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FINLEY'S

INTERACTIVE CADAVERIC DISSECTION GUIDE

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Foreword

Knowledge of anatomical structures is a basic tool used by a health professional. A cadaveric dissection course gives the student the opportunity to gain the anatomical knowledge essential for evaluating and treating a patient, and, to develop the attitudes, behaviors, and judgment necessary in clinical practice. Participation in a dissection course is a very special privilege for both the student and the instructor.

Dr. Claudia Senesac and Dr. Mark Bishop have developed an innovative dissection text to aid and support the student through the dissection experience. They have produced an interactive step-by-step instruction book using digital components, as well as anatomical text. A DVD is included, which parallels the procedures in the book. Digital still images are complemented by digital movie clips of the procedures, and in addition, line drawings are presented. All regions of the body are included as well as a comprehensive description for the dissection of joints, the pelvis, and the spine.

These authors recognize the inherent value of the study of anatomy employing cadaveric dissection. They have demonstrated in their teaching careers an appreciation for the multiple opportunities during laboratory classes to discuss and share with the students those skills essential for becoming a health care professional. These acquirements include: the student developing a clear visual picture of an anatomical area and the texture of the structures within, the student comprehending the damage to structures resulting from a pathological condition, and the student learning to exercise the mature judgment required in matters of confidentiality.

A cadaveric study of musculoskeletal anatomy and joint structures imprints on the student's mind a visual picture of muscle attachments to bone and the relationship of the muscle attachments to ligaments around the joint as well as the joint axes. Dissection of joints allows the student an opportunity to stress certain ligaments to better understand the stability the ligament affords the joint. The functional problem resulting from a tear of a ligament can be appreciated by cutting through a ligament and observing the instability created by such an injury. The site where a nerve enters the muscle and innervation within the muscle can also be studied. The direction of the muscle fibers which influences the action the muscle accomplishes can be observed as the student experiments with moving the limbs.

A dissection experience allows the student to become familiar with the genuine texture of anatomical structures. The student develops a sense of the "feel" of a variety of structures. For example, tendons have a distinctive feel from muscle, a ligament can be discerned from a tendon, and nerves are perceived differently from blood vessels. Repeated handling of these cadaveric structures throughout a course firmly establishes the special feel of the structures and is essential for developing palpation skills on a patient.

In addition to joint and musculoskeletal problems, an understanding of generalized medical conditions is essential for treating many patients. The anatomical knowledge gained from dissection of thoracic, abdominal, and pelvic viscera leads to a greater appreciation of pathological conditions encountered in patients. To feel the walls of an artery with arteriosclerosis, to observe enlargement of air spaces in the substance of a lung with emphysema, to view hypertrophy of the left ventricle of a heart, and to see tumor invasion in a liver affords a unique opportunity for a student to observe firsthand the impact of disease on tissue and its function.

Vital to cadaveric dissection courses is the cultivation of respect for the human body and recognition of the responsibility for confidentiality. As the instructor requires confidentiality

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of what is performed and observed in the lab, the student begins to develop a sense of the strict confidentiality they will have to maintain when treating patients. A decision concerning what is appropriate information that may or may not be shared about the cadaver lab with a person who is not in the class helps the student to develop judgment in maintaining patient confidentiality.

A dissection course is exciting for the student who is seeing the "real thing" for the first time and the instructor who shares and stimulates the student's wonderment. These courses lay the groundwork for the development of these attributes which are essential for a successful career as a health professional.

In 1974, I authored a manual that was a guide for the beginning student directing them through the process of dissection. It incorporated black and white illustrations and followed a step-by-step procedure for each anatomical area. This manual was used for a number of years in the Department of Physical Therapy at the University of Florida. Upon my retirement from the University of Florida in 2002, this manual and syllabus was handed over to Claudia Senesac, PT, PhD, PCS, who was my successor. Dr. Senesac had assisted in the teaching of this course for many years before joining the faculty. She now teaches the entry-level cadaver dissection course as well as pediatrics. Mark Bishop, PT, PhD teaches in the areas of functional musculoskeletal anatomy in the entry-level physical therapy program and advanced joint dissection in the sports medicine and orthopaedic physical therapy residency programs. He has assisted with the editing of this book and has written the introductory chapter and preface. Drs. Senesac and Bishop have developed an innovative anatomy text which incorporates some of the basic dissection approaches in the original syllabus. This interactive dissection guide will lead students in building a foundation of anatomical knowledge, giving a framework upon which the student can continue to build their clinical knowledge as they mature in their chosen health profession.

