of the Lower limb</strong></td>
</tr>
<tr>
<td>10</td>
<td>3.11.14 –</td>
<td>Revision</td>
<td></td>
<td><strong>Whole day cadaveric workshop</strong> (Sat 08.11.14)</td>
</tr>
<tr>
<td></td>
<td>7.11.14</td>
<td>Week</td>
<td></td>
<td>MERF Facility open from 9am until 3pm Monday – Friday</td>
</tr>
<tr>
<td>11</td>
<td>Mon</td>
<td>Exam Week</td>
<td></td>
<td><strong>Written Exam</strong> on Monday night</td>
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<tr>
<td></td>
<td>10.11.14</td>
<td></td>
<td></td>
<td><strong>Practical Exam</strong> on Tuesday night</td>
</tr>
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<td></td>
<td>Tues</td>
<td></td>
<td></td>
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</tbody>
</table>
Course Co-ordinator (Main Contact)

Mr Jim Kelly
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Anatomy Presentations and Surgical Demonstrations

- Commencing Week 1 of the course, each Wednesday night starting at 6pm, delegates are given a 1 hour anatomical presentation using cadaveric specimens to describe the anatomical features, innervations, blood supply and clinical relevance of a specific joint region.
- After a short break, delegates then receive a 2 hour clinical demonstration from an orthopaedic specialist for the surgical approach and dissection to the same region.

Assessment

- 10% Attendance (all modules and revision night)
- 20% Case Studies
- 35% Theory Exam
- 35% Practical Exam
- 100% Total

The overall levels of achievement are:

- 50-70% Pass Conceded*
- 70% Pass
- 80% Commendation
- 90% High Commendation

To pass this course overall, you need to pass each of the components of the course to a minimum standard of 60%**; N.B. Combined overall requirement of 70% to pass

*Pass conceded will not be awarded 3 credit points by the AOA.

Attendance

- Attendance is either in person or by correspondence with skype. (specified during enrolment)
- **Delegates are required to attend a minimum of 7 sessions during the course.
- On-site delegates are required to fill out an attendance sheet each week and remote delegates are required to email a password given in the duration of the session each week.
- Revision week is not compulsory, although it is highly recommended.
- Delegates are required to attend in person for both the theory and practical examinations during week 10

Case Studies

- Each week delegates will receive a case study which relates to the following week’s topic.
- Delegates have one week to complete and return-email their case studies.
- The case studies are due prior to 7pm on the Wednesday night. No late submissions are accepted#.
- Case studies marks will be returned within 2 weeks from the date of submission.
  # unless special consideration is applied.

Examinations

- All delegates, both on-site and remote are required to attend the examinations at MERF in person – there are no on-line examinations available – no exceptions.
- Both the theory and practical examinations are held during the exam week on separate days.
- The theory examination will be a 2 hour paper consisting of multiple choice, short answer and extended response questions.
- The practical examination will be a timed exam consisting of multiple stations. Delegates have a pre-determined amount of time at each station before moving to the next station.
- Photo identification is required for both examinations as proof of identity.
Special Consideration

Although it is a condition of enrolment of this course that delegates are required to attend the examinations in person during the 10th week of the course, there are circumstances/situations where delegates are able to apply for special consideration.

➢ Work Commitments
Work commitments are generally NOT grounds for special consideration unless there are exceptional circumstances – in these cases, immediate notification is required, followed by the submission of a written application with supporting documentation (including supporting documentation from employers) no longer than 3 days after the examination date.

NB: Continued heavy workload during the course or examinations is NOT grounds for special consideration

➢ Illness
In the event a delegate is unable to attend due to illness, prompt notification followed by a written application for special consideration prior to or no longer than 3 days after the examination. Supporting documentation must be included with the application.

Documentation required for medical grounds
A certificate from a registered medical or dental practitioner on surgery letterhead, or medical certificate on reverse side of special consideration application form. The certificate should state:

- date on which the practitioner examined you
- the nature, severity and duration of the complaint (where appropriate)
- in the practitioner’s opinion, the effect of the complaint on your ability to perform satisfactorily in the assessment item.

A statement that you are or were suffering from a 'medical condition' without supporting comments from the practitioner as to the effect of the complaint will not allow you full consideration.

➢ Other
All other grounds for consideration must be submitted prior to or no later than 3 days after the examinations. It should be noted that if special consideration is not requested until after the exam, it doesn’t guarantee the consideration will be granted (Please contact the course co-ordinator as soon as possible in the event of impending difficulties). Supporting documentation must be submitted with the application.

Documentation for reasons other than medical grounds
Supporting documentation is essential. In the absence of documentary evidence, a Statutory Declaration must be attached with full details of the exceptional circumstances which impacted on your ability to be present at the examinations.

Supplementary Examinations

Supplementary examinations are offered for both the theory and prac exams. To qualify for a supplementary examination, delegates will be required to achieve a minimum mark of 50% for the initial examination or meet the conditions for special consideration. Delegates will be contacted post-examination to notify them of the requirements to undertake a supplementary examination.
Revision Week

- The week following the last demonstration/presentation in the series, delegates are given access to cadaveric specimens at MERF from 9am until 3pm Monday to Friday of the revision week for their own Self Directed Learning (SDL).

- Delegates need only bring a copy of their learning outcomes and any textbooks they require. Anatomical pictures, diagrams and resources are available in the laboratory. There are no tutors or surgeons available for this week.

- The Saturday of the weekend prior to the exams (08.11.14), a revision drop-in session will be held at MERF. Delegates are given access to cadaveric specimens at MERF from 9am until 3pm; during this time there are tutors available to assist with the anatomy.

Resources

Recommended textbooks:

Recommended Websites:

QUT Code of Conduct

At all times during this course, delegates are expected to comply with the QUT Student Code of Conduct. This Code can be accessed at [http://www.mopp.qut.edu.au/E/E_02_01.jsp](http://www.mopp.qut.edu.au/E/E_02_01.jsp). In particular:

2.1.2 Application

The QUT Student Code of Conduct applies to all students of the University, and to individuals undertaking customised education programs, incoming placements, occupational traineeships or other similar programs. For the purposes of this Code, the general term 'student' is used.

Students are required to comply with the obligations set out in this Code while undertaking any activity in their capacity as a student or while engaged in any activity which impacts on the University or the University community. This includes on-campus activities, University or student-related activities at other sites (for example, placements, fieldtrips or exchange programs), and use of QUT IT resources, networks or other learning and support services or facilities regardless of whether accessed on campus or remotely.

2.1.4 Student Misconduct

The University will deal with a student who engages in any of the following conduct under student misconduct procedures. Misconduct can arise from a single act, an omission, or a pattern of conduct by a student.

(a) Engaging in conduct which does or tends to defeat or compromise the purposes of assessment of academic work, including by
   (i) cheating in examinations
   (ii) failing to comply with instructions relating to the conduct of examinations
   (iii) using, reproducing or adapting the work or ideas of another person without due acknowledgment
   (iv) representing the work of another person as the student's own work;
   (v) misrepresenting, falsifying, misstating or fabricating data, results or information used for the purposes of assessment
   (vi) otherwise breaching the University's policy on academic integrity
Case Study Format

Case Studies will be sent directly via email on a Thursday morning.

There is one week to complete the case study and return-email it. All emails must be sent prior to 7pm on the night of the course.

Each Case study will require you to review a clinical case, diagnose the injury/condition and then propose the course of treatment you would provide.

When you receive the case study, it will be given a file name:

E.g CS1 Shoulder.doc

Open the file and enter the answers in the space provided. You need to save the file with your details in the file name then email it back to the Course Co-ordinator as an attachment with this name in the email subject:

E.g CS1JaneSmith.doc

Marks awarded for the case studies will be made available within 3 weeks of submission. You will receive your marks via email.

