

PT 6058

GROSS ANATOMY

STUDENT DISSECTOR MANUAL

Edition 2021



PHYSICAL THERAPY

UNIVERSITY OF MINNESOTA

Driven to DiscoverSM

Gross Anatomy for Physical Therapy Student Dissector Manual, Edition 2021

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This human dissection manual was authored by three Ph.D. trained physical therapists, each having distinctly different clinical training and academic research backgrounds. Ward M. Glasoe was trained in orthopaedics, James R. Carey in neurology, and Brendan J. Dougherty in respiratory neurophysiology. Their careers intersect in the teaching Anatomy for Physical Therapy at The University of Minnesota.

Anatomy is the first course offered in the Doctor of Physical Therapy (DPT) educational curriculum at the University of Minnesota and the class meets every day for a total of six weeks. The course materials are delivered through lecture, laboratory dissection, and surface anatomy palpation training. Lecture is delivered from 8:00am to 10:00am, the students subsequently dissect human cadavers from 10:00am to 12:00pm, and the instruction of surface anatomy palpation is held for two hours each week in a single afternoon classroom session. This manual guides graduate physical therapy students through the process of whole body dissection. All students successfully completed prerequisite training in under-graduate anatomy.

The Anatomy for Physical Therapy course is supported by the University of Minnesota's Anatomy Bequest Program. This organization provides the cadavers and the human dissection teaching laboratories in association with The University of Minnesota Medical School. The laboratories are equipped with dissection tables and tools, and an assortment of anatomical models described throughout this manual. Because dissection governs the timing of content delivered in the course, this manual makes frequent reference to the instruction of anatomical structure and function that occurs in lecture. Readers not directly involved in this course may find the references made to lecture (course content not provided in this manual) to be a distraction. In acceptance of this reality, know that in teaching your own course, you are free to reproduce or adapt any information in this manual for your own purposes, provided this manual is properly referenced as your source.

In addition to the utility this manual provides in guiding the dissection efforts of graduate students, this dissector was written to pay tribute to Dr. James R. Carey. Dr. Carey taught this course for 30 years, until his retirement in 2017. The systematic body dissections described herein were developed by Dr. Carey. He participated in writing the first draft of this manual after retirement. One of his contributions was the addition of the italicized clinical notes that present in boxes throughout the manual. Many students consider the study of anatomy to be dull, so these notes were inserted to engage the students in their development as physical therapists.

The final draft of the dissection manual was written by Dr. Ward M. Glasoe, in collaboration with Dr. James R. Carey and Dr. Brendan J. Dougherty. As of the final writing of this 2021 Edition, Dr. Dougherty serves as Course Coordinator of the Gross Anatomy for Physical Therapy course and Dr. Glasoe assists.

STUDENT DISSECTOR

Introduction

As a student, you assume the responsibility for the proper care and handling of the body assigned to you to dissect. The cadaver was donated (donor) by a person wishing to contribute their body to further the advancement of medical education and research. This gift, and the entire dissection experience, should be treated with the same respect afforded by society to any living person.

Lab Rules and Guidelines

- Visitors are not permitted, and the doors entering the lab should be kept closed at all times.
- Never bring food or drink into the lab; never bring cell phones or electronic devices or take photographs in the lab. Always remove gloves and aprons when exiting the lab.
- The donor has been embalmed, draped with a cloth, and stored inside a dissection-table. Uncover only the region of the body assigned for dissection.
- Keep the body moistened as necessary, draped, and lowered in the dissection-table when the body is not in use. Draping slows the tissues from drying-out, which preserves the look and feel of the body tissues.
- Each table has two sets of dissection instruments. Scalpel blades are kept stored in a sealed package until loaded on the scalpel handle. Blades dull quickly, so replace as needed.
- Dispose of used blades in the designated sharps container; always rinse any tools used for dissection before placing them in storage.
- Keep the laboratory clean with used gloves and aprons disposed of in the garbage.
- Keep all tissues dissected from the body in the containers designated for that body.
- Review the anatomy assigned for dissection in advance of each lab period. Read the part of this manual that describes the dissection procedure for the lab that day, and by viewing the region of the body assigned for dissection in an anatomy atlas.
- Use your time in lab efficiently. When you are not dissecting, return to studying the structures previously dissected, or study the prosected models provided for you in lab.

Dissection Procedure

The removal of skin is the first step in dissection. Since physical therapy training is centered on the study of the human movement, the goal in dissection is to incise and remove the skin and fat and subcutaneous connective tissues from the body while leaving the muscles intact for study. A traction force applied to the skin delivered in combination with a sweeping cutting motion with a scalpel works well to lift and remove the skin and subcutaneous tissues from the muscle. This skin removal technique will be demonstrated by the instructor during the first lab period.

Tissue Identification

Muscles are easy to identify, as their red color and fiber striations makes them stand apart from the surrounding tissues. The names of **muscles are bolded black** in this dissection manual.

Identification of the other body tissues is more challenging, as adipose and connective tissue covers almost everything. These tissues are variable in color, appearance, and texture. Because fat and connective tissues are non-essential to producing movement, the dissection technique used in lab will intentionally involve the removal of these accessory tissues for cleaning the muscles. The removal of fat and connective tissue also makes it easier to locate and identify the nerve and blood vessels that will also be studied in detail.

In this manual, the name of the **nerve (n.) is bolded green**, the **artery (a.) is bolded red**, and the **vein (v.) is bolded blue**. These structures most often travel together in a neurovascular bundle.

- The **nerve (n.)** can be distinguished by its silvery cord or thread-like appearance. A nerve is comparatively strong and seldom breaks when tugged on, and feels solid when squeezed.
- The **artery (a.)** is pinkish in color, has a tubular look, and feels hollow when squeezed.
- The **vein (v.)** is bluish in appearance and often, filled with clotted blood. It has thin walls that tear when pulled-on, and is usually targeted for removal during dissection.

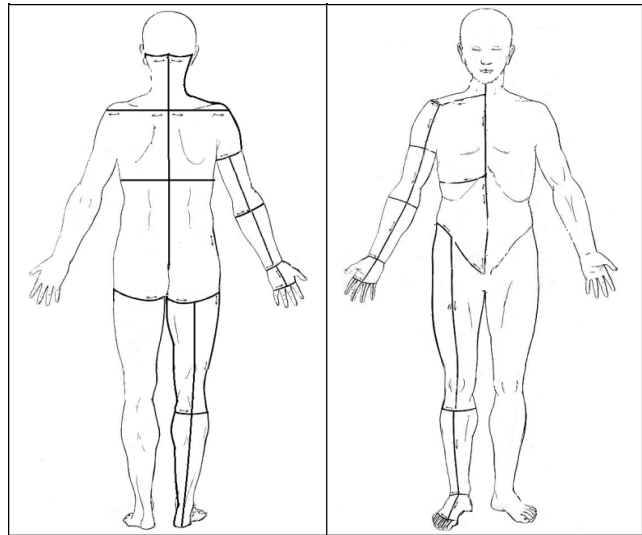
Lab Organization

This manual describes the systematic dissection of the body. There are 30 labs; each lab is 2 hours long.

Four students are assigned to a table, and work in pairs to dissect one side of the body.

Dissection starts in the upper trunk, moving into the upper extremity.

Diagrams in this manual illustrate the incisions made to remove the skin. All of the tissues removed from a body are kept stored with that body in a container under the table.

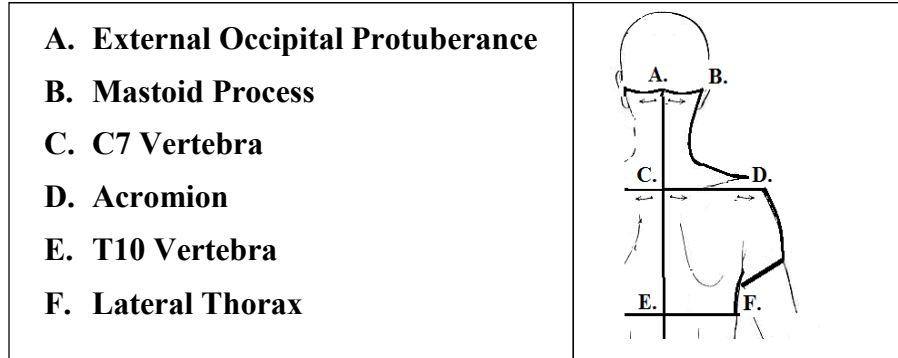


Lab 1. Upper Extremity Osteology; Posterior Shoulder

- The study of bone is called *osteology*. The upper extremity is studied in this lab.
- Knowing the shape of the bones and the names of the assorted tubercles, processes, and condyles of the skeleton is foundational to learning the action of muscles, joints, and ligaments (musculoskeletal system) that govern human movement. In this manual, the word ligament is abbreviated lig in this manual.
- Working independently in small groups, the students study the clavicle, scapula, humerus, ulna, radius, and bones of the wrist and hand with their classmates. An anatomical atlas is available at each table to use as a reference. The instructors are available to assist as needed.
- After studying osteology for the 20 minutes, the instructors will bring the class together to distribute aprons and gloves, and demonstrate operation of the dissection-tables, and instruct a method for loading and unloading a blade on a scalpel. Handle the scalpel with utmost caution, and always keep it stored in a safe place during dissection when it is not in use.
- Following this demonstration, the students return to their assigned table and work together to load a blade on one or two scalpels, and to lift the body in preparation to begin dissection.

Posterior Shoulder

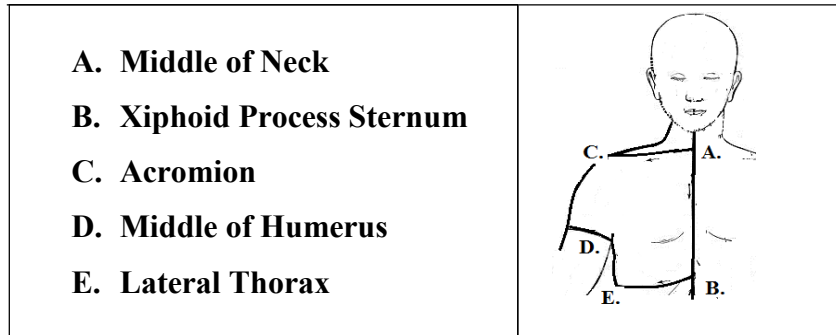
The instructors will demonstrate the first series of cuts using a scalpel to incise the skin and adipose tissues to the depth of the underlying muscle. The skin incisions are illustrated.