Claudette Finley, MS, PT
Associate Professor Emeritus

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Preface

Why write this book? And why write it now? Good questions for there are certainly other manuals that describe the sequential dissection of the human body. Perhaps a better question might be "why record it now?" Maryanne Wolf wonders, "Can the essence of a word, a thing, or a concept retain importance when so much learning occurs in thirty second segments on a moving screen?"[4] While her sentiment was particularly directed toward the acquisition of reading, I think that it applies equally to the acquisition of other skills. Can students learn the art and science of dissection by watching?

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Some authors [2, 3] have suggested that students born after 1980 are so immersed in digital technology that they are different in their manner of thinking not only from previous generations of students but the teachers as well. Prensky is credited with coining the term "digital native" to describe this group of students, and "digital immigrants" to describe the rest of us born before 1980. As an immigrant to the digital world, then, I have an "accent" that often shows; I don't text message well, I print papers out to read them and my seven year old son can out bowl me on the Wii (TM). Many have claimed that the observations are mainly anecdotal [1]. Well, my anecdote is that the students who are arriving every fall are very much techno-savvy. Also, when we found that we were repeating demonstration after demonstration, the decision was made to generate some training videos. Next thing you know, there were hours of digital footage and images. Really, the next logical step was to add those images to the dissectors guide and here we are.

So, back to "Can students learn the art and science of dissection by watching?" To be effective as a teacher of how to learn, an educator should consider presenting material using a variety of methods. This is independent of which version of the learning and teaching style literature you favor, or whether you prefer David Kolb's Experiential Learning or Zull's extension thereof. To learn dissection and the anatomy relationships within it, students will still need to read or watch, reflect, do and then reflect again on their efforts. So I think from that perspective we have added the extra dimension to the experience.

But really, why write this book? What was the personal motivation? The foremost reason for me was Ms Finley herself. In 1995 I sat in a class room ready to take an advanced joint dissection class about which I heard much from several professional colleagues. Punctually at 5:00pm, in walked a petite precisely dressed lady. She moved to the front of the class room and turned toward us. "Welcome class," she said. "My name is Claudette Finley. You may call me Ms Finley." So began my academic career. Ms Finley was a fantastic anatomist and a great role model. Thanks Ms Finley.

Mark Bishop

In 1977, I began my professional academic quest to become a Physical Therapist and was introduced to the anatomy laboratory first semester. I had dreamed of taking a course like this since high school biology, I was enthralled by the opportunity to learn visually and sensorally about the body and to translate that into rehabilitation. My instructor was Claudette Finley. She was precise, exact, motivating, and thoroughly engrossed in the course material. She had authored a small spiral notebook that was to be our guide for the course. When I graduated, I immediately volunteered to be her anatomy assistant and remained so until she retired (18 years). She joked with me that she had given me her brain when she retired and I know I was optimistic that she had done so. Anatomy dissection is not a glamorous task or glamorous job

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but a discovery such as a private investigator unearths clues to an exceptional case. Every semester is unique and each body although structurally similar provides a glimpse of the individuals' life journey. As technology has advanced forward and written words and illustrations are not quite enough to satisfy the palate of those learning new skills and new foundations it became obvious that filming the text would compliment the process and prepare the student for the experience that lay before them. Claudette had provided a template to do just that.

It is with great admiration that I thank Claudette Finley for the opportunity to assist, teach, grow and learn about the body. Without her continued guidance and encouragement my career would be very different. I have always been proud to have been one of her students and colleagues.