If you have any questions/concerns about your case study results, you will need to contact the course co-ordinator via email to discuss.
SHOULDER LEARNING OUTCOMES

1. Identify the surface anatomy landmarks of the shoulder.
2. Describe the joint classifications within the shoulder including accessory structures.
3. Identify the osteological features of the clavicle, proximal humerus and scapula.
4. Describe the compartments of the shoulder joint including ligaments and bursae.
5. Identify and describe the superficial, intermediate and deep (rotator cuff) muscle groups of the shoulder in terms of origin, insertion, action and innervation.
6. Identify and describe the organisation and the course of nerves and vessels through the shoulder region.
7. Describe the anatomical spaces within the axilla and identify their contents.

ASSUMED KNOWLEDGE

1. Identification of muscles of the pectoral and scapular regions, including attachments and innervation.
2. Understanding of the boundaries and contents of the axilla.
3. Organisation and identification of the nerves of the brachial plexus from the roots of the cervical region.
4. Vascular supply and drainage of the pectoral and scapular regions.

CLINICAL/SURGICAL APPLICATIONS

1. Surgical approaches to shoulder (anterolateral, deltopectoral, lateral and posterior), including the identification of structures at risk.
2. Minimisation techniques to reduce risk to these structures during surgical procedures.
3. Common injuries and damage to muscles, nerves and vessels of the shoulder and its implications for the distal structures of the arm (including rotator cuff injuries).
4. Arthroscopic portal placement for the shoulder for minimally invasive surgical procedure.
Osteology of the Shoulder
(ref: Moore p673 – 677; McMinn’s p118 – 125)

Clavicle:
- sternal end
- acromial end
- conoid tubercle
- trapezoid line
- subclavian groove

Scapula:
- acromion
- coracoid process
- spine
- spinoglenoid notch
- glenoid fossa
- supraglenoid tubercle
- infraglenoid tubercle
- suprascapular fossa
- infraspinous fossa
- subscapular fossa
- supraspinous fossa
- suprascapular notch
- infraspinous fossa
- groove for circumflex scapular artery

Proximal Humerus:
- head
- anatomical neck
- surgical neck
- greater tubercle
- lesser tubercle
- bicipital groove
- deltoid tuberosity

Arthrology of the Shoulder
(ref: Moore p793 – 800; McMinn’s p142 – 143; Hoppenfeld p18)

Acromioclavicular joint:
- acromioclavicular ligament
- coracoacromial ligament
- coracoclavicular ligaments (conoid and trapezoid parts)
- articular disc

Glenohumeral joint:
- superior, middle and inferior glenohumeral ligaments
- glenoid labrum
- coracohumeral ligament
- coracoacromial ligament
- transverse humeral (intertubercular) ligament
- subscapularis/subcoracoid bursa
- subacromial/subdeltoid bursa
- rotator interval

Scapulothoracic joint
(location only)

Sternoclavicular joint
(location only)
- anterior & posterior sternoclavicular ligaments
- interclavicular ligament
- costoclavicular ligament
- articular disc

Muscles of the Shoulder
(ref: Moore p697-707 ; McMinn’s p141, 148)

Superficial:
- deltoid
- trapezius
- pectoralis major
- latissimus dorsi
- teres major

Intermediate:
- pectoralis minor
- serratus anterior
- subclavius
- levator scapulae
- rhomboideus major and minor
- triceps brachii – long head
- coracobrachialis
- biceps brachii – long and short heads

Deep (Rotator Cuff):
- subscapularis
- supraspinatus
- infraspinatus
- teres minor
- Consider insertion of each muscle on the humerus with respect to joint stability
### Vessels of the Axilla
(ref: Moore p716, 717)

<table>
<thead>
<tr>
<th>subclavian artery and vein</th>
<th>axillary artery (3 divisions ÷ *) and vein</th>
<th>brachial artery and vein (if below Teres major)</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ Vertebal artery</td>
<td>➢ superior thoracic (1&lt;sup&gt;st&lt;/sup&gt; ÷)</td>
<td>➢ deep brachial &amp; venae commitantes</td>
</tr>
<tr>
<td>➢ Internal thoracic artery</td>
<td>➢ thoracoacromial (2&lt;sup&gt;nd&lt;/sup&gt; ÷)</td>
<td></td>
</tr>
<tr>
<td>➢ Thyrocervical trunk</td>
<td>➢ subscapular (3&lt;sup&gt;rd&lt;/sup&gt; ÷)</td>
<td></td>
</tr>
<tr>
<td>- suprascapular</td>
<td>➢ scapular circumflex</td>
<td></td>
</tr>
<tr>
<td>- inferior thyroid</td>
<td>➢ thoracodorsal</td>
<td></td>
</tr>
<tr>
<td>- superficial cervical</td>
<td>➢ anterior humeral circumflex</td>
<td></td>
</tr>
<tr>
<td>➢ Costocervical trunk</td>
<td>➢ posterior humeral circumflex</td>
<td></td>
</tr>
<tr>
<td>- superior intercostal</td>
<td>* 3 divisions relative to pectoralis minor</td>
<td></td>
</tr>
<tr>
<td>- deep cervical</td>
<td>* Can also branch from the axillary or subscapular</td>
<td></td>
</tr>
<tr>
<td>➢ Dorsal scapular artery</td>
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</table>

### Neurology of the Shoulder
(ref: Moore p721-726)

<table>
<thead>
<tr>
<th>Supraclavicular branches of brachial plexus</th>
<th>Infracavicular branches of brachial plexus</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ dorsal scapular nerve</td>
<td>➢ lateral cord</td>
</tr>
<tr>
<td>➢ long thoracic nerve</td>
<td>➢ lateral pectoral</td>
</tr>
<tr>
<td>➢ nerve to subclavius</td>
<td>➢ musculocutaneous</td>
</tr>
<tr>
<td>➢ suprascapular nerve</td>
<td>➢ medial cord</td>
</tr>
<tr>
<td></td>
<td>➢ medial pectoral</td>
</tr>
<tr>
<td></td>
<td>➢ medial brachial cutaneous</td>
</tr>
<tr>
<td></td>
<td>➢ medial antebrachial cutaneous</td>
</tr>
<tr>
<td></td>
<td>➢ median nerve</td>
</tr>
<tr>
<td></td>
<td>(lateral and medial cord)</td>
</tr>
<tr>
<td></td>
<td>➢ posterior cord</td>
</tr>
<tr>
<td></td>
<td>➢ upper subscapular</td>
</tr>
<tr>
<td></td>
<td>➢ thoracodorsal</td>
</tr>
<tr>
<td></td>
<td>➢ lower subscapular</td>
</tr>
<tr>
<td></td>
<td>➢ axillary</td>
</tr>
<tr>
<td></td>
<td>➢ radial</td>
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Anatomical Spaces of the Shoulder
(ref: Moore p735; McMinn’s)

<table>
<thead>
<tr>
<th>Quadrangular space (Superior)</th>
<th>Triangular interval (Lateral)</th>
<th>Triangular space (Medial)</th>
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<tbody>
<tr>
<td>boundaries</td>
<td>boundaries</td>
<td>boundaries</td>
</tr>
<tr>
<td>teres minor - superior</td>
<td>teres major - superior</td>
<td>Teres major – inferior</td>
</tr>
<tr>
<td>subscapularis -superior</td>
<td>triceps brachii long head - medial</td>
<td>Long head of triceps – lateral</td>
</tr>
<tr>
<td>triceps brachii long head - medial</td>
<td>triceps brachii lateral head – lateral</td>
<td>Teres minor – superior</td>
</tr>
<tr>
<td>surgical neck of humerus - lateral</td>
<td>NB: (humerus – alternative lateral)</td>
<td>NB: (Subscapularis – alternative superior)</td>
</tr>
<tr>
<td>teres major - inferior</td>
<td></td>
<td></td>
</tr>
<tr>
<td>contents</td>
<td>contents</td>
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</tr>
<tr>
<td>axillary nerve</td>
<td>radial nerve</td>
<td>scapular circumflex</td>
</tr>
<tr>
<td>posterior circumflex</td>
<td>deep brachial artery</td>
<td>artery and vein</td>
</tr>
<tr>
<td>humeral artery &amp; vein</td>
<td></td>
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</tr>
</tbody>
</table>
ELBOW LEARNING OUTCOMES

1. Identify the surface anatomy landmarks of the elbow.
2. Describe the joint classifications within the elbow including accessory structures.
3. Identify the osteological features of the distal humerus, proximal radius and proximal ulna.
4. Describe the cubital tunnel of the elbow and the cubital fossa.
5. Identify and describe the muscles of the anterior and posterior compartments of the elbow region in terms of origin, insertion, action and innervation.
6. Identify and describe the organisation and the course of nerves and vessels through the elbow region.