- While you cut, slide your fingers under the edge of the subcutaneous tissues and lift the skin and adipose tissues off the body.
 - Cut from C to E to the depth of the spinous processes.
 - Cut from C to D to a depth of the fascial sheath that covers the **trapezius**.
 - Cut from C to A down to muscle using a traction technique to pull the skin off.
 - Cut from E to F and from A to B transversely to a depth of skin thickness only.
- After making this series of incisions, reflect the skin flaps laterally, or remove the skin flaps entirely. Do not discard large skin flaps. Instead, keep them available to place on the body at the conclusion of the lab. Covering exposed tissues with skin slows the drying process.
- Study the **trapezius**, in particular the fiber alignment of the **upper**, **middle**, and **lower** parts of the muscle. Cut the **upper trapezius** off the skull; reflect this muscle laterally while leaving it attached to the acromion of the scapula. Next, cut the **trapezius** off the spine and reflect it laterally.
- With the **trapezius** reflected, run your fingers along the inner surface of this muscle in an attempt to find **spinal accessory n.** As with most small structures, you may not find this nerve on your body. For this reason, the teaching staff is always looking to find good examples of the nerves, arteries and small muscles, and will alert the class to the best examples identified.
- Deep to the **trapezius**, find the **levator scapulae** as well as the **rhomboid minor** and **major**.
- To continue, cut the **rhomboid minor** and **major** from the spine, leaving these muscles attached to the scapula. Cutting the **rhomboids** allows the scapula and the entire shoulder girdle to fall forward into protraction.
- Now feel along the costal (rib) surface of the scapula to identify the **serratus anterior** and consider how the action of this muscle both protracts and upwardly rotates the scapula. This concludes **Lab 1**.

Lab 2. Chest Wall

Spend the first 20 minutes of lab finishing or reviewing yesterday's dissection. Afterwards, the body needs to be turned facing up (supine) to dissect into the chest wall. While keeping the head and legs of the body covered, the instructors will help the students turn the body over.



- Begin dissection by making the following incisions.
 - From A to B cut down on the sternum; from A to C cut down on the clavicle.
 - From B to E cut along the inferior margin of the rib cage.
 - From D to E cut along the side of the thorax. At D cut around on the humerus.
- Find where the **platysma** rests within the skin and subcutaneous tissues superior to the clavicle. Cut this muscle from clavicle, leaving it attached to the mandible. Also in this area, find where the small **subclavius** fills the space inferior to the clavicle.
- Next, lift the skin and breast tissues off the chest as one large flap to expose the **pectoralis major**. Keep the skin flap available to cover the body at the end of lab.
- Study the fiber alignment of the **pectoralis major** and its **sternal** and **clavicular heads**. Cut this muscle off the sternum and clavicle, and reflect laterally to expose the **pectoralis minor**.
- Now look to identify three nerves that innervate the chest wall musculature.
 - The **medial pectoral n.** pierces through the center of the **pectoralis minor** muscle belly.
 - The **lateral pectoral n.** enters the undersurface of the **pectoralis major** from the axilla.
 - The **long thoracic n.** runs down the lateral chest wall and enters the **serratus anterior**.
- Next, in preparation to gain access in dissecting out the **brachial plexus** (tomorrow's lab):
 - Cut the **pectoralis minor** from the coracoid process of the scapula.
 - Cut the **subclavius** off the clavicle and remove it from the body
 - Using a hacksaw, cut out the middle section of the clavicle.
- To finish, rinse off any tools (e.g. hacksaw, etc...) used for dissection, spray down the non-skin body tissues with preserving agent (kept in a central location of the lab in spray bottles), drape and lower the body into the dissection table, and clean your table and area of the room.
- This concludes **Lab 2**.

Lab 3. Anterior Shoulder; Brachial Plexus

The **brachial plexus** runs from the neck into the axilla. The structure is complex and difficult to dissect, so be patient with the process, and in growing your knowledge of this region of anatomy.

Anterior Shoulder / Brachial Plexus

- Remove the skin from the front of the arm below the elbow, exposing the muscles. The anterior border of the axilla is formed by the **pectoralis major** and **minor**.
- Moving into the axilla, remove the excessive fat with your fingers, and use a dull probe to strip away the adipose and lymphatic tissues.
- The **brachial plexus** resides in the axillary sheath. Split apart the sheath that surrounds the **brachial plexus** and neighboring vessels (artery and vein) with a dull probe. There are a large number of superficial and deep veins in this region. Pull the veins out, while working to preserve the network of nerves and arteries for study.
- Unravel the **brachial plexus** network of nerves working distal-to-proximal. Starting at the elbow, tease the nerves away from **biceps brachii** and **brachialis**. Trace the nerves back to the axilla and begin to identify. Moving from the medial side of the arm lateral, find the **medial brachial** and **medial antebrachial cutaneous nn.** (these two nerves may present as one), and the **ulnar**, **median**, and **musculocutaneous nn.**
- The **musculocutaneous n.** itself enters the **coracobrachialis** and travels down the arm. The smaller nerves and neighboring arteries located in the axilla will take time to identify, but begin the task by comparing your dissection to illustrations shown in the atlas.
- Conclude this part of the lab by reviewing the anterior shoulder muscles. Study the nerve innervation and action of the **subscapularis**, **deltoid**, and **pectoralis major** and **minor**.

Posterior Shoulder

With 20 minutes remaining in this lab period, turn the body over (prone) and return to studying the posterior shoulder. Students are required to learn the origin and insertion, nerve innervation, and action of the muscles, so help each other.

- Study the fiber orientation of the axioscapular (trunk to scapula) muscles. They include the **trapezius**, **levator scapulae**, **rhomboids**, **serratus anterior**, and **latissimus dorsi**.
- Next, identify the scapulohumeral muscles to include the **deltoid**, **supraspinatus**, **infraspinatus**, and **teres major** and **minor**.
- Also, locate the individual **rotator cuff** muscles and the distinct heads of **triceps brachii**. These muscles are studied in detail in the next lab. This concludes **Lab 3**.

Lab 4. Arm and Elbow

- Remove the skin from the back of the arm to the middle of the forearm. This exposes the **deltoid**, the **long-, lateral-, and medial head** of the **triceps brachii**, as well as the small **anconeus** muscle at the elbow.
- Cut the **posterior deltoid** off the scapula and reflect it laterally. Near where the **deltoid** inserts on the humerus, identify the **axillary n.** and **posterior humeral circumflex a.** This nerve and artery exit the axilla posteriorly via quadrangular space, and enters the **deltoid**.
- Review the nerve innervations and actions of scapulohumeral (from scapula to humerus) muscles. Study the three distinct heads of the **triceps brachii** now fully exposed. Dissect apart the **triceps** by sliding a probe under the **lateral head** at the radial groove of the humerus. Cut through the **lateral head** down on the probe to expose the **radial n.** and **profunda brachii a.**
- At the elbow, observe the triangular-shaped **anconeus** between the lateral epicondyle and olecranon. With one hour remaining in lab, turn the body back over supine.
- To continue, review the borders of the axilla. The anterior border is formed by the internal rotators of the shoulder. This powerful muscle group includes the **subscapularis, teres major, latissimus dorsi, anterior deltoid, and pectoralis major.**
- Next, review the nerve and arteries in the axilla. For example, find where the **axillary n.** combine with the **posterior humeral circumflex a.** exits the axilla at the quadrangular space. Work as partners to identify other critical nerves and arteries that reside in the axilla.

Cubital Fossa / Elbow

- Remove the skin from the front (volar) of the forearm down to the wrist. Now use your fingers to tease apart the **biceps** from the **brachialis** and **brachioradialis**.
- Clean-up the dissection around the elbow, working to preserve the nerves (motor and sensory) that cross the elbow joint. Identify the anatomy; start by naming the borders of the cubital fossa, and the structures that comprise the “MATR” taught in lecture.
- Cut the **biceps** aponeurosis (not tendon) from where it spreads and covers the **common flexor tendon (CFT)**. The **CFT** projects from the medial epicondyle, and then splits to become the *superficial layer* of anterior forearm muscles. The superficial layer has the **pronator teres, flexor carpi radialis (FDR), palmaris longus (PL), and flexor carpi ulnaris (FCU)**.
- Digging deeper, follow the **brachial a.** to where it splits into the **radial a.** and **ulnar a.** In the cubital fossa, the **median n.** is easy to identify but as a challenge, find the **musculocutaneous n.** where it crosses the elbow and travels down the lateral side of the forearm.
- This concludes the dissection part of **Lab 4**, leaving time to review the **brachial plexus** network of nerves, or study the major arteries of the shoulder and arm.

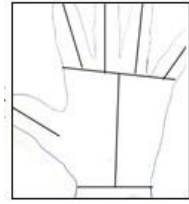
Lab 5. Anterior Forearm

Spend the first 15 minutes of lab reviewing the **brachial plexus** and neighboring arteries in the axilla and the cubital fossa of the elbow, and the muscles of the anterior arm and forearm.