Claudia R. Senesac

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Introduction

ANATOMY . . . IS THE VESTIBULE OF THE TEMPLE OF MEDICAL SCIENCE.
—DE LINT, 1926[1]

The ability to perform dissection provides a unique opportunity to observe the intricate interplay of human structure. This is especially true if the student is able to participate in an anatomy laboratory in which several (or many) different cadavers are located. A consistent theme in the treatises of early anatomists is awe and wonder at the incredible complexity and variety of the human organism.

This unique and special opportunity was not always available to aspiring students. Imagine the difficulty of performing studious dissection before the development of effective embalming or refrigeration, for example. Anatomists traveled from town to town to study from "fresh" bodies that had not yet begun to decay. To compound matters, dissection of human bodies sometimes happened in secret, in closed rooms and furtively at night.

For more than 4000 years, we have sought to determine the structure and function of the human body. Chinese writings and drawings from about 2500 BCE describe the circulation, breathing, and many internal organs.[2] Around 1600 BCE, Egyptians recorded that the blood vessels were known to come from the heart, and these early anatomists recognized the liver, spleen, kidneys, uterus, and bladder.[2] Hindu medicine dating from 600 BCE contains references to the skeleton and advanced surgical procedures.[2]

In the 3rd and 4th centuries BCE, Hippocrates, Aristotle, and their followers compiled observations about the musculoskeletal system and organs. Most of these were made by combining external observation with conjecture based on the dissection of nonhuman animals.[2] Herophilus and Erasistratus, working as surgeons in Alexandria in approximately 300 BCE, made systematic studies designed to discover the workings of human anatomy.[2]

However, the most influential anatomist of ancient times was, perhaps, Galen. As a physician to the gladiators, Galen likely studied many different types of wounds. He also compiled much of the work of previous writers and studied internal organs by performing vivisection on animals. Although he was able to examine human skeletons from remains found in tombs, his drawings were based mostly on dogs, apes, and pigs.[2] Despite this limitation, Galen's works became the standard anatomy textbook for 1500 years.

After Galen, the study of anatomy progressed little in Europe. However, it flourished in the Islamic world. Arabic philosopher–physicians studied medicine from the wide Persian Empire, including Indian, Greek, and Egyptian sources. An unattributed saying goes, "Medicine is born; Hippocrates created it. It was dead; Galen revived it. It was scattered; Rhazes reassembled it. It was imperfect; Avicenna perfected it."[3] Rhazes was a prolific writer and compiler of medical knowledge; however, Avicenna contributed to more than the science of anatomy, presenting a classification of the organs and their function.[2] Avicenna expanded the Galenic teachings on anatomy in *The Canon of Medicine* (ca. 1000 CE),[2] which became the standard text used throughout the Islamic world and Christian Europe.

The physicians Ibn Zuhr and Ibn Jumay performed human dissections and postmortem autopsy, recording their findings. This work was extended by the Arabian physician Ibn al-Nafis. In 1242, he described the pulmonary and coronary circulation of the blood. He also developed new systems of anatomy and physiology to replace the Avicennian and Galenic doctrines followed in *The Canon of Medicine.*

In Christian Europe, advancement of anatomy coincides with the rise of the university, especially in Italy. Dissection of a human body occurred annually at centers that had medical

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faculty and trained surgeons. Dissection transpired rapidly over a course of days and nights in a viewing hall. During this period, Leonardo da Vinci drew a series of anatomical figures based on dissection of human corpses, many of them at a mortuary in Rome, until he was ordered to stop by the pope of the time. His drawings included pictures of bone structures, muscles, internal organs, the brain, and a fetus in the womb. Others, such as Jacopo Berengario da Carpi, Mondino de Liuzzi, and Alessandro Achillini, also dissected cadavers and contributed to the accurate description of organs and their functions.