ASSUMED KNOWLEDGE

1. Identification of muscles of the upper limb, elbow and forearm, including attachments and innervation.
2. Understanding of the boundaries and contents of the cubital fossa.
3. Identification and course of the nerves of the upper limb through the elbow region.
4. Vascular supply and drainage of the upper limb.

CLINICAL/SURGICAL APPLICATIONS

1. Surgical approaches to shoulder (anterolateral, posterior, medial anterolateral to cubital fossa, lateral/Kocher) including the identification of structures at risk.
2. Minimisation techniques to reduce risk to these structures during surgical procedures.
3. Common injuries and damage to muscles, nerves and vessels of the elbow and its implications for the distal structures of the forearm. Specifically Ulnar nerve entrapment and cubital tunnel syndrome.
4. Arthroscopic portal placement for minimally invasive surgical procedures.
Osteology of the Elbow

**Distal Humerus:**
- spiral/radial groove
- medial epicondyle
- lateral epicondyle
- ulnar groove
- trochea
- capitulum
- olecranon fossa
- radial fossa
- coronoid fossa
- medial and lateral supracondylar ridges

**Proximal Ulna:**
- coronoid process
- olecranon process
- ulna tuberosity
- radial notch
- trochelear notch
- supinator crest
- interosseous border

**Proximal Radius:**
- head (and its fovea)
- neck
- radial tuberosity
- interosseous border
- anterior oblique line

*Order of Ossification around Elbow:* capitulum, radial head, medial epicondyle, trochea, olecranon, lateral epicondyle

Arthrology of the Elbow

**Proximal Radio-ulnar joint:**
- annular ligament of radius
- quadrature ligament
- fibrous capsule
- synovial membrane
- sacciform recess

**Elbow Joint:**
- Radial / Lateral Collateral ligament
- Ulnar / Medial Collateral ligament
  - Superior bands
  - Posterior bands
  - Transverse/oblique bands
- Fat pads

**Bursae:**
- Subcutaneous olecranon
- Intratendinous olecranon
- Subtendinous olecranon
Muscles of the Elbow
(ref: Moore p731 – 735, p748 - 752)

**Anterior Compartment of the arm**
(distal only)
- Coracobrachialis
- Biceps brachii (long and short heads)
- Bicipital aponeurosis
- Brachialis
- Medial Intermuscular septum
- Lateral Intermuscular septum

**Posterior Compartment of the arm**
(distal only)
- Triceps brachii (long lateral and medial heads)
- Anconeus

**Anterior Compartment of the forearm**
(proximal only)

**Superficial**
- Pronator teres
- Flexor Carpi Radialis
- Palmaris longus
- Flexor carpi ulnaris

**Intermediate**
- Flexor digitorum superficialis

**Deep**
- Flexor digitorum profundus
- Flexor pollicis longus
- Pronator quadratus

**Posterior Compartment of the forearm**
(proximal only)

**Superficial**
- Brachioradialis
- Extensor carpi radialis longus
- Extensor carpi radialis brevis
- Extensor digitorum
- Extensor digiti minimi
- Extensor carpi ulnaris
  ^ Mobile wad of Henry

**Deep**
- Supinator
- Extensor Indicies
- Anconeus

**Outcropping Deep**
- Abductor pollicis longus
- Extensor pollicis brevis
- Extensor pollicis longus
Vessels of the Elbow

**Arm**
- **Brachial Artery**
  - Humeral nutrient a
  - Superior ulnar collateral a
  - Inferior ulnar collateral a
  - Deep artery of the arm
    - Radial collateral a
    - Middle collateral a

**Superficial Veins**
- Cephalic v
- Basilic v

**Deep Veins**
- Brachial v’s

**Forearm**
- **Ulnar Artery**
  - Anterior ulnar recurrent a
  - Posterior ulnar recurrent a
  - Recurrent Interosseous a
  - Common Interosseous a
  - Anterior Interosseous a
  - Posterior Interosseous a

**Radial Artery**
- Radial recurrent a

**Superficial veins**
- Median cubital v
- Median antebrachial v
  - Median cephalic v
  - Median basilic v
- Cephalic v of forearm
- Basilic v of forearm

**Deep Vein**
- Perforating vein

Neurology of the Elbow

**Median Nerve**

**Ulnar**

**Musculocutaneous**
- Lateral cutaneous n of forearm

**Radial**
- Superficial branch of radial n
- Deep branch of radial n
WRIST LEARNING OUTCOMES

1. Identify the surface anatomy landmarks of the wrist.
2. Describe the joint classifications within the wrist including accessory structures.
3. Identify the osteological features of the distal radius distal ulna, carpal bones and metacarpals.
4. Describe the carpal tunnel of the wrist.
5. Identify and describe the muscles of the anterior and posterior compartments of the forearm region in terms of origin, insertion, action and innervation.
6. Identify and describe the organisation and the course of nerves and vessels through the wrist region.

ASSUMED KNOWLEDGE

1. Identification of muscles of the upper limb, elbow and forearm, including attachments and innervation.
2. Understanding of the boundaries and contents of the carpal tunnel and Guyon canal
3. Identification and course of the nerves of the upper limb through the wrist region.
4. Vascular supply and drainage of the upper limb.

CLINICAL/SURGICAL APPLICATIONS

1. Surgical approaches to wrist including the identification of structures at risk.
2. Minimisation techniques to reduce risk to these structures during surgical procedures.
3. Common injuries and damage to muscles, nerves and vessels of the wrist and its implications for the phalanges. Specifically Carpal Tunnel Syndrome.
4. Arthroscopic portal placement for minimally invasive surgical procedures.
### Osteology of the Wrist

<table>
<thead>
<tr>
<th>Distal Radius:</th>
<th>Distal Ulna:</th>
<th>Carpal:</th>
<th>Metacarpals:</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ Dorsal tubercle</td>
<td>➢ Anterior surface</td>
<td>➢ Scaphoid</td>
<td>➢ Head</td>
</tr>
<tr>
<td>➢ Interosseous border</td>
<td>➢ Medial surface</td>
<td>➢ Lunate</td>
<td>➢ Shaft</td>
</tr>
<tr>
<td>➢ Anterior surface</td>
<td>➢ Posterior surface</td>
<td>➢ Triquetral</td>
<td>➢ Base</td>
</tr>
<tr>
<td>➢ Posterior surface</td>
<td>➢ Head</td>
<td>➢ Pisiform</td>
<td></td>
</tr>
<tr>
<td>➢ Styloid Process</td>
<td>➢ Interosseous border</td>
<td>➢ Hamate</td>
<td></td>
</tr>
<tr>
<td>➢ Ulnar notch</td>
<td>➢ Styloid process</td>
<td>➢ Capitate</td>
<td></td>
</tr>
</tbody>
</table>

**Order of Ossification of carpal bones:** capitate, hamate, triquetrum, lunate, scaphoid, trapezium, trapezoid, pisiform