- Begin dissection by removing any remaining skin from the palmar surface of the forearm, hand and thumb, while leaving the fingers untouched for dissection later. When removing the skin from the palm, note the presence of the **palmaris brevis** that once covered the hypothenar muscles on the ulnar side of the hand.
- At the elbow, find where the **median n.** travels between the heads of the **pronator teres**, and deep to the fibrous tendinous arch of the **flexor digitorum superficialis (FDS)**. The FDS tendinous arch bridges between the radius and ulna, and this structure is a nerve entrapment site for the **median n (AIN branches)**.
- Cut the **pronator teres** off the radius, leaving the tendon intact such that its two heads encircle the **median n.** While studying the **pronator teres**, name the *superficial layer* of forearm muscles and discuss their actions on the forearm and wrist.
- The **flexor digitorum superficialis (FDS)** is the *intermediate layer*. Cut the **FDS** off the radius lengthwise and reflect towards the ulna. Just distal to the tendinous arch of the **FDS**, see where the **median n.** gives off the **anterior interosseous n.** (motor threads) that innervate some (but not all) of *deepest layer* of anterior forearm muscles.
- In the *deep layer*, slide the **flexor digitorum profundus (FDP)** towards the ulna with your fingers and looking under it, confirm the **flexor pollicis longus (FPL)** originates on the radius and interosseous membrane. Also, identify the **pronator quadratus** proximal to the wrist and deep to the long finger flexor tendons (**FDS** plus **FDP**).
- At the elbow, trace the **radial a.** down the forearm to where it bifurcates at the base of the thumb. Both of these smaller vessels retain the name **radial a.** though the volar branch can be called the **superficial radial a.** and the other, can be referred to as the **deep radial a.**
- Also find where the **ulnar a.** gives off the **common interosseous a.** which dives deep. The **common interosseous a.** immediately splits into the **anterior** and **posterior interosseous aa.** Find the **anterior interosseous aa.** running deep to the **pronator quadratus**.
- On the ulnar side of the forearm, find where the **ulnar a.** joins with the **ulnar n.** and travels under the **flexor carpi ulnaris (FCU)**. Confirm the **ulnar n.** innervates the **FCU**, and look for additional motor branches that innervate half (the two medial heads) of the **FDP**.
- Returning to the elbow/forearm, identify each muscle and recite their action on the forearm, wrist, and digits of the hand. This anatomy is complex, so be deliberate in your study.
- Though dissection is done for today, use any time remaining to review the osteology of the wrist and hand, and name the joints of the wrist, hand, and fingers. This concludes **Lab 5.**

Lab 6. Wrist, Hand, and Fingers

- Remove all skin from the palmar surface of the thumb and two fingers (ideally the index finger), while leaving the skin on the dorsum of the forearm and hand. Work on the fingers by having one student stretch the fingers flat while another makes the incisions. The fingers are sometimes contracted or deformed, but do the best you can with this dissection.



- Study the intact palmar aponeurosis. After, reflect it distally by clamping and lifting the cut end of the **palmaris longus** tendon while simultaneously scratching it off the palm with a scalpel. Stay superficial to avoid damaging the underlying subcutaneous structures of the hand.

Dupuytren's contracture is a hand deformity caused by idiopathic shortening of the palmar aponeurosis.

- Tease apart, identify, and name the thenar and hypothenar muscles. The **opponens pollicis** and **opponens digiti minimi** are small and lie deep beneath the respective eminences.

- Dissect into the carpal tunnel by sliding a probe under the flexor retinaculum and transverse carpal lig while staying superficial to the **median n.** Cut down on the probe. In the tunnel, the muscle tendons are surrounded by synovial sheaths.

The synovial sheaths inside the carpal tunnel can become inflamed (synovitis) with repetitive use, and cause carpal tunnel syndrome.

- In the forearm, cut the **FDS** and **FDP** tendons at different levels (to distinguish them) proximal to the wrist. Now pull the cut ends of the tendons out of the carpal tunnel distally, but not so far as to disrupt the **superficial palmar arch**. Pulling the tendons out of the tunnel tears apart the synovial sheaths, and leaves a "cobweb" appearance. Examine the contents inside the tunnel that include the finger flexor tendons, **FPL** tendon, and **median n.**

- The **median n.** gives off two nerves. One branches proximal to the carpal tunnel, the other distal.
 - The **palmar cutaneous branch** presents proximal to the tunnel. It runs outside the tunnel distally to innervate the skin covering the volar surface of the wrist and palm.
 - The **recurrent branch** is found distal to the tunnel. It motors the thenar muscles.

- The **ulnar n.** gives off a sensory branch proximal to the wrist called the **dorsal branch of ulnar n.**, or **DUC (dorsal ulnar cutaneous)**. The **ulnar n.** itself enters the hand with part of the **ulnar a.** at the Tunnel of Guyon. Pass a probe into the tunnel to study its contents; the tunnel walls are formed by the pisiform and hamate, and the pisohamate lig.

In identifying the ulnar nerve, seek to understand why sensory symptoms resulting from an injury to the nerve in the Tunnel of Guyon vs proximal to the DUC present differently.

- Follow the **ulnar n.** and **median n.** into the palm. Both nerves branch to become the **common palmar digital nn.**, which split to become **proper palmar digital nn.** that run on the sides of the fingers. Verify how branching from the **ulnar n.** serves the medial one and one-half digits, while branching from the **median n.** serves the lateral three and one-half digits of the hand.

- On the thumb side, examine where the **radial a.** splits near the scaphoid bone at the wrist.
 - The smaller branch of **radial a.** passes volarly into thenar muscles and beyond, into the **superficial palmar arch.**
 - The main part of the **radial a.** passes across the anatomical snuffbox and distally into the first interosseous space, supplying the **deep palmar arch.** This **arterial anastomosis** also receives small contributions from the **ulnar a.**
- The first interosseous space is located between the thumb and index finger. The **first dorsal interosseous** spans the space, and note its bipennate fiber alignment. The remaining **dorsal interossei** are studied in a future lab so if possible, leave the skin on the dorsal surface of the hand and forearm.
- Dissect the palm of the hand.
 - The horse-shoe shaped **superficial palmar arch** is fed mostly by the **ulnar a.** By contrast, the **deep palmar arch** runs deep, and it cannot be seen unless cutting deep into the palm and destroying the dissection.
 - The **princeps pollicis** and **radialis indicis aa.** The small arteries arise within the first interosseous space (fed from both **palmar arches**) and supply the thumb and index finger.
 - Identify the palmar intrinsics. Find four **lumbricales** alongside the **FDP** tendons. Once identified, study the assigned name/number of the individual **lumbricales**, and their nerve innervations and actions on the fingers.
 - Find the **adductor pollicis** deep inside the first interosseous space. Identify its **oblique** and **transverse heads**, and where they insert on the ulnar side of the proximal phalanx of the thumb. Seeing the size, fiber alignment, and direction-of-pull of the **adductor pollicis** will help you realize its importance in grip.
 - The **palmar interossei** are located too deep to dissect out, so study where these muscles originate (metacarpals 2, 4, 5) and insert (fingers 2, 4, 5) in the atlas.
 - Finish the dissection by reviewing the previously identified nerves. Just saying the name **proper palmar cutaneous branch of the median n.** presents as a challenge.
- Dissect the palmar surface of one or two fingers.
 - Incise the length of the fibrous digital sheath to expose the long finger flexor tendons.
 - Observe how the bands of fibrous sheath encircle the tendons, and contain their actions in flexing the finger joints.
 - Name the finger joints (MCP, PIP, and DIP). Naming the joints should no longer be difficult but if needed, study the joints on a skeleton.
 - After slicing the fibrous digital sheath, lift the long flexor tendons away from the finger in a “bowstring” manner to see how the **FDS** tendon splits, allowing the **FDP** tendon to pass.
 - Study the extensor hood. Observe the hood-like appearance that surrounds the MCP joint, and investigate where the **lumbricales** and **interossei** insert on the palmar aspect of the hood mechanism.
- Finish lab today by spraying the hands with the preserving agent and cover the hands with gloves, as much as possible. Covering the hands will slow the tissues from drying out.
- This concludes **Lab 6.**

Lab 7. Posterior Forearm; Dorsum Hand

Start lab by reviewing yesterday's dissection. For example, inspect the extensor hood mechanism on the index finger to recognize how the line of pull of the **first lumbrical** and **first dorsal interosseous** falls on the palmar side of the axis of flexion/extension at the MCP joint but, because of the oblique nature of the hood, the line of pull falls dorsal to the axes at the PIP and DIP joints, thus making these muscles flexors of the MCP and extensors of the IP joints.

- Remove skin from the forearm. At the elbow, use a dull probe to penetrate the fascial plane between the **brachioradialis (BR)** and **brachialis** to dissect out the **radial n.** Find where the **radial n.** splits into the **deep** and **superficial** branches. To differentiate, the **deep radial n.** enters the **supinator**, whereas the **superficial radial n.** continues down the lateral forearm.
- Dissect apart the muscles of the posterior forearm. Start by releasing the tendons from the extensor retinaculum at the wrist. Examine how the superficial fibrous band creates six fibro-osseous tunnels. After dislocating the tendons from the tunnels, tease apart the muscles of the distal forearm with your fingers. Working proximally up the forearm, find where the *superficial layer* of muscles unite at the common extensor tendon.
- At the common extensor tendon, identify the **extensor carpi radialis longus (ECRL)** and **brevis (ECRB)**, **extensor digitorum (ED)**, **extensor digiti minimi (EDM)**, and **extensor carpi ulnaris (ECU)**.

Lateral epicondylitis, referred to as golfer's elbow, is a painful overuse condition involving inflammation of the common extensor tendon.
- Superficially cut lengthwise between the **BR** and **ECRL** near their origin to find the **supinator**. At the Arcade of Froshe, the **deep radial n.** dives into the **supinator**. Follow the **deep radial n.** from where it exits beneath the **supinator** and its name changes to **posterior interosseous n. (PIN)**. The PIN displays as threads of motor nerves distally deep within the forearm muscles.

The posterior interosseous nerve (PIN) may be entrapped at the Arcade of Froshe. Realize that muscles receiving their motor innervation proximal to the Arcade of Froshe are spared in PIN syndrome, but muscles located distal in the posterior forearm to the compression point of injury may be weakened.
- The **posterior interosseous a.** is the only named artery in the posterior forearm. Small, it can be found along the posterior surface of the interosseous membrane. Recall, this artery comes from the **common interosseous a.** which in turn, comes from the **ulnar a.** in the cubital fossa of the anterior elbow.
- The **extensor digitorum (ED)** sits under the **extensor carpi radialis longus**. The **ED** has four distinct tendons that insert into the extensor hood mechanism of the fingers. Running in close proximity, find the **extensor indicis (EI)** tendon going to the index finger, and the **extensor digiti minimi** tendon going to the little finger.
- Find the **superficial radial n.** superficial to the wrist and hand. It passes along the radial side of the forearm and wrist, and is sensory to the lateral three and a half digits dorsally.