In the 16th century, Vesalius was the first to significantly challenge Galen's descriptions of anatomy. As a medical student, he had attended anatomy lectures in which the instructor was unable to find the organ as described by Galen. This prompted Vesalius to dissect corpses himself and describe what he found. His drawings demonstrated the discrepancies between dogs, apes, and humans, and he was able to show that in many cases Galen's observations were correct for the dog and ape, but had little relation to humans.

A succession of researchers proceeded to refine the body of anatomical knowledge, giving their names to a number of anatomical structures along the way. However, only certified anatomists were allowed to perform dissections, and sometimes then only yearly.

During the 19th century, the discipline advanced knowledge in histology and developmental biology, not only of humans but also of animals. An important 19th century milestone occurred in 1832 when England passed the Anatomy Act to prevent body snatching, grave robbing, and murdering as means of finding cadavers. This legislation resulted in an adequate and legitimate supply of bodies for study and provided a suitable environment for *Gray's Anatomy*, which soon became the foremost anatomical reference text.

Since then, anatomical research continues to take advantage of technological developments. Disciplines such as microbiology and endocrinology have explained the purpose of glands that anatomists previously could not explain, and imaging technology such as magnetic resonance imaging and computerized tomography enable the study of the body in cross-section. Subsequently, macroscopic (gross) anatomy has been very well described, and microscopy anatomy continues to progress.

The study of anatomy over the centuries has provided the focus for sculpture, diagram, and illustration of the body and continues to be the base and foundational training for medical and health-related professions throughout the world. With the curiosity of anatomists and pioneers in this area of study from days long ago, we continue to advance our knowledge of the body through exploration identified as dissection.

GETTING STARTED

Study of the human body using cadavers is a privilege and a unique opportunity in your training. Dissection is to be done with respect for those who have graciously donated their bodies so that we may learn how to help those who are living. We can maintain this privilege only if the highest standards of conduct in both work and personal behavior are upheld in the lab. This next section will discuss many suggestions for study and professional conduct in the anatomy laboratory. Many of those listed are general to all facilities in which dissection is performed. However, states and institutions will have a formal set of regulations that govern behavior where you are studying. You are encouraged to acquaint yourself with those rules so as not to run afoul of them.

CARE OF THE ANATOMY LABORATORY

1. **Visitors are not allowed in the lab**. As a student of anatomy, you are asked to help monitor who enters this lab and views these cadavers. Please report all violations to the instructor. Each State Anatomical Board will have rules and regulations that gov-

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ern the viewing and dissection of cadavers. Breaking these rules is a serious breach of conduct warranting action at the instructor's discretion. Anatomy rooms are often monitored by security systems that record who enters the room and when.

2. Tables are to be kept clean and free from bits of tissue. A small aluminum or plastic container should be placed on the table for collecting tissue while dissecting. Clean up your table and bits of tissue with a paper towel **at the end of each lab period**. There should be NO loose tissue left on the table or in the bag unless still attached to the cadaver at the completion of your lab period. Skin flaps should be kept to cover the body part dissected.
3. **Tissue** to be discarded must be placed **ONLY** in the containers marked for tissue disposal. Paper towels, gloves, and other trash must be placed in the containers labeled for regular garbage in your laboratory!
4. If there is a bucket under the table, it is for collection of embalming fluid and drainage from the body. It is not for refuse. It will need emptying occasionally by someone at your table. This is emptied into a tissue sink. It will be necessary to flush the tissue sink once the fluid from the bucket is disposed of.
5. Sinks are for washing. They are not receptacles for paper towels, body tissue, chewing gum, etc. If you see these items in the sink, please take the initiative to remove them and prevent the sink from overflowing. Be sure to flush the tissue sink to keep it from becoming clogged.
6. The floor must be kept clean at all times. If tissue falls on the floor, pick it up immediately before it is stepped on. The tissue will be very greasy, and a person can slip easily on a small piece left on the floor. Spilled embalming fluid is also very greasy and should be mopped up quickly. Please report all spills to the instructor before leaving the lab.
7. Please return chairs or stools to the side of the tables neatly when you have finished dissecting. This is part of cleaning up at the end of your lab period.