### Arthrology of the Wrist & Hand

<table>
<thead>
<tr>
<th>Distal Radio-ulnar joint:</th>
<th>Radiocarpal Joint</th>
<th>Intercarpal joints</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ Interosseous membrane</td>
<td>➢ Dorsal radiocarpal lig</td>
<td>2-5 Carpometacarpal joints</td>
</tr>
<tr>
<td>➢ Dorsal radioulnar lig</td>
<td>➢ Palmar radiocarpal lig</td>
<td>➢ Dorsal carpometacarpal lig</td>
</tr>
<tr>
<td>➢ Palmar radioulnar lig</td>
<td>➢ Dorsal ulnocarpal lig</td>
<td>➢ Palmar carpometacarpal lig</td>
</tr>
</tbody>
</table>

**Palmar Fascial Complex**

- Transverse fibres of palmar aponeurosis (Skoog’s fibres)
- Longitudinal fibres of palmar aponeurosis
  - 3 layers (spiral band of Gosset)
- Natatory Ligament
- Transverse metacarpal ligament

**Digital Fascial Complex**

- Grayson’s ligaments
- Cleland’s ligaments
- Landsmeer’s ligaments

**Flexor Tendon Sheath**

- Annular pulleys (1-5)
- Cruciform pulleys (0-3)

**Flexor Retinaculum**

**Extensor Retinaculum**

- 6 dorsal compartments
Muscles of the Distal Forearm

**Anterior Compartment of forearm**

- **Superficial**
  - Flexor carpi radialis
  - Palmaris longus
  - Flexor carpi ulnaris

- **Intermediate**
  - Flexor digitorum superficialis

- **Deep**
  - Flexor pollicis longus
  - Flexor digitorum profundus
  - Pronator quadratus

**Posterior Compartment of forearm**

- **Superficial**
  - Brachioradialis
  - Extensor carpi radialis longus
  - Extensor carpi radialis brevis
  - Extensor digitorum
  - Extensor digiti minimi
  - Extensor carpi ulnaris

- **Deep**
  - Supinator
  - Extensor indicies
  - Abductor pollicis longus
  - Extensor pollicis longus
  - Extensor pollicis brevis

Muscles of the Hand

- **Thenar compartment**
  - Abductor pollicis brevis
  - Flexor pollicis brevis
  - Opponens pollicis

- **Adductor compartment**
  - Adductor pollicis

- **Hypothenar compartment**
  - Abductor digiti minimi
  - Flexor digiti minimi brevis
  - Opponens digiti minimi

- **Central compartment**
  - 1<sup>st</sup> and 2<sup>nd</sup> lumbricals
  - 3<sup>rd</sup> and 4<sup>th</sup> lumbricals

- **Interosseous compartment**
  - Dorsal interossei
  - Palmar interossei
Vessels of the forearm and wrist

**Ulnar artery**
- Anterior Interosseous artery
- Posterior Interosseous artery
- Palmar carpal branch
- Dorsal carpal branch
- Deep palmar branch
- Superficial palmar Arch
  - Common & proper palmar digital arteries

**Radial artery**
- Radial recurrent a
- Dorsal carpal arch
  - Dorsal metacarpal arteries
    - Dorsal digital arteries
- Palmar carpal branch
- Superficial palmar branch
- Deep palmar arch
  - Princeps pollicis
  - Radialis indicis
  - Palmar metacarpal (x3) – common digital
  - Perforating branches – dorsal MC arteries

**Superficial veins**
- Median cubital v
- Median antebrachial v
  - Median cephalic v
  - Median basilic v
- Cephalic v of forearm
- Basilic v of forearm
- Dorsal metacarpal v

**Deep veins**
- Perforating vein

Neurology of the Forearm & Wrist

**Lateral cutaneous nerve of forearm**

**Medial cutaneous nerve**

**Anterior Interosseous nerve**

**Median nerve**
- Palmar cutaneous branch
- Medial branch
  - Common palmar digital
  - Proper palmar digital n
- Recurrent branch
- Lateral branch
  - Palmar digital n
  - Proper palmar digital n
- Common palmar digital n
  - Proper palmar digital n

**Ulnar nerve**
- Palmar cutaneous branch
- Superficial branch
  - Common palmar digital (4,5)
- Deep branch
- Dorsal cutaneous branch
  - Dorsal digital n
  - Digital branches of dorsal digital n

**Radial nerve**
- Superficial branch
  - Dorsal digital (1-3)
- Deep (Posterior Interosseous) branch
- Posterior cutaneous n
BACK AND SPINE LEARNING OUTCOMES

8. Identify the surface anatomy landmarks of the back and spine.
9. Describe the joint classifications within the spine including accessory structures.
10. Identify the osteological features of the vertebrae, sacrum and coccyx as well as the curvatures of the spine.
11. Identify and describe the superficial, intermediate and deep muscle groups of the back in terms of origin, insertion, action and innervation.
12. Identify and describe the organisation and the course of the vessels through the vertebral regions.
13. Identify and describe the brachial, lumbar and sacral plexes and their courses.

ASSUMED KNOWLEDGE

5. Identification of muscles of the back, shoulder and hip regions including attachments and innervation.
6. Understanding basic sympathetic and parasympathetic pathways.
7. Organisation and identification of the cranial nerves.
8. Identification and organisation of the spinal cord and spinal nerve roots.

CLINICAL/SURGICAL APPLICATIONS

5. Surgical approaches to the cervical, thoracic and lumbar spine including the identification of structures at risk.
6. Minimisation techniques to reduce risk to these structures during surgical procedures.
7. Common injuries and damage to muscles, nerves and vessels of the back and its implications for the appendicular skeleton.
# Osteology of the vertebral column

## General features
- **Vertebral body**
  - superior annular epiphyses
  - inferior annular epiphyses
- **Vertebral arch**
  - pedicle
  - lamina
  - superior vertebral notch
  - inferior vertebral notch
- **Transverse process**
- **Spinous processes**
- **Superior articular facet**
- **Inferior articular facet**
- **Vertebral foramen**
- **Intervertebral foramen**

## Cervical vertebra
- bifid spinous process
- spinous process with tubercle (prominens only)
- lamina
- body
- uncus/posterolateral lip
- transverse foramina
- anterior tubercle of transverse process
- posterior tubercle of transverse process
- intertubercular lamella of transverse process

## Atlas
- anterior arch and tubercle
- posterior arch and tubercle
- facet for dens of axis
- groove for vertebral artery
- lateral mass with inferior and superior articular facets

## Axis
- anterior arch
- posterior arch
- dens
- transverse foramen

## Thoracic vertebra
- costal facet of transverse process (2-9)
- superior costal facet
- inferior costal facet
- uncus/posterolateral lip (T1)

## Lumbar vertebra
- mammillary process

## Sacrum
- anterior sacral foramina
- posterior sacral foramina
- median crest
- ala
- sacral promontory
- sacral hiatus
- sacral cornua
- apex
- superior articular processes
- inferiorlateral angle
- auricular surface
- sacral canal

## Coccyx
- transverse process
- sacrococcygeal notch
- cornua
- apex
- base
Arthrology of the vertebral column

**Atlantooccipital Joint**
- Anterior membrane
- posterior membrane
- capsule

**Atlanto-axial Joint**
- Cruciate ligament
  - superior longitudinal band
  - inferior longitudinal band
  - transverse lig of atlas
- Alar ligament
- Apical Ligament Apical ligament of dens
- Tectorial membrane

**Zygapophyseal Joint**

**Intervertebral Joints**
- Annulus fibrosis
- Nucleus pulposus

**Ligaments of the vertebral column**
- Anterior Longitudinal Lig
- Posterior Longitudinal Lig
- Suprapinous Lig
- Ligamentum nuchae
- Ligamenta flava
- Interspinous Lig
- Intertransverse Lig

**Sacroiliac Joint**
- anterior sacroiliac lig
- Interosseous sacroiliac Lig
- posterior sacroiliac lig

**Lumbosacral Joint**
- iliolumbar ligament
- intervertebral disc

**Sacroccocygeal joint**
- anterior sacroccocygeal ligament
- posterior sacroccocygeal ligament

Muscles of the back and vertebral column

**Extrinsic Back Muscles**

- **Superficial**
  - Trapezius
  - Latissimus dorsi
  - Levator scapulae
  - Rhomboid major
  - Rhomboid minor