- Study the deepest forearm muscles. Two are packed together, the **abductor pollicis longus (APL)** and **extensor pollicis brevis (EPB)**. Split them apart and note where they insert. The **extensor pollicis longus (EPL)** also acts on the thumb. It travels the “long” way around Lister’s tubercle of the radius, and inserts on the distal phalanx of the thumb.
- On the dorsum of the hand, find the four **dorsal interossei**. These muscles are bipennate, with each muscle arising from the adjacent sides of the five metacarpals.
- This concludes **Lab 7**. Use any extra time to move about the lab and view the dissections on several cadavers. Restudy anterior forearm muscles or the intrinsic of the hand. Quiz your lab partners on the nerve innervation and muscle actions of the hand **extrinsics** and **intrinsic**s, or spend time reviewing the brachial plexus network of nerves.

De Quervain’s syndrome is tenosynovitis (inflammation of tendon and synovial sheath) of the APL and EPB tendons in the area of the anatomical snuffbox.

Labs 8 and 9. Upper Extremity Joints; Review

The lab activities for the next two days run together. The primary objective of these combined lab days is to dissect apart the major joints of the upper extremity. To assist in the study of the joints, in addition to dissections, prosected joints and anatomical models are made available in the lab.

During lab, the instructors will teach the anatomy on the prosected joints in small-group breakout sessions. Students are also given the freedom to mingle throughout the lab to view the assortment of anatomic models, as well as the variety of joint dissections performed on selected cadavers.

- Movement of the shoulder involves the sternoclavicular (SC) joint. There is little gained by dissecting apart the SC joint. Instead, apply force with your fingers to sternal end of the clavicle on the manubrium (sternum) to stress the intact joint and assess the stability afforded to the clavicle by the sternoclavicular, interclavicular, and costoclavicular lig.
- If the glenohumeral joint is stiff, the entire shoulder girdle can be stretched by aggressively pulling the humerus away from the body. Similarly, without dissection, apply stress force to the acromioclavicular (AC) joint to assess the stability afforded this joint by the coracoacromial (trapezoid and conoid) bands of extracapsular lig, and the acromioclavicular capsular joint lig. The AC joint structures are best seen and studied on the prosected joints.
- Dissect the glenohumeral joint using an anterior approach. Start by reflecting the **anterior deltoid** off the clavicle and humerus to expose the coracoacromial lig. Find where the **supraspinatus** tendon emerges from under the acromion along with neighboring joint tissues. The “subacromial space” contains the glenohumeral joint capsule and lig, the coracohumeral lig and bursae.

Impingement syndrome is a shoulder problem that involves inflammation or injury of the rotator cuff where the muscles emerge from under the acromion and coracoacromial ligament.

- Continue into the glenohumeral joint by first cutting through the **subscapularis**. Cut down on a probe slid between the muscle and capsule. The cut exposes the capsule. Note how the capsule wrinkles with movement of the humerus, and observe the redundant folds of the inferior joint capsule. Incise the joint and observe the smooth articular cartilage of the humeral head, the labrum surrounding the glenoid, and find the **long head** of the **biceps tendon**. Move the joint into flexion and abduction to watch how movements change the orientation of the **biceps** long head tendon with respect to the humeral head. Apply a stretch to the **biceps**

Stretch a muscle by moving it opposite to its actions. For example, stretch the biceps by extending the shoulder while moving the elbow into extension and pronation.

- Dissect the elbow using an anterior approach. Start by removing the muscles three inches above and below the joint. Carefully shave away any remaining tissues while preserving the joint capsule. With capsule exposed:
 - Watch how flexing the elbow puckers the anterior capsule, whereas extending the elbow elongates (stretches) the anterior capsule.
 - Continue to clean off the capsule, while trying to tease out the annular and collateral lig.
 - Now, apply a valgus and varus stress force to feel the resistive action of the collateral lig.
 - Next, pronate and supinate the forearm watching the annular lig constrain the head of the radius, and see how the radius rotates about the ulna. Observe this pivot and twisting type of joint motion at the proximal radioulnar joint (elbow), and at the distal radioulnar joint (wrist).
- Dissect the wrist by first reflecting (or cutting) the extrinsic tendons.
 - Use a volar approach to slice through the thick wrist capsule at the radiocarpal joint.
 - Observe the proximal row of carpal bones, and corresponding concavity of the radius.
 - Recognize the scaphoid forms the floor of the anatomical snuffbox, and that when moving the hand into radial deviation the radial styloid process makes contact with the scaphoid.
 - Identify the triangular fibrocartilage complex (TFCC) between the triquetrum and ulna.
 - The carpus of the hand and surrounding joint ligaments are complex. Finish by reviewing the names and relative locations of the carpal bones, and restraining action of the joint lig.
- Dissect into the base of the thumb.
 - At the first-CMC joint, recognize its unique saddle shape. This joint allows considerable movement, including opposition, with movement of the thumb critical for grasp function.
 - At the first-MCP joint, though it is difficult to discriminate the joint capsule from the collateral lig, apply force to stress this joint.
 - When stressing the ulnar collateral lig, recognize how the offset position of the thumb relative to the hand makes this lig vulnerable to traumatic injury.
- Dissect into the fingers.
 - Find the collateral lig on the finger joints, and assess the stability of the individual joints.
 - Cut transversely the thick palmar plate at one or more joints of the fingers and afterwards, observe how easily that finger joint can dislocate into hyperextension.
 - Review the fibrous digital sheath, and the extensor hood mechanism on a finger.
- This concludes **Labs 8 and 9.**

Lab 10. Skull Osteology; Anterior Neck

This lab starts by studying the osteology of the skulls. The skulls are provided for you in the lab.

- Lab dissection begins by removing the skin from the anterior neck. Incise the skin midline, and along the edge of the mandible. Remove the **platysma** with the skin, while keeping the **sternocleidomastoid (SCM)**. The **SCM** is a paired muscle that lies on each side of the neck.
- Beneath the angle of mandible, remove the submandibular gland with a dull probe and fingers by digging deep into the submandibular space. Now look to find the intermediate tendon of the **digastric** where it binds to the hyoid. This tendinous attachment separates the **anterior** and **posterior digastric** muscle bellies.
- Next, examine how the **stylohyoid** splits and runs parallel and around **posterior digastric**. Probe deep along the **stylohyoid** with one finger in an attempt to feel for the pointed styloid process. Observe the long slender **omohyoid**. Its intermediate tendon that connects the **omohyoid** to the clavicle is often torn away, so the **omohyoid** may hang loose along the side of the neck.
- Connecting to the mandible, the **mylohyoid** sits deep beneath the **anterior digastric**. Slice the **mylohyoid** midline to find **geniohyoid** deep. The **geniohyoid** fibers run anteroposterior.
- Find the **subclavian a.** between the **anterior** and **middle scalenes**. The **posterior scalene** is not easily visible from an anterior view, but can be found running deep to the **levator scapula** when the body is turned prone.

Scalene syndrome involves entrapment of the brachial plexus and subclavian artery resulting in paresthesia, a diminished radial pulse (not rate but volume) and temporary weakness.
- Also locate the **brachial plexus** between the **anterior** and **middle scalenes**. The **upper trunk** is formed by the **C5** and **C6 nerve roots**. Though the **C7**, **C8**, and **T1 roots** are deep and difficult to find, with effort, see where the **C8** and **T1** converge to form the **lower trunk**.
- The **suprascapular n.** branches off the **upper trunk** and runs to **supraspinatus**. Follow the nerve distal to the scapula, and find the distinct edge of the superior transverse scapular lig. Verify how the **suprascapular a.** travels over this ligament while the **suprascapular n.** runs under it (Army over Navy).

The superior transverse scapular ligament can thicken and ossify making the scapular notch a site for nerve entrapment.
- Dig out the carotid sheath that runs lengthwise beneath the **sternocleidomastoid**. Open the sheath and inside, identify the **vagus n. (CN X)**, **common carotid a.** and **internal jugular v.**
- Several other important structures can be examined in the anterior neck.
 - Find the **phrenic n.** rests on the anterior surface of the **anterior scalene**.
 - Palpate the cricoid cartilage, and the cartilaginous rings that form the trachea.
 - Identify the hyoid bone, and the accompanying **infra-** and **suprahyoid** muscles.
- This concludes the dissection part of **Lab 10**.

Lab 11. Head, Neck, and Face

Continue dissection of the anterior neck and afterwards, proceed to study the head and face.

- Not on every cadaver, but on those where the neck dissection did not turn out well, dissect out the **deep neck flexor (prevertebral)** muscles that rest deep beneath the trachea and esophagus on the anterior surface of the vertebral column.
 - If the trachea is mobile, slide it laterally to expose the **deep neck flexors**. Or, as far inferior as possible, cut the trachea and esophagus transversely. This cut exposes the fixed cross-sectional area of the trachea, compared to the flattened esophagus.
 - With either approach, find where the **longus colli** runs obliquely along the spine, and the **longus capitis** where it sits more laterally and has muscle fibers that ascend to the skull.
- Dissection of the face muscles is optional. Start by removing the skin from the nose around the mouth, and covering the cheek.
- Several nerves can now be located. The **facial n.** (or at least one of its branches) is found where it emerges through the parotid gland anterior and inferior to the ear.
- The **trigeminal n. (CN V)** innervates the muscles of mastication, and is sensory to the face. Its branches are the **ophthalmic (V.1)**, **maxillary (V.2)**, and **mandibular (V.3)**. The **V.1** branch exits the supraorbital foramen; **V.2** the infraorbital foramen; **V.3** the mental foramen.
- This concludes **Lab 11**, leaving time to review.

The facial nerve (CN VII) can be inadvertently injured with surgical removal of the parotid gland, or from any source of idiopathic pressure on the nerve where it exits the skull, leading to paralysis (Bell's palsy) of the facial muscles plus other symptoms.

Lab 12. Brain; Eye

The calvaria skull cap is cut by an instructor using an electric bone saw, and the brain is removed for you. When holding the brain, reflect on the uniqueness of this moment. The better quality brains are kept stored in a container of liquid, as floating the brain preserves its natural shape.