CARE OF THE CADAVER

1. Keep the cadaver moistened between dissection periods. Extra care should be given to the face, forearm, hands, and feet, which tend to dry quickly. It is your responsibility to cover the hands and feet with ***white socks*** to preserve these structures. Expose only the area being dissected in order to prevent drying.
2. Wet down your cadaver with preserving fluid supplied by the laboratory at least twice weekly and more often if you know the cadaver has been used for long periods of time for studying. A small spray bottle is often used by students and kept at the table. Spraying of the skin will NOT protect the tissue lying underneath. Preserving fluid is not absorbed by the skin.
3. If there is a bag covering the cadaver, it SHOULD NOT TOUCH the floor. It will pick up dust and spores, causing mold. If mold or flying insects are sighted, tell the instructor immediately so that proper measures can be taken to prevent spreading.
4. The following suggestions will help improve your care of the cadaver:
   a. Dissect with blunt instruments (probe) and with the fingers whenever possible.
   b. Locate major nerves and arteries before cutting into a block of tissue to avoid damaging delicate structures. This often requires that you progress slowly through the dissection.

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c. Keep tendons intact, cutting only when necessary to get at underlying structures. When tendons are cut, return the cut tendons to their original position at the end of the dissection period.
d. Place the point of the forceps or a probe under a tendon or ligament that needs to be cut, and make the incision along the surface of the forceps or probe. This will isolate the structure to be severed.
e. When it is necessary to cut through the belly of a muscle to explore deeper areas, dissect a few muscle fibers at a time rather than making one deep incision.

CARE OF THE DISSECTOR

1. Small cuts should be washed under running water for a few minutes.
2. A first aid kit should be available in the lab to treat minor cuts. If cuts are larger, you may need to go to the student infirmary or the emergency room of your facility.
3. Most State Anatomical Boards require that **all persons handling cadaveric materials must wear gloves**. Masks may be used, particularly if embalming fluid is irritating to your skin or nose. Masks may be purchased at a drugstore. Gloves are sold at the medical bookstores, drugstores, and medical supply stores. Molded masks work well, and exam gloves are better than the large, thick rubber gloves.
4. Fluids can soak through lab coats and stain clothes. Scrubs are a good alternative to wear under your lab coat. Think twice before wearing an expensive dress or suit to lab even if you use a lab coat. Wool tends to absorb odors.
5. Lab coats must be clean. You may be able to wear a lab coat for about a week before washing, depending on the area you are studying. Remember that odors in lab coats will penetrate your clothing, then your closet, then your living quarters!
6. Lab coats should not be left in the lab. They may "disappear." Be sure to put your name in your lab coat.
7. You must wear closed-toe shoes in the laboratory. NO open-toe shoes may be worn in the lab.
8. Work quietly. Conform to professional conduct at all times.
9. No smoking. No eating or drinking in the lab. (This is usually not a problem!)

CARE OF INSTRUCTIONAL MATERIALS

1. Mounted skeletons or plastic models are difficult to prepare, fragile, and **EXPENSIVE**. They are for study and reference. Push or pull the skeleton stand with care. Do not force the scapula on the rib cage or handle the skeleton with roughness, which could break a bone or disarticulate a joint. Do not position the skeleton with disrespect.
2. The disarticulated skeletons are equally valuable and should receive the same care and precautions. **Most State Anatomical Boards forbid any bones or cadaver material from leaving the laboratory. This is considered to be unauthorized possession of human remains. Do not even think about it! You can get into legal trouble with the State Anatomical Board of your state.**
3. Special atlases and dissections may occasionally be placed in the lab for your study. Ensure that your hands are clean and dry before using them. DO NOT wear gloves to handle the models.