- **Intermediate**
  - serratus posterior superior
  - serratus posterior inferior

**Suboccipital Muscles**
- Rectus Capitis Posterior Major
- Rectus capitis Posterior Minor
- Inferior Oblique of the Head
- Superior Oblique of the Head

**Intrinsic Back Muscles**

- **Superficial**
  - Splenius capitis
  - Splenius cervicis

- **Intermediate (erector spinae)**
  - iliocostalis
  - longissimus
  - spinalis

- **Deep (transversospinals)**
  - semispinalis
  - rotatores
  - multifidus

- **Minor Deep muscles**
  - interspinales
  - intertransversarii
  - levatores costarum
**Spinal Cord**

**Lumbar and Sacral Plexuses**

**General features**
- dura mater
- arachnoid mater
- pia mater
- dural sac
- epidural space
- subarachnoid space
- denticulate ligaments
- anterior spinal arteries and veins
- posterior spinal arteries and veins
- cervical enlargement
- lumbar enlargement
- conus medullaris
- cauda equina
- filum terminale

**Spinal nerves**
- cervical
- thoracic
- lumbar
- sacral
- coccygeal

- features:
  - dorsal and ventral rootlets
  - dorsal and ventral roots
  - dorsal root ganglion
  - spinal nerve body
  - ventral rami
  - dorsal rami
  - grey and white rami communicans

**Brachial Plexus**

**Roots C5-T1**

**Trunks**
- Superior C5-C6
- Middle C7
- Inferior C8-T1

**Divisions**
- Anterior
- Posterior

**Cords**
- Posterior C5-C8,T1
- Lateral C5-C7
- Medial C8-T1

**Cords**

- **Posterior C5-C8, T1**
  - upper subscapular n (C5,C6)
  - lower subscapular n (C5,C6)
  - thoracodorsal n (C6,C7,C8)
  - radial n (C5,C6)
  - axillary n (C5,C6,C7)
  - =ULTRA=

- **Lateral C5-C7**
  - lateral pectoral n (C5,C6,C7)
  - lat root of median n (C6,C7)
  - musculocutaneous n (C5,C6,C7)
  - =LLM – ladies love men=

- **Medial C8-T1**
  - medial pectoral n (C8,T1)
  - med cutaneous n of arm (C8,T1)
  - med cutaneous n of forearm (C8,T1)
  - ulnar n (C7,C8,T1)
  - med root of median n (C8,T1)
  - =MMMUM – most medical men use morphine=
**Lumbar Plexus L1-L4**
- Iliohypogastric (T12,L1)
- Ilioinguinal (L1)
- Genitofemoral (L1,L2)
- Lateral femoral cutaneous (L2,L3)
- Obturator (L2-L4)
- Femoral (L2-L4)

**Sacral Plexus L4 – S4**
- Lumbosacral trunk (L4,L5)
- Posterior division
  - Superior gluteal n (L4,L5,S1)
  - Inferior gluteal n (L5,S1,S2)
  - N to piriformis (S1-S2)
  - Common fibular n (L4,L5,S1)
- Anterior division
  - N to quadratus femoris (L4,L5,S1)
  - N to obturator internus (L5,S1,S2)
  - Post femoral cutaneous n (S1-S3)
  - Pudendal n (S2,S3,S4)
  - N to levator ani (S3,S4)
  - Tibial n (L4,L5,S1-S3)
  - Sciatic n
    - Common fibular n
    - Tibial n

**Vasculature**

**Longitudinal Arteries**
- Anterior spinal
- Posterior spinal (x2)

**Intersegmental Vessels**

**Cervical**
- Deep cervical artery
- Ascending cervical artery

**Vertebral artery**
- Basilar artery
- Ant inferior cerebellar artery
- Ant spinal artery
  - Sulcal arteries
- Post inferior cerebellar arteriosler a
- Posterior spinal arteries

**Thoracic**
- Post intercostal artery

**Lumbar**
- Lumbar artery

**Sacral**
- Lateral sacral artery
HIP LEARNING OUTCOMES

1. Identify the surface anatomy landmarks of the pelvic girdle.
2. Describe the joint classifications within the pelvic girdle including accessory structures.
3. Identify the osteological features of the pelvic girdle and hip including sacrum, coccyx, ischium, ilium, pubis, acetabulum and proximal femur.
4. Describe the greater and lesser pelvis, greater and lesser sciatic foramen and the obturator foramen including any structures which pass through these.
5. Identify and describe the muscles of the pelvis and hip region.
6. Identify and describe the organisation and the course of nerves and vessels through the hip and pelvic region as well as sexual variations between male and female pelves.

ASSUMED KNOWLEDGE

1. Identification of muscles of the pelvis and hip, including attachments and innervation.
2. Understanding of the boundaries and contents of the pelvic foramen.
3. Identification and course of the nerves of the lower limb through the hip and pelvis region.
4. Vascular supply and drainage of the lower limb.

CLINICAL/SURGICAL APPLICATIONS

1. Surgical approaches to hip including the identification of structures at risk.
2. Minimisation techniques to reduce risk to these structures during surgical procedures.
3. Common injuries and damage to muscles, nerves and vessels of the hip and its implications for gait.
4. Arthroscopic portal placement for minimally invasive surgical procedures.
# Osteology of the Hip

<table>
<thead>
<tr>
<th><strong>Ilium</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>- Ala</td>
</tr>
<tr>
<td>- Body</td>
</tr>
<tr>
<td>- Pelvic surface</td>
</tr>
<tr>
<td>- Anterior superior iliac spine (ASIS)</td>
</tr>
<tr>
<td>- Anterior inferior iliac spine</td>
</tr>
<tr>
<td>- Iliac fossa</td>
</tr>
<tr>
<td>- Iliac Tuberosity</td>
</tr>
<tr>
<td>- Auricular surface</td>
</tr>
<tr>
<td>- Iliopectineal line</td>
</tr>
<tr>
<td>- Iliac crest</td>
</tr>
<tr>
<td>- Posterior superior iliac spine (PSIS)</td>
</tr>
<tr>
<td>- Posterior inferior iliac spine</td>
</tr>
<tr>
<td>- Gluteal surface</td>
</tr>
<tr>
<td>- Posterior gluteal line</td>
</tr>
<tr>
<td>- Anterior gluteal line</td>
</tr>
<tr>
<td>- Inferior gluteal line</td>
</tr>
<tr>
<td>- Auricular surface</td>
</tr>
<tr>
<td>- greater sciatic notch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Ischium</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>- ischial tuberosity</td>
</tr>
<tr>
<td>- ischial spine</td>
</tr>
<tr>
<td>- ischial ramus</td>
</tr>
<tr>
<td>- lesser sciatic notch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Pubis</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>- body</td>
</tr>
<tr>
<td>- superior pubic rami</td>
</tr>
<tr>
<td>- inferior pubic rami</td>
</tr>
<tr>
<td>- pectin pubis</td>
</tr>
<tr>
<td>- pubic(oblurator) crest</td>
</tr>
<tr>
<td>- pubic tubercle</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Acetabulum</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>- formed by ilium, ischium and pubis</td>
</tr>
<tr>
<td>- lunate surface</td>
</tr>
<tr>
<td>- acetabular fossa</td>
</tr>
<tr>
<td>- acetabular rim</td>
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<tr>
<td>- acetabular notch</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th><strong>Coccyx</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>- transverse process</td>
</tr>
<tr>
<td>- sacroccocygeal notch</td>
</tr>
<tr>
<td>- cornua</td>
</tr>
<tr>
<td>- apex</td>
</tr>
<tr>
<td>- base</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Sacrum</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>- anterior sacral foramina</td>
</tr>
<tr>
<td>- posterior sacral foramina</td>
</tr>
<tr>
<td>- median crest</td>
</tr>
<tr>
<td>- ala</td>
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<tr>
<td>- sacral promontory</td>
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<tr>
<td>- sacral hiatus</td>
</tr>
<tr>
<td>- sacral cornua</td>
</tr>
<tr>
<td>- apex</td>
</tr>
<tr>
<td>- superior articular processes</td>
</tr>
<tr>
<td>- inferolateral angle</td>
</tr>
<tr>
<td>- auricular surface</td>
</tr>
<tr>
<td>- sacral canal</td>
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</table>