- Study the gross features of the brain.
 - Observe the gyri and sulci of the brain's cortex. The central sulcus that runs obliquely superiorly from the lateral fissure at the temporal lobe to the longitudinal fissure that separates the hemispheres. The central sulcus divides the frontal and parietal lobes.
 - Tenderly separate the right and left hemispheres, and look for the sulcus separating parietal lobe from the occipital lobe.
- Recognize the cerebellum, and the midbrain, pons and medulla of the brain stem. On the inferior surface of the brain, recognize the olfactory tracts (part of **CN I**) under the frontal lobe and the **optic chiasm** (part of **CN II**). These structures including the **cranial nerves (CN)** are taught in small group sessions (content taught in lecture, and not described in this manual).

- To dissect inside the skull (cranium), use a chisel to remove the bone covering the eye socket. Penetrate the socket, and then break off pieces of bone with a pliers to create a triangular-shaped opening above the eye. Inside the socket, use a hemostat to remove the fatty adipose tissues surrounding the eyeball.
- In the cranium, recognize the **frontal n.** on its way to the supraorbital foramen. Now find the **supraorbital n.** on the face from earlier dissection. Tug it, and see the **frontal n.** move, confirming this is actually one nerve (branch of **V I – ophthalmic division**). Inside the socket, Find the **optic n. (CNII)** where it enters the eye, and admire the white sclera covering of the eyeball.
- Dissect the eye muscles.
 - Find the **levator palpebrae** above the socket. Pull on it while observing the eyelid move.
 - Deeper, the **superior rectus** inserts on the superior surface of the eyeball.
 - Medial to the eye, find the **superior oblique** and going deeper, identify the **medial rectus**.
 - Lateral to the eye, locate the **lateral rectus**.
 - Going still deeper on the lateral side of the eyeball you may sometimes find the **inferior oblique** and **inferior rectus** eye muscles.
- This concludes **Lab 12.**

Loss of eye tracking, or a stationary eye deviation may be symptomatic of an injury to the brain or cranial nerve. For example, medial deviation (strabismus) of the eye could suggest the medial rectus is intact but unopposed because of a weak lateral rectus potentially due to an injury of the abducens nerve (CN VI).

Lab 13. Temporomandibular Joint; Midterm Review

Review all preceding materials, and take the mock lab exam set up for you on one body. Work in small groups to prepare for the midterm exam. The instructors will be available in the lab to field questions, and to help you identify structures.

- During lab, study the muscles of mastication and temporomandibular joint (TMJ) dissected (making cuts into the skull with a bone saw) on one or two bodies by an instructor.
 - Appreciate the considerable cross-sectional area of the **temporalis** and **masseter**.
 - Inside the ramus of the mandible, distinguish the **medial-** and **lateral pterygoids**. While studying these muscles, describe their primary actions in moving the mandible.
 - On the TMJ itself, identify the articular disc located between the condyle (head) of the mandible and the mandibular fossa of the temporal bone. **This concludes Lab 13.**

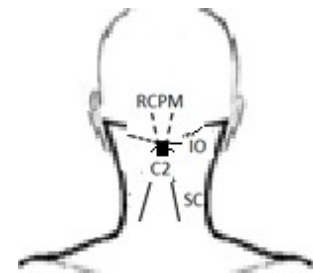
Lab 14. Midterm Exam

The students take the midterm lab exam in the lab today. The exam requires the identification of tagged structures, with students writing the name of the structure on an answer sheet. The answer sheet is then handed in for grading. Points are not taken off for misspelling words, but always study with intent to pronounce and spell anatomical structures correctly.

Lab 15. Suboccipital Region

The course continues with dissection of the posterior neck. This dissection is performed with body positioned prone. To reduce the concavity of the neck, place a block under the chest and force the head into flexion.

- Reflect the **upper** and **middle trapezius** off the scapula laterally so it hangs attached only to the acromion. The superficial layer of neck muscles are now exposed along the spine. Note the spinous processes of the spine; the large C7 is called the vertebra prominens.
- The **splenius capitis** and **cervicis** cover the neck region running obliquely up- and lateral. Cut these muscles from the spinous processes, leaving the insertions on the head and neck intact. This exposes the thick **semispinalis capitis**.
- Inferior to the occipital bone, find the fascial plane between the **semispinalis capitis** and the underlying **suboccipital** muscles. Cut the **semispinalis capitis** from the skull, and reflect laterally to find the **suboccipitals**, named by their location below the occiput.
- Find the busy C2 spinous process and “starburst” of muscles (diagram) including the **rectus capitis posterior minor** and **major**, **inferior oblique**, and **semispinalis cervicis**. Also find the **superior oblique** (not shown) located far lateral. Identify the muscles that border the suboccipital triangle.
- Two nerves are associated with this region. The **suboccipital n.** (which is the **C1 dorsal rami**) is located inside the suboccipital triangle, but it is too small to find. The **greater occipital n.** (which is the **C2 dorsal rami**) is large and found outside the suboccipital triangle where it enters the now reflected **semispinalis capitis**.
- Superior to the C1 vertebra dig deep to find the **vertebral a.** Recall, this artery originates from the **subclavian a.** at the base of the neck. It ascends through the foramen transversaria of the cervical spine, and it then turns medially along the superior surface of the C1 vertebrae before turning vertically to enter the brainstem.
- Finish by spraying all the exposed tissues of the body with the preserving agent, and drape the body to help keep the tissues from drying out. Also, clean your table and area of the lab.
- The back muscles are identified in lab tomorrow. The task of learning these muscles by name and region does tend to overwhelm. Simplify the process by looking at illustrations of the anatomy in an atlas in the lab with your classmates today, if time allows.
- This concludes the dissection part of **Lab 15**.



“Beauty Parlour Syndrome” is one term for feeling lightheaded or dizzy. The syndrome can occur with hyperextension of the head and neck (as during a shampoo,) due to compression of the vertebral artery.

Lab 16. Back Muscles

- If not done, make the incisions shown and remove the skin and adipose tissue from the back to the depth of the thoracolumbar fascia. Uncover only the superior fibers of the **gluteus maximus**.
- Also remove the thin **serratus posterior** that runs transversely across the thorax. This muscle assists with accessory respiration.
- With the **trapezius**, **rhomboids**, and **latissimus dorsi** reflected laterally, find the **erector spinae**. This muscle group comprises the **spinalis**, **longissimus**, and **iliocostalis (SLI)**. Separate the parts of this muscle into individual bundles with your fingers.
- Proper naming of the back muscles includes the identification of body region. For example, the **iliocostalis lumborum**, or **longissimus thoracis**. At first glance, the task of naming of the individual muscles seems arbitrary, but give it some time. The regions are called lumborum, thoracis, cervicis, and capitis. During lab, identify all of the erector spinae muscles (taught in lecture) by their complete name and according to region.
- Incise into thoracolumbar fascia to find the **multifidus**. See how the direction of pull of this muscle rotates the body away to the opposite side. Insert a probe through the **multifidus**, and appreciate its overall size. The rotatores rest under the multifidus; these small intersegmental rotator muscles are present in all regions of the spine, but they are too deep to dissect-out.
- During today's lab, view the lumbar laminectomy dissected by an instructor on one cadaver. Removal of the posterior part of the vertebral column (spinous process and lamina) in the lumbar region exposes the structures inside the vertebral canal, and allows you to study the terminal end of the **spinal cord** encased in dura mater.
 - When the dura mater is first incised, observe the collection of cerebrospinal fluid. Now proceed to tear the meninges covering off the **spinal cord**.
 - On the **spinal cord**, identify the **conus medullaris**, **cauda equina**, and filum terminale.
 - Look closely at the **cauda equina** strands in attempt to distinguish between the **ventral** (motor) and **dorsal** (sensory) **rootlets** that form the succession of **nerve roots** that exit the vertebral column via the intervertebral foramen.
 - Using a probe, slide the **spinal cord** and its parts to one side of the vertebral canal to examine the posterior longitudinal lig (PLL).
 - This lig runs lengthwise along the posterior surface of the vertebral body and discs.
- With the help of an instructor, place this cadaver on its side and perform the straight leg raise test. This maneuver tensions the **spinal nerves**, and **spinal cord**.
- This concludes **Lab 16**.

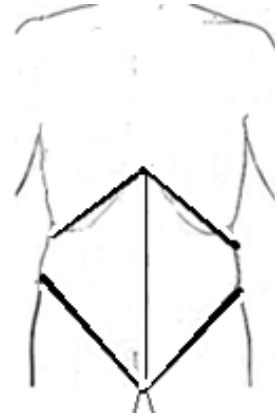


A straight leg raise (SLR) test is a maneuver used by clinicians to provoke pain that radiates down the leg in patients having problems with the sciatic nerve where it exits the spine and/or pelvis.

Lab 17. Abdomen

Removal of the abdominal and pelvic viscera is the primary objective today. The majority of this dissection is done by the instructors, with the students helping as able.

- Cut through the skin and superficial fascia at the sites shown. Recognize the **rectus abdominis** running vertically in the center of the abdomen. Incise the rectus sheath to see the fibers within. The tendinous intersections create this muscle's "six pack" appearance.
- Study the other abdominal wall muscles by first making a shallow (first layer) 6 inch incision running obliquely downward and medially in parallel with the **external oblique** fibers. Separate these fibers with your fingers and make another cut, this time running downward and laterally in parallel with the **internal oblique** fibers. Separate these fibers and make a third thin cut to find the **transversus abdominis**.



- Cut through the **rectus abdominis** midline. Pull the abdominal wall muscles laterally, while cutting along the lines diagrammed. Reflect the abdominal wall laterally leaving the flaps attached to the side of the body. The **transversus abdominis** is deepest; its heavy fascia internal surface rests on the fatty omentum.

Diastasis recti is a splitting of the rectus abdominis fibers from overstretching, as in pregnancy, allowing the intestines to herniate anteriorly.