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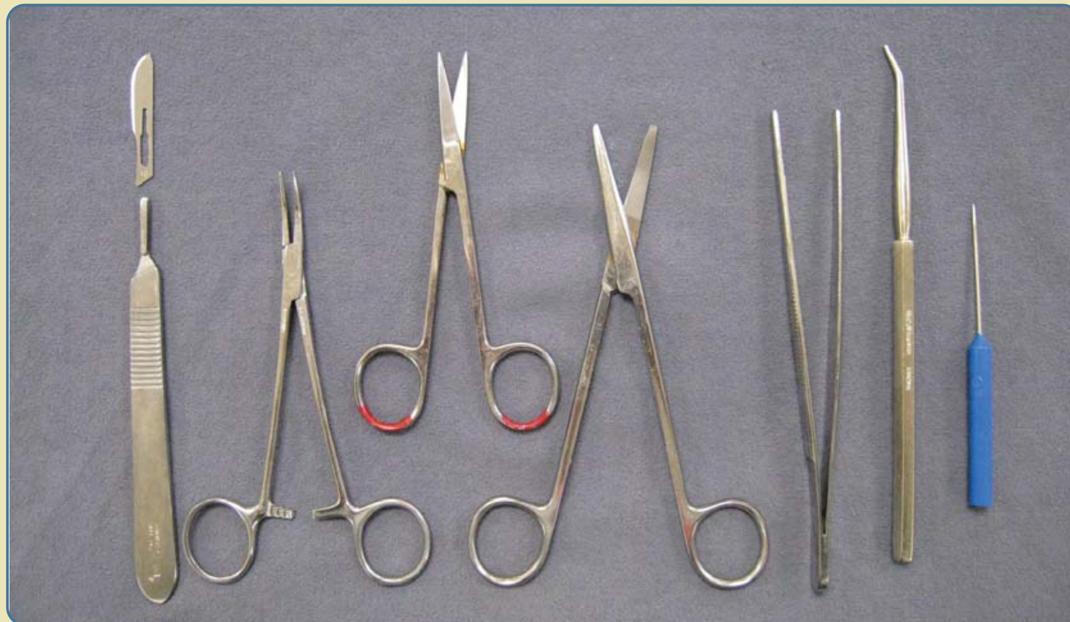
4. It is suggested that a pencil eraser be used to turn pages in your atlas when dissecting, since your hands will be very greasy.

TOOLS OF THE TRADE

1. A dissection kit is REQUIRED Figure 0.1. Most kits include:
   a. Scalpel and blades:
      i. You will need approximately 20–30 blades (#10) for a semester.
      ii. Do NOT use your fingers to change the scalpel blade. Refer to the DVD for a demonstration of inserting and removing a scalpel blade.
   b. Angle tip probe.
   c. Hemostat forceps.
   d. Tissue forceps (without teeth).
   e. Check with your anatomy instructor for other tools that may be used in your laboratory. These other tools include scissors and forceps with teeth.
2. Be sure to put your name on each instrument. Marks made with fingernail polish are resistant to most preserving fluids.
3. At the end of dissection, be sure to clean and dry your instruments. There should be no tissue left in your dissection kit.

Figure 0.1 "Tools of the trade." Each of these dissection tools has a separate function. For example, not all dissection should be done with a scalpel. Refer to your dissection manual for specific instructions about when to use each one.



a b c d e f g

a—Scalpel handle and blade (this image shows a #3 handle and #10 blade)
b—Surgical forceps (hemostats)
c—Sharp point scissors (note the nail polish markings on Ms. Finley's scissors)
d—Blunt nose scissors
e—Tissue forceps without teeth
f—Angle probe
g—Dissection pin

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TECHNIQUES

The techniques of dissection can be developed only through practice. Those that we describe throughout the text are demonstrated for you on the videos accompanying this guide. Read this section and watch the DVD. When in doubt, consult this guide, the DVD, or your instructors.

Once you begin to read and follow through this guide, you will notice that the majority of the instructions follow a regional rather than systemic pattern. Grant and Cates (1940) indicate, "Unless each step in the dissection is carried out, and in the given order, confusion will result. This, of course, is true of any guide; but the point needs emphasizing, for our experience is that a great many difficulties the student encounters result from failure to meet this very fundamental obligation."[4] This can be reworded as "Consult your atlas and read the guide before you begin each section." Most problems can be avoided by reading before you cut.