<table>
<thead>
<tr>
<th><strong>Proximal Femur</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>- Head</td>
</tr>
<tr>
<td>- Anatomical Neck</td>
</tr>
<tr>
<td>- Surgical Neck</td>
</tr>
<tr>
<td>- Greater trochanter</td>
</tr>
<tr>
<td>- Lesser trochanter</td>
</tr>
<tr>
<td>- Intertrochanteric linePectineal line</td>
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<tr>
<td>- Intertrochanteric crest</td>
</tr>
<tr>
<td>- Quadrate tubercle</td>
</tr>
<tr>
<td>- Trochanteric fossa</td>
</tr>
<tr>
<td>- Fovea</td>
</tr>
<tr>
<td>- Gluteal tuberosity</td>
</tr>
<tr>
<td>- Angle of inclination</td>
</tr>
<tr>
<td>- Angle of anteverision</td>
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</tbody>
</table>
### Arthrology of the Hip

<table>
<thead>
<tr>
<th>Hip Joint</th>
<th>Sacroiliac Joint</th>
<th>Sacroccocygeal Joint</th>
</tr>
</thead>
<tbody>
<tr>
<td>acetabular labrum</td>
<td>anterior sacroiliac ligaments</td>
<td>anterior sacroccocygeal ligament</td>
</tr>
<tr>
<td>transverse acetabular ligament</td>
<td>interosseous sacroiliac ligaments</td>
<td>posterior sacroccocygeal ligament</td>
</tr>
<tr>
<td>ligament for head of femur</td>
<td>posterior sacroiliac ligaments</td>
<td></td>
</tr>
<tr>
<td>zona orbicularis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iliofemoral ligament</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pubofemoral ligament</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ischiofemoral ligament</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lumbosacral Joint</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>iliolumbar ligament</td>
<td></td>
</tr>
<tr>
<td>intervertebral disc</td>
<td></td>
</tr>
</tbody>
</table>

### Muscles of the Hip & Thigh

<table>
<thead>
<tr>
<th>Gluteal Region</th>
<th>Anterior Thigh</th>
<th>Posterior Thigh</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Superficial Abductors and Rotators</strong></td>
<td><strong>Hip Flexors</strong></td>
<td><strong>Hip Extensors/Knee flexors</strong></td>
</tr>
<tr>
<td>gluteus maximus</td>
<td>pectineus</td>
<td>semitendinosus</td>
</tr>
<tr>
<td>gluteus medius</td>
<td>iliopsoas</td>
<td>semimembranosus</td>
</tr>
<tr>
<td>gluteus minimus</td>
<td>• Psoas major</td>
<td>biceps femoris</td>
</tr>
<tr>
<td>tensor fascia lata</td>
<td>• Psoas minor</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Iliacus</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Sartorius</td>
<td></td>
</tr>
<tr>
<td><strong>Deep Abductors and Rotators</strong></td>
<td><strong>Knee extensors</strong></td>
<td><strong>Medial Thigh</strong></td>
</tr>
<tr>
<td>piriformis</td>
<td>Quadriceps femoris</td>
<td><strong>Thigh Adductors</strong></td>
</tr>
<tr>
<td>obturator internus</td>
<td>• Rectus femoris</td>
<td>adductor longus</td>
</tr>
<tr>
<td>superior gemellus</td>
<td>• Vastus lateralis</td>
<td>adductor brevis</td>
</tr>
<tr>
<td>inferior gemellus</td>
<td>• Vastus medialis</td>
<td>adductor magnus</td>
</tr>
<tr>
<td>quadratus femoris</td>
<td>• Vastus intermedius</td>
<td>gracilis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>obturator externus</td>
</tr>
</tbody>
</table>
## Vessels of the Hip & Thigh

<table>
<thead>
<tr>
<th>Gluteal and Posterior Thigh</th>
<th>Anterior and Medial Thigh</th>
<th>Trochanteric Anastomosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>superior gluteal</td>
<td>femoral</td>
<td></td>
</tr>
<tr>
<td>inferior gluteal</td>
<td>deep artery of the thigh</td>
<td></td>
</tr>
<tr>
<td>internal pudendal</td>
<td>medial circumflex femoral</td>
<td></td>
</tr>
<tr>
<td>perforating</td>
<td>lateral circumflex femoral</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Obturatorobturator</td>
<td></td>
</tr>
</tbody>
</table>

## Neurology of the Hip & Thigh

### Lumbar Plexus
- obturator
- femoral
- lateral femoral cutaneous
- femoral branch of genitofemoral
- lumbosacral trunk

### Sacral Plexus
- sciatic
- pudendal
- superior gluteal
- inferior gluteal
- posterior femoral cutaneous
- nerve to obturator internus
- nerve to quadratus femoris
### Structural Relationships of the Hip and Thigh

#### Femoral Triangle

**boundaries**
- superior – inguinal ligament
- medial – adductor longus
- lateral – Sartorius
- floor – iliopsoas and pectineus
- roof – fascia lata and cribiform fascia

**contents**
- femoral nerve and terminal branches
- femoral vein and tributaries
  - great saphenous v
  - deep femoral v
- deep inguinal lymph nodes

#### Spaces between pelvis and lower limb

**Obturator foramen**
- obturator a
- obturator v
- obturator n

**Lesser Sciatic Foramen**

**boundaries**
- ischial tuberosity - anterior
- ischial spine and sacrospinous ligament – superior
- sacrotuberous ligament – posterior
  (aka lesser sciatic notch and 2 ligaments)

**contents**
- obturator internus tendon
- internal pudendal vessels
- pudendal n
- n to obturator internus

**Greater sciatic foramen**

**boundaries**
- greater sciatic notch – anterolateral
- sacrotuberous ligament – posteromedial
- sacrospinous ligament – inferior
- anterior sacroiliac ligament – superior

**contents**
- suprapiriform foramen
- superior gluteal vessels
- superior gluteal n
- infrapiriform foramen
- inferior gluteal vessels
- internal pudendal vessels
- inferior gluteal n
- pudendal n
- sciatic n
- posterior femoral cutaneous n
- n to obturator internus
- n to quadratus femoris
KNEE LEARNING OUTCOMES

1. Identify the surface anatomy landmarks of the knee.
2. Describe the joint classifications within the knee including accessory structures.
3. Identify the osteological features of the distal femur, proximal tibia and proximal fibula.
4. Describe the Popliteal fossa of the knee.
5. Identify and describe the muscles of the anterior, medial and posterior compartments of the leg and anterior and posterior lower leg regions in terms of origin, insertion, action and innervation.
6. Identify and describe the organisation and the course of nerves and vessels through the knee region.
7. Describe the vasculature which makes up the periarticular anastomosis.

ASSUMED KNOWLEDGE

1. Identification of muscles of the lower limb including attachments and innervation.
2. Understanding of the boundaries and contents of the popliteal fossa.
3. Identification and course of the nerves of the lower limb through the knee region.
4. Vascular supply and drainage of the lower limb.