- Remove the fatty omentum that covers the intestines. Recognize the large and small intestines, liver, gallbladder and stomach. Observe the abdomen for possible hernias of the intestines or tumors. Dissection will next target the removal of the viscera.
- Begin with the liver. Grasp and pull it downward from the lower ribs. You will meet heavy resistance from the falciform lig connecting the liver to the **diaphragm**. Cut this ligament, while using your hands again to pull the liver down. Pull and cut as needed until the liver and gallbladder (small green organ) become free. Bile is the green digestive fluid made by the liver, and stored in the gallbladder. Avoid tearing the **diaphragm**, if possible.
- On the left side of the abdomen, reach far posteriorly and feel for the baseball-sized spleen. Find the stomach and tie off the esophagus with a string. Cut the esophagus above the string. Next, find the rectum and tie it off as low as possible; cut the rectum below the string. Now with the stomach and intestines tied off as one large unit, aggressively lift (cutting any remaining attachments as you go) and remove the viscera. With the posterior wall now visible, find the kidneys and trace the ureters to the pelvic region. Now you can remove the kidneys.
- In the pelvic cavity, the bladder rests anteriorly hidden underneath the peritoneum. In a female, observe the uterus and maybe the fallopian tubes leading to the ovaries. The rectum is deep, but it becomes obvious when using your hands to free the viscera from the pelvic cavity. While pulling on the viscera, use a long-bladed knife to cut through the base of these organs, and remove the viscera. Cut the base of the rectum again to fully remove it from the body. Flush the abdomen with water, and wipe as clean as possible with paper towels. This concludes **Lab 17**.

Lab 18. Abdominal and Pelvic Cavities

Start by using paper towels to vigorously wipe away any remaining loose tissues from the abdominal and pelvic cavities of the body. Afterwards, take time to clean your table and area of the lab.

- Observe the size and shape of the abdominal cavity, and dome configuration of the **diaphragm**.
 - Study the central tendon of the **diaphragm**, and distinguish the right and left crura tendinous attachments that anchor the **diaphragm** to the lumbar vertebrae.
 - Examine where the **abdominal aorta**, **inferior vena cava**, and esophagus pass through the **diaphragm**. Follow the **aorta** to where it descends between the right and left crura (aortic hiatus) at the level of the T12 vertebra. Squeeze the **aorta** to feel for stiffness and crunchiness, as this life-sustaining artery can sometimes be narrowed internally by layers of calcium.
- The **aorta** splits into the **common iliac aa**. They in turn, split into the **external** and **internal iliac aa**. Follow these arteries distally to find where the **external iliac a.** exits the abdomen beneath the inguinal lig, and where the **internal iliac a.** dives deep into the pelvis.
- Many vessels housed in the pelvic cavity were broken with removal of the viscera. Removing this debris will help you identify the structures that remain. To clean the pelvis, cut the **aorta** transversally at the L2 vertebra. Pull the cut end distally away from the spine, leaving the aorta attached to the body via the **common iliac aa**. Remove the veins and other debris from the pelvis.
- Find the **subcostal n. (T12)** along the lower border of rib 12. Next identify the **lumbar plexus** nerve branches:
 - The **iliohypogastric** and **ilioinguinal nn.** project laterally on the posterior wall. These two nerves often combine and present as one single structure.
 - The **lateral femoral cutaneous n.** runs into skin and superficial fascia of the thigh.
 - The **genitofemoral n.** exits from the anterior surface of the **psaos major**.
 - The **femoral n.** enters the anterior thigh at the femoral triangle, studied in the next lab.
 - The **obturator n.** emerges on the medial side of the **psaos major**. Find where it crosses the pelvis and enters the medial thigh through the obturator foramen via the obturator canal.
- The lower **lumbar** and **sacral nerve roots** exit the vertebral column from inside the pelvis.
 - Examine how the **L4-L5 nerve roots** combine to form the **lumbosacral trunk**, and where the **S1-4 nerve roots** pass through the foramina of the sacrum.
 - See where the **L4-5, S1-3 nerve roots** combine to form the **sciatic n.**, and examine where the **sciatic n.** exits the pelvis through the greater sciatic foramen.
- Finish this lab by identifying muscles. The **quadratus lumborum** runs between rib 12 and iliac crest. The **psaos major** rests along the lumbar spine, and joins the **iliacus** to form the **iliopsoas**. The tendon-like **psaos minor** rests anterior to the **psaos major**.
- Muscles, supported by bone and connective tissue, form the walls and floor inside the pelvis. The sacrum holds the **piriformis** posteriorly, with a tendinous arch providing a “sling” of support along the sides of the pelvis. The **obturator internus** fills in the sidewalls, deep to the tendinous arch. The pelvic floor consists of several small muscles.
 - The **iliococcygeus** sits posteriorly and abuts up against the **piriformis**.
 - The **pubococcygeus** runs between the pubis and coccyx bones of the pelvis.

- The **coccygeus** lies deepest and this paired muscle has a triangular shape.
- The **puborectalis** forms a loop around the rectum (though it is not found with dissection).
- The muscles inside the pelvis are difficult to identify, but try. It helps to compare what you see in dissection to the anatomy illustrated in an atlas. This concludes **Lab 18**.

Lab 19. Chest, Heart, and Lung

Prior to cutting into the chest cavity, observe the different oblique fiber alignment of the **external** and **internal intercostals**. These **intercostals** assist with deep breathing function.

- Cut the ribs along the lateral chest with a hand snipper, and to sever the first rib from the clavicle. After the ribs are cut, reflect the chest wall downward so it rests on the abdomen. Find the **internal mammary a.** on the internal surface of the chest wall.

- See the lungs that are now collapsed, and the pericardial sac covering the heart. Note the sponginess of the lungs, and verify that the right lung is larger and has 3 lobes; the left lung has only 2 lobes.

In the normal state, the apex of the lung ascends to above the clavicle. A Pancoast tumor involves a cancerous tumor in the apex of the lung that can impinge upon the lower trunk of the brachial plexus.

- Detach the **SCM** muscles from the clavicle and manubrium. Now trace the **vagus n.** and the **phrenic n.** from the anterior neck into the chest cavity. Preserve both nerves so their pathways can be studied later in this lab period.
- Slice open the pericardial sac, and peel it off the heart and major vessels. Distinguish the **pulmonary trunk** from the **ascending aorta**. The **pulmonary trunk** divides into the **right** and **left pulmonary aa**, which lead to the lungs. The **right coronary a.** is easy to find, but the **left coronary a.** is covered by the **pulmonary trunk**. Returning to the **aortic arch**, find its three main branches (**brachiocephalic trunk, left carotid, left subclavian aa**).
- Depending on the condition of the heart, look to find the **circumflex a.** and the **left anterior descending a. (LAD)** separating the right and left ventricles anteriorly. Also find the **posterior interventricular a.** on the posteroinferior surface of the heart. These smaller arteries will be easier to identify after the heart has been dissected apart from the lungs later in this lab period.
- Dissect into the heart.
 - Begin by cutting the **inferior vena cava** near where it enters the heart.
 - While lifting the heart from the **diaphragm**, cut the four **pulmonary veins** posteriorly.
 - Keeping the heart attached to the body by the **superior vena cava** and **ascending aorta**, make an incision along the inferior aspect of the heart, entering both the right and left ventricles separately.
 - Take time to appreciate the thickness of the exterior walls of the heart. This special type of tissue is called cardiac muscle.

- Pick the dried blood out of the heart. Start this task by passing the tip of your finger into the

heart through the **inferior vena cava** and beyond. Explore the valves that connect the adjoining chambers.

- The left ventricle has two (bicuspid) valves; the right ventricle has three (tricuspid) valves.
- Observe how the string-like chordae tendineae connect the valves to the **papillary** muscle, and recognize how contraction of these muscles prevent prolapse of the valves into the atria during ventricular contraction.

- With the heart and lungs now dissected, locate these major nerves inside the chest cavity.
 - The **phrenic n. (C3-5)** traverses the neck and heart to reach the diaphragm.
 - The **vagus n. (CN X)** descends the neck within the carotid sheath, and then passes through the chest to reach the abdomen.
 - The **recurrent laryngeal n.** branches from the **vagus n.** in the lower neck to innervate the larynx (voice box).

Ortner's syndrome involves injury to the left recurrent branch of the laryngeal n. with a consequent hoarseness of voice. One cause stems from an "aortic dissection" whereby the wall of the arch of the aorta distends and stretches this nerve as it loops underneath.

- Though it takes effort, dissect out the complete pathway of the **recurrent laryngeal n.** Look deep on the **left side** of the chest cavity posterior to the lung, and find where it branches from the **vagus n.** and then travels under the **aorta**, before ascending to the larynx.
- This concludes **Lab 19**, leaving time for review. The instructors are available to help the students review during each lab period.

The concepts taught in this course are not overly difficult. Instead, what challenges students most is the sheer volume of the material covered, as well as the pace of the course. To help you embrace the challenge, reflect some on the uniqueness of the human dissection educational experience.

Lab 20. Low Extremity Osteology; Review

The osteology of the lower extremity is studied during this lab. The bones of the pelvis include the innominate consisting of the fused ilium, ischium, and pubic bones. Also studied are the femur, patella, tibia, fibula, and the bones of the foot and toes. Following, the remainder of this lab period is for review. Students are encouraged to work together and share any tricks you have learned in studying the dissections.

Additionally, a large number of anatomical models are now available in the lab. The classroom models include skeleton parts, skulls, prosected joints and plasticized models of human tissues. Moving forward, these models can be studied in small group breakout sessions, with the instructors assisting as needed. Some of the classroom models are expensive, or composed of real bone and connective tissues. Always handle the models, including plasticized human tissues, with clean gloves, and with care.

This concludes **Lab 20**.