Also as you read, you will encounter terms used to describe location and terms related to movement of the body. The majority of these terms relate to "the anatomical position," which is shown in Figure 0.2, and described below.

- Regions of the body:

  1. Sagittal plane—median plane—a plane dividing the body into right and left halves
     a. Medial—toward the midline or median plane
     b. Lateral—away from the midline or median plane
  2. Frontal or coronal plane—plane dividing the front from the back
     a. Anterior (ventral)—toward the front of the body
     b. Posterior (dorsal)—toward the back
  3. Horizontal or transverse plane—divides the body at right angles to both sagittal and coronal planes
     a. Superior—above a horizontal plane (toward the head)
     b. Inferior—below a horizontal plane (toward the feet)

- Movements relative to the body:

  4. Proximal—nearest to a point of reference; direction toward a point of attachment to the body (shoulder is proximal to the elbow)
  5. Distal—away from a point of reference; direction away from a point of attachment to the body (wrist is distal to the elbow)
  6. Superficial—toward the surface of the body part
  7. Deep—away from the surface of the body part
  8. Internal—toward the inside of the body
  9. External—toward the outside of the body
  10. Ipsilateral—same side of the body; affecting the same side of the body
  11. Contralateral—originating in or affecting the opposite side of the body
  12. Palmar (volar)—palm of hand
  13. Plantar—sole of foot
  14. Cranial (cephalic)—head or superior aspect; toward the head

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Figure 0.2 The Anatomical Position

15. Caudal—inferior aspect; toward the tail
16. Anterior (volar)—front
17. Posterior (dorsal)—back

- Parts of the body:

18. Arm—from the shoulder to the elbow (brachium)
19. Forearm—from the elbow to the wrist (antebrachium)
20. Thigh—from the hip to the knee
21. Leg—from the knee to the ankle

- Positions of the body:

22. Supine—lying on the back with the face upward
23. Prone—lying horizontal with the face downward

TERMS OF MOTION

- Monoplanar motions:
  1. Sagittal plane
     a. Flexion—occurs when the angle between two bones is decreased
     b. Extension—occurs when the angle between two bones is increased

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2. Frontal plane
    a. Abduction—movement away from the midline of the body
    b. Adduction—movement toward the midline of the body
3. Transverse plane
    a. Rotation—motion around a central axis without undergoing any displacement from this axis

- Multiplanar motions or those that can occur in any plane:
    1. Circumduction—when a bone is made to circumscribe a conical sphere
        a. Orderly combination of flexion, abduction, extension, and adduction in sequence
    2. Pronation—triplanar motion of the forearm, wrist, or joints of the foot
        a. Turning the palm down, for example
    3. Supination—triplanar motion of the forearm, wrist, or joints of the foot
        a. Turning the palm up, for example
    4. Elevation—to raise a point of reference
    5. Depression—to lower a point of reference
    6. Protraction—to move forward or away from the midline
    7. Retraction—to move backward or toward the midline

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Dedication

To Ms. Finley: thank you for teaching me the art of dissection and giving me the opportunity and gift of teaching others.

To my past, present, and future students; may you all become private investigators as you discover the wonders of anatomy and learn the science of healing.

To Bob and Emily:

With love and much appreciation for your ability to endure, encourage, and provide an unmatched sense of humor that has carried us through the years.

In loving memory of our daughter Ashley O'Mara who is greatly missed.

A day never goes by that I am not thankful for my family, friends, colleagues, and students that have provided me with the continued experience of life long learning.

Each day you enter the lab is a privilege and honor that a generous person has given you in their hope that you will learn to treat the living. May you do just that.

Claudia R. Senesac

I would like to dedicate this book to two anatomy teachers – Nikolai Bogduk (BSc(Med), MB BS, PhD, FAFRM) for making anatomy fun to learn the first time around, and Claudette Finley, PT, MS for making me want to learn it really well.

Mark Bishop

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