CLINICAL/SURGICAL APPLICATIONS

1. Surgical approaches to knee including the identification of structures at risk.
2. Minimisation techniques to reduce risk to these structures during surgical procedures.
3. Common injuries and damage to muscles, nerves and vessels of the knee and its implications.
4. Ligament and meniscal injury and repair indications.
5. Arthroscopic portal placement for minimally invasive surgical procedures.
# Osteology of the Knee

<table>
<thead>
<tr>
<th>Distal Femur</th>
<th>Proximal Tibia</th>
<th>Fibula</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Anterior</strong></td>
<td><strong>Anterior</strong></td>
<td><strong>Anterior border</strong></td>
</tr>
<tr>
<td>- Patella surface</td>
<td>- Anterior border</td>
<td>- Interosseous border</td>
</tr>
<tr>
<td>- Medial condyle</td>
<td>- Interosseous border</td>
<td>- Posterior border</td>
</tr>
<tr>
<td>- Medial epicondyle</td>
<td>- Medial border</td>
<td>- Medial surface</td>
</tr>
<tr>
<td>- Lateral condyle</td>
<td>- Medial surface</td>
<td>- Lateral surface</td>
</tr>
<tr>
<td>- Lateral epicondyle</td>
<td>- Lateral surface</td>
<td>- Tubercles of intercondylar</td>
</tr>
<tr>
<td>- Adductor tubercle</td>
<td>- Tubercles of intercondylar eminence</td>
<td>- eminence</td>
</tr>
<tr>
<td></td>
<td>- Tibial tuberosity</td>
<td>- Lateral</td>
</tr>
<tr>
<td></td>
<td>- Lateral condyle</td>
<td>- Medial</td>
</tr>
<tr>
<td></td>
<td>- Medial condyle</td>
<td>- Lateral</td>
</tr>
<tr>
<td></td>
<td>- Anterior intercondylar area</td>
<td>- Separated by</td>
</tr>
<tr>
<td></td>
<td>- Impression for iliobibial tract</td>
<td>- Medial</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Lateral</td>
</tr>
<tr>
<td><strong>Posterior</strong></td>
<td><strong>Posterior intercondylar area</strong></td>
<td><strong>Posterior surface</strong></td>
</tr>
<tr>
<td>- Popliteal surface</td>
<td>- Lateral tibial plateau</td>
<td>- Medial</td>
</tr>
<tr>
<td>- Intercondylar fossa</td>
<td>- Medial tibial plateau</td>
<td>- Lateral</td>
</tr>
<tr>
<td>- Medial supracondylar line</td>
<td>- Articular facet for fibula</td>
<td>- Separated by</td>
</tr>
<tr>
<td>- Lateral supracondylar line</td>
<td><strong>Patella</strong></td>
<td>- Medial crest</td>
</tr>
<tr>
<td></td>
<td>- Base</td>
<td>- Apex</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Anterior surface</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Posterior surface</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Facet for lateral condyle of</td>
</tr>
<tr>
<td><strong>Latera</strong></td>
<td></td>
<td>- Facet for medial condyle of</td>
</tr>
<tr>
<td>- Impression for lateral head</td>
<td></td>
<td>- Fibula</td>
</tr>
<tr>
<td>of gastrocnemius (sup)</td>
<td></td>
<td>- Vertical ridge</td>
</tr>
<tr>
<td>- Groove for popliteus tendon</td>
<td></td>
<td>- “odd” facet</td>
</tr>
<tr>
<td>(inf)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Arthrology of the Knee

<table>
<thead>
<tr>
<th>Joint Capsule</th>
<th>Intracapsular ligaments</th>
<th>Tibiofibular Joint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Patellar ligament*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Infrapatella fat pad and bursa</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Infrapatella synovial folds</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Alar folds</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Medial patellar retinacula</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lateral patellar retinacula</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Iliotibial tract</td>
<td></td>
</tr>
<tr>
<td>Posterior</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oblique Popliteal ligament*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Arcuate Popliteal ligament*</td>
<td></td>
</tr>
<tr>
<td>Lateral</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fibula collateral ligament(lat)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tibial collateral ligament (med)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>popliteofibular</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Anterior cruciate ligament (ACL)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Posterior cruciate ligament (PCL)</td>
<td></td>
</tr>
</tbody>
</table>

Menisci

- Lateral meniscus
- Medial meniscus
- Transverse genicular ligament
- Posterior meniscofemoral ligament
- Anterior meniscofemoral ligament
- Ant & post horn of medial meniscus
- Ant & post horn of the lateral meniscus
- Coronary ligament
- Politeus hiatus

Patella

- Vastus intermedius of quadriceps tendon
- Rectus femoris of quadriceps tendon
- Vastus medialis of quadriceps tendon
- Vastus lateralis of quadriceps tendon
- Patellar ligament

Bursae

- Suprapatellar
- Popliteus
- Anserine
- Gastrocnemius
- Semimembranosus
- Subcutaneous prepatellar
- Subcutaneous infrapatellar
- Deep infrapatellar

Nerves of the knee

- **Sciatic nerve**
  - Common fibular/peroneal
  - Lateral sural cutaneous
  - Superficial fibular
  - Deep fibular
  - Tibial
    - Medial sural cutaneous

- **Femoral nerve**
  - Saphenous
  - Infrapatellar branch

- **Obturator nerve**
  - Anterior cutaneous branch
Muscles of the Knee

<table>
<thead>
<tr>
<th>Thigh</th>
<th>Lower leg</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Posterior Compartment</strong></td>
<td><strong>Anterior Compartment</strong></td>
</tr>
<tr>
<td>Semitendinosus*</td>
<td>Tibialis anterior</td>
</tr>
<tr>
<td>Semimembranosus</td>
<td>Extensor digitorum longus</td>
</tr>
<tr>
<td>Biceps femoris</td>
<td>Extensor hallucis longus</td>
</tr>
<tr>
<td>• Long head</td>
<td></td>
</tr>
<tr>
<td>• Short head</td>
<td></td>
</tr>
<tr>
<td>Collectively known as hamstrings</td>
<td></td>
</tr>
<tr>
<td><strong>Anterior Compartment</strong></td>
<td><strong>Lateral Compartment</strong></td>
</tr>
<tr>
<td>Articularis genu</td>
<td>Fibularis longus &amp; brevis</td>
</tr>
<tr>
<td><strong>Flexors of the hip</strong></td>
<td></td>
</tr>
<tr>
<td>Sartorius*</td>
<td></td>
</tr>
<tr>
<td><strong>Extensors of the knee</strong></td>
<td></td>
</tr>
<tr>
<td>Rectus femoris</td>
<td></td>
</tr>
<tr>
<td>Vastus lateralis</td>
<td></td>
</tr>
<tr>
<td>Vastus medialis</td>
<td></td>
</tr>
<tr>
<td>Vastus intermedius</td>
<td></td>
</tr>
<tr>
<td>Collectively known as the quadriceps femoris</td>
<td></td>
</tr>
<tr>
<td><strong>Adductors of the thigh</strong></td>
<td></td>
</tr>
<tr>
<td>Adductor magnus</td>
<td></td>
</tr>
<tr>
<td>Gracilis*</td>
<td></td>
</tr>
<tr>
<td>* pes anserinus – converging tendons</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Lower leg</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Anterior Compartment</strong></td>
<td></td>
</tr>
<tr>
<td>Tibialis anterior</td>
<td></td>
</tr>
<tr>
<td>Extensor digitorum longus</td>
<td></td>
</tr>
<tr>
<td>Extensor hallucis longus</td>
<td></td>
</tr>
<tr>
<td><strong>Lateral Compartment</strong></td>
<td></td>
</tr>
<tr>
<td>Fibularis longus &amp; brevis</td>
<td></td>
</tr>
<tr>
<td><strong>Posterior Compartment</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Superficial</strong></td>
<td></td>
</tr>
<tr>
<td>Gastrocnemius</td>
<td></td>
</tr>
<tr>
<td>• Medial head</td>
<td></td>
</tr>
<tr>
<td>• Lateral head</td>
<td></td>
</tr>
<tr>
<td>Plantaris</td>
<td></td>
</tr>
<tr>
<td>Soleus</td>
<td></td>
</tr>
<tr>
<td><strong>Deep</strong></td>
<td></td>
</tr>
<tr>
<td>Popliteus</td>
<td></td>
</tr>
<tr>
<td>Tibialis posterior</td>
<td></td>
</tr>
<tr>
<td>Flexor digitorum longus</td>
<td></td>
</tr>
<tr>
<td>Flexor hallucis longus</td>
<td></td>
</tr>
</tbody>
</table>
Vessels of the Knee

- Femoral Artery
- Popliteal artery
- Anterior tibial artery
- Posterior tibial artery

- Small Saphenous vein
- Popliteal vein
- Great Saphenous vein

**Periarticular Genicular anastamosis**
- Descending genicular (& saphenous artery)
- Lateral femoral circumflex descending branch
- Superior lateral genicular
- Superior medial genicular
- Middle genicular
- Inferior lateral genicular
- Inferior medial genicular
- Circumflex fibular
- Anterior tibial recurrent
- Posterior tibial recurrent
ANKLE LEARNING OUTCOMES

1. Identify the surface anatomy landmarks of the lower leg, ankle and foot.
2. Describe the joint classifications within the ankle including accessory structures.
3. Identify the osteological features of the distal tibia and distal fibula, tarsal bones and metatarsals.
4. Identify and describe the muscles of the anterior and posterior compartments of the lower leg region in terms of origin, insertion, action and innervation.
5. Identify and describe the organisation and the course of nerves and vessels through the lower leg, ankle and foot regions.