Lab 21. Anterior Thigh

- Make superficial cuts as shown. Reflect the skin and adipose tissue fascia covering the thigh sideways. The **greater saphenous v.** is best removed with the adipose and subcutaneous superficial layer of fascia. Be on alert for the **sartorius**, as it rests superficial and not in the same fascial plane as the **quadriceps**. This is also true for the **gracilis** which rests far medially relative to the **adductors**. After finding and preserving the **sartorius** and **gracilis**, remove the deeper fascia to expose the muscles of the thigh.
- The deep fascia is thicker on the lateral side, forming the iliotibial band (tract) that merges to envelope the **tensor fasciae latae** and **vastus lateralis**. Remove the fascia, but leave a two-inch strip of the iliotibial band intact on the body.
- Study the arrangement of the **quadriceps**. Composed of the **rectus femoris**, **vastus lateralis**, **intermedius**, and **medialis**. The **rectus femoris** originates on the AIIS, whereas the **vasti** muscles surround the femur. The **vastus lateralis** is largest; the **vastus intermedius** sits on the femur under the **rectus femoris**; the **vastus medialis** is located most medially. The **quadriceps** converge distally as the quadriceps tendon and inserts on the patella.
- Identify the **sartorius**, **gracilis**, and **adductor longus**. The **sartorius** originates on the ASIS of the pelvis, traverses the **quadriceps** obliquely, and inserts into the upper tibia as part of the pes anserine. The **adductor longus** is the most superficial muscle of the **adductor** group. Next, locate the **gracilis** most medially, and find where it conjoins the **sartorius** at the pes anserinus.
- The “femoral triangle” is now in full view. Locate its borders formed by the inguinal lig, **sartorius**, and **adductor longus**.
- Before dissecting into the femoral triangle, appreciate how it is protectively covered with fascia, adipose tissue, and vein branches. Remove these tissues with a dull probe. With the area opened:
 - Observe the **external iliac a.** passes under the inguinal lig and becomes the **femoral a.**
 - See where the **femoral n.** “starbursts” into multiple motor branches that innervate the muscles of the anterior thigh.
 - Trace the terminal motor branch of the **femoral n.** that exits the apex of the femoral triangle (continuous with the adductor canal) and confirm it enters the **vastus medialis**.
- Inspecting the arteries in the femoral triangle, observe where the **femoral a.** gives off the large **profunda a.**, which in turn, gives off the **medial** and **lateral femoral circumflex aa.** The **medial femoral circumflex a.** dives deep between the **iliopsoas** and **pectineus**, while the **lateral femoral circumflex a.** stays anterior and splits into **ascending**, **transverse** and **descending arterial branches**. The **profunda a.** descends (too deep to follow) down the thigh and gives off four **perforating branches** posteriorly that supply the **hamstrings**.
- The **iliopsoas** and **pectineus** form the floor of the triangle. Cut the **pectineus** off the pelvis and reflect it inferiorly to expose the **obturator externus** on the external surface of the pelvis. Push a probe through this muscle and see the probe emerge inside the pelvis.



- Distal to the femoral triangle, the **sartorius** forms the roof of the “adductor canal”. Examine the canal to find the **femoral a**, **femoral v** (if present), and two prominent nerves. Follow the **femoral a**. distal to the adductor hiatus (gap), and trace the **nerve to the vastus medialis**, and the sensory **saphenous n.** distal into the skin and fascia along the medial knee and leg.
- Cut through the mid-belly of the **adductor longus**, leaving its origin and insertion attached. This exposes the **adductor brevis**. Re-identify the **obturator n.** inside the pelvis. Now trace the **obturator n.** into the thigh to see it split into the **anterior** and **posterior n. divisions**. Recognize the **posterior division** innervates the proximal part of the **adductor magnus**.
- Located deep, the **adductor magnus** is large, as its name suggests. This muscle is best examined on the posterior thigh where it rests deep to the **hamstrings**. This concludes **Lab 21**.

Lab 22. Gluteal Region

Start by reviewing the structures identified yesterday. When ready, turn the body prone and begin dissection of the gluteal region by removing the skin and adipose from the buttock and thigh.

- Note the coarse texture of the **gluteus maximus** fibers. The **gluteus medius** can now also be seen at the upper lateral edge of the **gluteus maximus**.
- At the borders of the **gluteus maximus** insert your fingers between the **gluteus maximus** and **medius** until the fingers of your two hands touch. Now cut the superior margin of the **gluteus maximus** of the sacrum taking care not to cut the small muscles, nerves, and vessels that reside deep. Though part of the **inferior gluteal n.** and vessels that enter the **gluteus maximus** will be sacrificed, aggressively reflect the gluteus maximus laterally and off the greater trochanter.
- On the greater trochanter, locate the trochanteric bursa. This bursa can only be identified now, as it all but disappears when the tissues dry out. With the **gluteus maximus** reflected, cut the **gluteus medius** from its origin transversely by making a fan-shaped incision. Reflect this muscle to find the **gluteus minimus** deep where it rests superior to the greater trochanter.
- At the center of the buttock, observe the terminal-end of the **piriformis** where it emerges through the greater sciatic foramen. Also find the **sciatic n.** where it exits this foramen inferior to the **piriformis**. The **piriformis** serves as a key landmark in the gluteal region.
- Find the **superior gluteal n.** and **inferior gluteal n.** that are named according to where they exit the pelvis in relation to the **piriformis**. Inferior to the **piriformis**, locate the **obturator internus** tendon that emerges from the lesser sciatic foramen and unites with the **gemellus superior** and **inferior**. Together, the **obturator internus** and **gemelli** form the **triceps coxae**.
- Find the **quadratus femoris** coming from the ischial tuberosity. With your hands bending the knee and holding the leg, internally rotate the hip to stretch the **external rotators** of the hip. Stretching the cadaver in this manner may be required to find many of the deepest structures.

- At the ischial tuberosity, clean the **gluteus maximus** off the white sacrotuberous lig, and proceed to cut the inferior end of this lig at the ischial tuberosity. Inside the pelvis find the **internal pudendal a**, **internal pudendal n**, and the **nerve to obturator internus** where they exit the greater sciatic foramen (over the sacrospinous lig) and then re-enter the pelvis via the lesser sciatic foramen. This concludes **Lab 22**.

After exiting the true pelvis, the pudendal n. travels along the medial margin of the ramus of the ischium and pubis (Alcock's Canal). This location makes it vulnerable to compression when riding a bicycle or a horse, causing pain in the genitalia.

Lab 23. Posterior Thigh and Knee

- Remove skin and fascia from the thigh to half way down the leg. Stay superficial in the leg to spare the cutaneous **sural n**. which travels midline along the leg before going lateral (with the **lesser saphenous v.**) to the foot.
- There are three **hamstring** muscles. Follow the **long** and **short heads** of the **biceps femoris** to where they insert below the knee on the fibula. Medially, appreciate the “half tendon” nature distally of the **semitendinosus** and the “half membrane” nature proximally of the **semimembranosus**. See how the **semitendinosus** joins the **sartorius** and **gracilis** tendons at the pes anserinus. Deep to the **medial hamstrings**, distinguish the hamstring-part of the **adductor magnus** from its more proximal adductor-part.
- Posteriorly, find the **sciatic n**. running down the thigh giving off multiple motor branches.
- Distinguish these motor nerves from the **perforating aa**. that branch off the **profunda femoris a**. anteriorly, and then pierce through the **adductor magnus** and supply the **hamstrings**. Place your finger in the adductor hiatus of the **adductor magnus**. Realize this location is where the **femoral a**. name changes to the **popliteal a**.
- Follow the **sciatic n**. down the thigh to where it gives off the **common fibular n**. and becomes the **tibial n**. Observe how the **common fibular n**. diverges laterally and further distally, inspect the superficial surface of the leg for sensory nerve branches (**sural n**. and **lateral cutaneous n. of the calf**).
- Use a dull probe and your fingers to clean out the popliteal fossa. Inside the fossa, moving from superficial to deep, identify the **popliteal v**, **tibial n**, and **popliteal a**. While cleaning around the artery, recognize parts of the **genicular arterial anastomosis** taught in lecture.
- Late in the lab, cut both **heads** of the **gastrocnemius** off the femoral condyles, while taking care to avoid cutting the **plantaris** from its origin on the femur. Dig deep to find the **popliteus**. This flat muscle along with popliteal-arcuate lig complex supports the posterior knee.
- This concludes the dissection part of **Lab 23**, leaving time for review.



Lab 24. Posterior Leg

- With the body prone, remove any remaining skin from the back of leg and plantar surface of the foot. Also, remove the plantar fat pad from the calcaneus while leaving the plantar fascia intact.
 - In the popliteal fossa of the knee, study how **medial** and **lateral heads** of the **gastrocnemius** attach to the condyles of the femur, whereas the **soleus** attaches to the soleal line of the tibia. Despite the discriminant attachments, together these two muscles form the **triceps surae**. Between the heads of the **gastrocnemius**, follow the **plantaris** down the leg and realize why this muscle tendon is called the “freshman nerve”.
 - Clean and remove any unwanted tissues from the popliteal fossa preserving the **plantaris** as well as the major arteries and nerves that supply the leg and foot. Follow the **popliteal a.** to where it becomes the **posterior tibial a.** at the inferior edge of the **popliteus**.
 - Dissect into the *superficial* posterior compartment by cutting the Achilles tendon from the calcaneus. Next, cut the **soleus** from the soleal line of the tibia while lifting and cutting it lengthwise from the shaft of the tibia. Reflect the **triceps surae** laterally, leaving it attached only to the proximal fibula. Inside the posterior compartment, identify the **posterior tibial a.** and **tibial n.** within a neurovascular bundle, and the **fibular a.** where it runs along the fibula yet inside the posterior compartment.
 - Now dissect apart the contents of the *deep* posterior compartment. Start by removing the flexor retinaculum from the medial malleolus and calcaneus, taking care not to cut the underlying structures. Dislocate the **tibialis posterior** and **flexor digitorum longus (FDL)** tendons out from the retromalleolar groove, and follow these tendons up the leg and study the muscle origins.
 - Near the medial malleolus, identify the **posterior tibial a.** and **tibial n.** and deeper, find where the **flexor hallucis longus (FHL)** tendon travels beneath the sustentaculum tali. Trace this tendon into the foot, and consider how it acts with the **tibialis posterior** to support the hindfoot and the medial longitudinal arch.
- Posterior tarsal tunnel syndrome involves compression of the tibial nerve at the ankle. This entrapment syndrome causes paresthesia on the plantar foot and intrinsic muscle weakness.*
- With the posterior compartment leg opened for study:
 - Observe where the **posterior tibial a.** gives off the **anterior tibial a.**, which then perforates the interosseous membrane to supply the anterior compartment.
 - Further distal, find where the **posterior tibial a.** gives off the **fibular a.** Though the **fibular a.** travels in the posterior compartment, it supplies the lateral compartment.
 - Finally, trace the **posterior tibial a.** the length of the posterior compartment, and confirm that it divides into the **medial** and **lateral plantar aa.** near the medial malleolus with these smaller branches continuing into the plantar surface of the foot.
 - This concludes the dissection part of **Lab 24.**

Lab 25. Plantar Foot

- With the skin and plantar adipose tissues removed, appreciate the plantar fascia (aponeurosis) running from the calcaneal tuberosity to the metatarsal heads and toes. While the plantar fascia remains intact, simultaneously dorsiflex the ankle and toes. This activates the windlass mechanism and elevates the arch.
- Cut the plantar fascia off the calcaneus. Then, grasp the cut end of the aponeurosis with a hemostat, and reflect it distally using a scalpel to scratch it off muscles. Finish by leaving plantar fascia attached but tucked in between the toes. The muscles are dissected in four layers.