ASSUMED KNOWLEDGE

1. Identification of muscles of the lower limb, knee and lower leg, including attachments and innervation.
2. Identification and course of the nerves of the lower limb through the ankle region.
3. Vascular supply and drainage of the lower limb.

CLINICAL/SURGICAL APPLICATIONS

1. Surgical approaches to lower leg, ankle and foot including the identification of structures at risk.
2. Minimisation techniques to reduce risk to these structures during surgical procedures.
3. Common injuries and damage to muscles, nerves and vessels of the lower leg, foot and ankle and its implications for the phalanges.
4. Arthroscopic portal placement for minimally invasive surgical procedures.
Osteology of the Lower Leg and Foot

Distal Tibia:
- Anterior surface
- Posterior surface
- Medial surface
- Inferior articular surface
- Interosseous border
- Medial malleolus
- Groove for tibialis posterior
- Chaput’s tubercle
- Volkman’s tubercle
- Fibular notch

Distal Fibula:
- Articular facet for lateral malleolus
- Malleolar fossa
- Lateral malleolus
- Triangular subcutaneous area
- Groove for peroneus brevis
- Surface for interosseous ligament
- Wagstaffe’s tubercle

Tarsals:
- Talus
- Calcaneus
- Navicular
- Cuboid
- Medial cuneiform
- Intermediate cuneiform
- Lateral cuneiform

Metatarsals:
- Head
- Shaft
- Base

Phalanges
- Proximal
- Middle
- Distal (except 1st)

Osteology of the Tarsals

Talus
- Body surfaces
  - Superior (trochlea)
    - Medial malleolus
    - Lateral malleolus
  - Lateral
  - Medial
  - Posterior process (stieda’s tubercle)
    - Medial tubercle
    - Lateral tubercle
    - Groove for tendon of flexor hallucis longus
  - Inferior/plantar
    - Anterior, middle, posterior facets
    - Sulcus tali

- Neck

- Headhead

Calcanéus
- Surfaces
  - Superior
    - Posterior talar facet
    - Calcaneal sulcus
    - Anterior talar articular surface
    - Middle talar articular surface
  - Inferior/plantar
    - Calcaneal tuberosity
      - Lateral process
      - Medial process
    - Anterior tubercle
  - Medial
    - Sustentaculum tali
    - Groove for tibialis posterior
  - Lateral
    - Fibular trochlea
    - Groove for fibularis tendons
    - Attachment of calcaneofibular lig.

Cuboid
- Tuberosity
- Groove for fibularis longus tendon
### Arches

<table>
<thead>
<tr>
<th>Medial Longitudinal Arch</th>
<th>Lateral Longitudinal Arch</th>
<th>Transverse Arches</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ calcaneus</td>
<td>➢ calcaneus</td>
<td>➢ prominent at distal row of tarsals and base of metatarsals</td>
</tr>
<tr>
<td>➢ talus</td>
<td>➢ cuboid</td>
<td></td>
</tr>
<tr>
<td>➢ navicular</td>
<td>➢ metatarsals 4-5</td>
<td></td>
</tr>
<tr>
<td>➢ 3 cuneiforms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>➢ metatarsals 1-3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Arthrology

#### Tibiofibular syndesmosis

- interosseous tibiofibular lig
- anterior tibiofibular lig
- posterior tibiofibular lig
- inferior transverse tibiofibular lig

#### Ligaments of the Foot

- Plantar calcaneonavicular (spring) ligament
- Long calcaneocuboid (long plantar) ligament
- Plantar calcaneocuboid (short plantar) ligament

#### Talocrural (ankle) Joint

- Anterior and posterior joint capsule - thin
- Supported by:
  - Medial collateral (deltoid) ligament
  - tibionavicular lig
  - tibiocalcaneal lig
  - anterior tibiotalar lig
  - posterior tibiotalar lig
- Lateral collateral ligament
  - anterior talofibular lig
  - posterior talofibular lig
  - calcaneofibular lig

#### Foot Joints

- Talocalcaneal joint
  - anatomical subtalar jt (posterior part of “functional subtalar jt”)
- Talocalcaneonavicular jt
- talocalcaneal part
talonavicular part (part of transv tarsal jt)
- Calcaneocuboid Joint (part of transverse tarsal joint)
- Intermetatarsal joint
- Metatarsophalangeal joint
- Tarsometatarsal Joints (Lis Franc joint)
- Interphalangeal joints

### Bursae of Heel

- Retrocalcaneal
- Superficial calcaneal
- Subcalcaneal
## Myology

### Anterior compartment
*(dorsiflexors of ankle and extensors of toes)*
- tibialis anterior
- extensor digitorum longus
- extensor hallucis longus
- fibularis/peroneus tertius

**features**
- superior extensor retinaculum
- inferior extensor retinaculum

### Lateral Compartment
*(eversion)*
- fibularis/peroneus longus
- fibularis/Peroneus brevis

**features**
- superior fibular retinaculum
- inferior fibular retinaculum

### Posterior Compartment
*(plantarflexors)*
- superficial muscles
  - gastrocnemius
  - soleus & tendinous arch of soleus
  - triceps surae
  - calcaneal tendon
- plantaris
- deep muscles
  - popliteus
  - flexor hallucis longus
  - flexor digitorum longus
  - tibialis posterior

### Dorsal surface
- extensor digitorum brevis
- extensor hallucis brevis

### Plantar surface

**first layer**
- abductor hallucis
- flexor digitorum brevis
- abductor digiti minimi

**second layer**
- quadratus plantae
- lumbricals

**third layer**
- flexor hallucis brevis
- adductor hallucis
- flexor digiti minimi brevis

**fourth layer**
- plantar interossei (3 in total) – PAD
- dorsal interossei (4 in total) - DAB
Vasculature

- popliteal a and v
- anterior tibial a and v
  - dorsalis pedis a
  - lateral tarsal a
  - 1st dorsal metatarsal a
  - arcuate a
  - 2nd, 3rd, 4th metatarsal a
  - dorsal digital a

- perforating veins – sup to deep v
- dorsal metatarsal v
- dorsal venous arch of foot
- plantar venous arch
- medial marginal v > greater saphenous v
- lateral marginal v > lesser saphenous v
- accessory saphenous v

- posterior tibial a and v
  - fibular a and v
  - perforating branch of fibular a
  - medial plantar a
    - superficial plantar arch
  - lateral planter a
    - deep plantar arch/plantar arterial arch
    - plantar metatarsal a
    - plantar digital a

Nerves

- femoral n
  - saphenous n

- common fibular/peroneal n
  - deep fibular n
  - superficial peroneal n
  - lateral communicating branch
    - sural n > dorsal lateral cutaneous nerve of foot

- tibial nerve
  - medial communicating branch contributing to sural nerve
  - lateral plantar n
  - medial plantar n