Intrinsic Muscles

- *In layer 1*, recognize the **abductor hallucis** far medially and detach it from the calcaneus. Examine the neurovascular bundle that travels behind the medial malleolus. Find where the **posterior tibial a.** splits to become the **medial** and **lateral plantar aa.** and where the **tibial n.** splits to become the **medial** and **lateral plantar nn.** On the plantar surface, identify the **flexor digitorum brevis**, **flexor digitorum brevis**, and the **abductor digiti minimi** muscles.
- *In layer 2*, insert a probe beneath the **flexor digitorum brevis** at the calcaneus, and cut the muscle. Reflecting this muscle distally, recognize the **quadratus plantae** inserting into the **FDL** tendon. See where the **FDL** tendon splits distally into four tendons that travel to the toes, and where the **FHL** tendon where it passes to the hallux. “Henry’s Knot” is the crossing connections of the **FDL** over the **FHL** tendon in the midfoot. Within the musculature, identify the **medial plantar** and **lateral plantar aa.** and the companion **medial** and **lateral plantar nn.** The **lateral plantar a.** crosses the forefoot as the **plantar arch**, which, in turn, branches distally as the **plantar metatarsal** and **interdigital aa.** (located deep, and travels with the **common** and **interdigital nn.**) that goes onto the toes.
- *In layer 3*, insert a probe obliquely under the **FDL** common tendon (before it splits). Cut down to the probe. Tease the **FDL** tendons distally. Observe the **lumbricales** arising from the four tendons after the split. The **lumbricales** are small, but usually all four can be identified. Also, look to identify the **oblique head** of the **adductor hallucis**, and the **transverse head** part of this muscle runs transversely from the heads of the metatarsals. At the hallux, recognize the split tendon configuration of **flexor hallucis brevis** that allows passage of the **FHL** and feel with the tip of your finger the sesamoid bones the rest under the head of the first metatarsal.
- *In layer 4*, the **plantar interossei** are located just lateral to the **adductor hallucis oblique head** but these muscles are difficult to identify. The **dorsal interossei** sit between the metatarsals, and these muscles are found when dissecting the dorsum of the foot. Collectively, the **intrinsic** play a critical role in supporting body weight during gait propulsion.

Sesamoiditis is a condition of the first metatarsal head that results from excessive or prolonged pressure to this plantar area of the foot (e.g. long-term standing on a narrow ladder rung).

- The anatomy is complex, so give this region extra study. For example, make time in lab today to review the osteology and names of the foot and ankle joints. This concludes **Lab 25**.

Lab 26. Anterior Leg; Dorsum Foot

- With the body supine, remove the skin from the leg and foot. Save the cutaneous portion of the **superficial fibular n.** that exits the lateral compartment halfway down the leg. This nerve passes deep to the extensor retinaculum at the ankle. Study the retinacular folds of fascia that surround the ankle, and play a role in holding the extrinsic tendons in place.
- Slice open the crural fascia covering the anterior compartment of the leg. Identify the **tibialis anterior (TA)**, **extensor hallucis longus (EHL)**, **extensor digitorum longus (EDL)**, and **fibularis tertius**. Probe the interosseous membrane, and find the **deep fibular n.** and **anterior tibial a.** Note how all of these anterior compartment structures pass deep to the extensor retinaculum and enter the foot. Now cut the retinacula and dislocate the tendons to study where the muscles attach in the leg, and on the foot.

Compartment syndrome is an emergent situation caused by excessive swelling in a leg secondary to traumatic injury. Swelling closes down arterial flow resulting in ischemic pain. A fasciotomy may be required to relieve pressure and save the muscles in the compartment.

Anterior tarsal tunnel syndrome with compression of the deep fibular nerve may result in weakness of the EDB and sensory changes between the toes.
- In the lateral compartment, distinguish the **fibularis longus** and **fibularis brevis**. Follow these tendons, especially the **fibularis longus** to where it runs over the cuboid (pulley). Incise apart the fibers of the **adductor hallucis oblique head** to find the **fibularis longus** tendon near where it inserts on lateral side of the first ray (cuneiform and metatarsal).
- Trace the **common fibular n.** from the popliteal fossa into the **fibularis longus**. Place a hemostat over the nerve to protect it, and cut the muscle. See how the nerve splits into the **superficial** and **deep fibular nn.** which then enter separate compartments of the leg.

The common fibular nerve is vulnerable to compression injury. Pressure from a tight plaster cast or a surgical table can injure this nerve causing a foot drop paralysis.
- The lateral compartment does not have a major artery. Recall, the **fibular a.** travels in the posterior compartment where it sends unnamed branches to supply the lateral compartment.
- Returning to the anterior compartment, observe where the **deep fibular n.** joins with the **anterior tibial a.** and travels distal to the foot. The **deep fibular n.** innervates **extensor digitorum brevis (EDB)**. The nerve then dives deep as a sensory twig that resurfaces between the first and second metatarsals. In studying the **EDB** - follow its tendons to the four medial toes and where they blend with the **EHL** and **EDL** tendons on the extensor hood mechanism of the toes. In the forefoot, locate the four **dorsal interossei** between the metatarsals.
- Recognize that the **anterior tibial a.** becomes the **dorsalis pedis a.** Trace it into the first interosseous space, where it dives deep (disappearing from sight) to make a small contribution to the **deep plantar arch (arterial anastomosis)** located on the plantar surface of the foot.
- This concludes **Lab 26.**

Labs 27 and 28. Lower Extremity Joints; Review

- *Dissect the hip* anteriorly by cutting the muscles away from the joint capsule immediately inferiorly and laterally to the ASIS. Find the capsular “Y” ligament by shaving away any non-capsular tissues. Cut the joint capsule from the rim of the acetabulum, leaving the labrum intact. Dislocate the hip by aggressively flexing and externally rotating the hip to force the femoral head out of the acetabulum. Inspect the femoral head for joint erosions; note the fovea capitis and lig of teres; observe the acetabulum and labral ring that surrounds it.
- *Dissect the knee* anteriorly making a U-shaped cut beginning at the medial retinaculum, across the **quadriceps** tendon and down the lateral retinaculum. Reflect the patella down, leaving it attached by the patellar tendon. Looking inside the knee:
 - Examine the articular cartilage for arthritic erosions. Maybe observe a thin band of plica (fold in synovial membrane) along the anteromedial aspect of the knee.
 - Recognize the medial and lateral menisci attached to the tibia via the coronary lig; find the transverse lig between the anterior poles (horns) of the menisci.
 - Find the anterior cruciate lig (ACL) attaching anteriorly on the intercondylar eminence of the tibia. See the posterior cruciate ligament (PCL), and intercondylar notch of the femur.
 - Palpate the broad medial collateral lig (MCL); search into the pes anserinus in attempt to find the bursae that resides between the group of muscle tendons and the tibia.
 - Dissect out the lateral collateral lig (LCL) by first palpating this cable-like extracapsular lig superior to the fibular head, now expose it by removing the surrounding fascial tissues.
 - Assess the stability by manually delivering valgus-varus and anterior-posterior joint stresses to the knee while observing how certain maneuvers stress certain ligaments.
- *Dissect the hindfoot* by reflecting (or removing) the extrinsic muscles that cross the ankle.
 - On the lateral side, remove any tissues that cover the lateral collateral lig (LCL). The three bands are named the anterior-talofibular, calcaneofibular, and posterior-talofibular lig.
 - On the medial side, confirm the triangular (deltoid) arrangement of the medial collateral lig (MCL) fibers.
 - To dissect into the ankle, cut the MCL inferior to the medial malleolus while forcing the hindfoot into eversion and pulling the talus away from the tibia, disarticulating the joint.
 - To dissect apart the subtalar joint and all its articulations, while prying the talus and calcaneus bones apart cut the interosseous lig housed inside the joint. When disarticulation is complete, feel the smoothness of the joint surfaces and imagine how the bones move in relation to each other during pronation and supination movement of the foot.
 - Remove the intrinsic muscles (layers 1 and 2) to observe the plantar ligaments of the foot. Carve the muscles off distal to the anterior tubercle of the calcaneus, and see:
 - The long-plantar lig that spans the midfoot and covers the **fibularis longus** tendon.
 - The short-plantar lig where it runs just medial in the crevice of the medial arch,
 - The calcaneonavicular “spring” lig that sits immediately deep to **tibialis posterior** tendon. Apply force to the spring-lig with your fingers (or using a hemostat) and feel how it stretches under an imposed load.

Time is provided in these combined lab periods to finish any remaining dissections and to review.

This concludes **Labs 27 and 28.**

Lab 29. Final Review

Students can now turn their full attention to studying the full body dissections in preparation for the final examinations (both lecture and lab). About 15% of the structures tagged in the final lab exam and questions asked in the written exam will come from material covered prior to the midterm exam.

Lab 30. Final Exam

The final lab examination involves the identification of structures on the body dissections, and the anatomical models used in the lab. Today is the last day you will be in the lab, so be sure to remove all belongings from the lab and take time to reflect on this a unique learning experience, knowing that a person contributed their body to advance your medical education.