
The National Medical Series for Independent Study

anatomy

Ernest W. April, Ph.D.

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Acknowledgments

Preface

I. PURPOSE

A. OVERALL OBJECTIVES

1. To **organize** and **list** items and topics for easier comprehension, study, and review.
2. To **maximize** use of the limited time available to the student physician.
3. To **direct** the new student toward the most fruitful aspects of anatomic study by illustrating and emphasizing structural and functional detail pertinent to the skillful practice of up-to-date medicine.

B. INTERMEDIATE OBJECTIVES

1. To **present** pertinent **basic anatomy** with illustrations, diagrams, and tables; functional anatomic concepts; and **clinical notes** to provide the student physician with a framework upon which he or she may construct a working knowledge of human anatomy.
2. To **assist** the student physician in determining the relative importance of anatomic structures.
 - a. The treatment of the included subject material does not represent detailed discussions of every topic in anatomy, nor does it belabor the major points of anatomy, which are obvious and easily assimilated.
 - b. For the clinician in training some anatomic structures and concepts are more important than others.
 - c. Effort has been made to distinguish between the included *minutia* (clinically important detail) and the excluded *trivia* (inconsequential detail of interest only to anatomists and specialists).
3. To **provide** a **review** of human anatomy for:
 - a. **In-course examinations** in the professional health sciences curricula.
 - b. **Subsequent courses** in the medical curriculum.
 - c. **Clinically oriented licensure examinations:**
 - (1) The **NBME, Part I** (National Board Examinations).
 - (2) The new **FLEX I** (Federated Licensure Examination).
 - (3) The **ECFMG** (Examination Certifying Foreign Medical Graduates).
 - (4) Various medical **specialty board examinations**.

II. SUGGESTED METHOD OF USE

- A. The subject presentation is **regional**, which is the method used in most medical teaching programs.
 1. The **section order** is only one of a number of sequences that have proved workable, but one for which I have a preference.
 2. Because the topics are extensively **cross-referenced**, the user of this outline and study guide need not proceed in any particular order.
- B. To obtain maximal benefit from this outline and study guide:
 1. Use in conjunction with:
 - a. A textbook of human anatomy.
 - b. An atlas of human anatomy.
 2. Review from time to time the stated goals and learning objectives set forth before each section.

3. Use the pretest, section questions, and post-test.
 - a. Taking the pretest will help the student to understand the direction and philosophy of this book.
 - b. The questions at the end of each section and the post-test will not only indicate whether a basic knowledge of anatomy has been attained, but also, because many of the questions are clinical in nature, enable the user to determine whether he or she has a working knowledge of human anatomy.

Ernest W. April

Acknowledgments

Because the function of a text or review book is to present concisely the basic information that forms an accepted body of knowledge, only the organization and presentation of those facts and concepts may be original. As such, I humbly acknowledge the numerous anatomic reference texts against which the material presented herein has been checked for accuracy. Even more humbly, I acknowledge those uncounted and anonymous deceased individuals as well as my numerous academic and clinical colleagues who have contributed over the years to my fund of knowledge and, finally, the student physicians against whom this anatomic knowledge has been honed. In addition, I am indebted to Dr. Timothy Chuter, a surgical colleague, for his thorough reading of the manuscript, his lively discussions, and his contributions to the Extremities and the Head and Neck.

The anatomic illustrations of Anne Erickson and Salvatore Montano confirm the importance of the visual aspects of anatomy. Much of their work has been based upon their own dissections.

Introduction

Anatomy is one of seven basic science review books in a series entitled, *The National Medical Series for Independent Study*. This series has been designed to provide students, house officers, as well as physicians, with a concise but comprehensive instrument for self-evaluation and review within the basic sciences. Although *Anatomy* would be most useful for students preparing for the National Board of Medical Examiners examinations (Part I, FLEX, VQE, and ECFMG), it should also be useful for students studying for course examinations. These books are not intended to replace the standard basic science texts, but, rather, to complement them.

The books in this series present the core content of each basic science area using an outline format and featuring a total of 300 study questions. The questions are distributed throughout *Anatomy* at the end of each section and in a pretest and post-test. In addition, each question is accompanied by the correct answer, a paragraph-length explanation of the correct answer, and specific reference to the outline points under which the information necessary to answer the question can be found.

We have chosen an outline format to allow maximum ease in retrieving information, assuming that the time available to the reader is limited. Considerable editorial time has been spent to ensure that the information required by all medical school curricula has been included and that each question parallels the format of the questions on the National Board examinations. We feel that the combination of the outline format and board-type study questions provides a unique teaching device.

We hope you will find this series interesting, relevant, and challenging. The authors, as well as the John Wiley and Harwal staffs, welcome your comments and suggestions.

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Pretest

QUESTIONS

Directions: Each question below contains five suggested answers. Choose the **one best** response to each question.

- Which of the following structures drains into the inferior meatus of the nose?
 - Ethmoidal sinuses
 - Frontal sinus
 - Maxillary sinus
 - Nasolacrimal duct
 - Sphenoidal sinus
- Hysterectomy (surgical removal of the uterus and ovaries) may result in injury to adjacent anatomic structures. One structure commonly injured is the
 - external iliac artery
 - rectum
 - triangular ligament
 - ureter
 - urethra
- A typical thoracic vertebra includes all of the following components EXCEPT
 - a heart-shaped vertebral body
 - inferior articular facets
 - a neural canal
 - superior costal facets
 - transverse foramina
- The tendon that can be seen and felt just posterior to the medial malleolus of the tibia during inversion of the foot is the tendon of which of the following muscles?
 - Flexor hallucis longus
 - Peroneus brevis
 - Peroneus longus
 - Tibialis anterior
 - Tibialis posterior
- Which of the following statements correctly describes the papillary muscles in the heart?
 - They are rudimentary and have no major function
 - They contract to close the atrioventricular valves during ventricular systole (contraction)
 - They contract to open the atrioventricular valves during ventricular diastole (relaxation)
 - They secure the chordae tendineae to the atrioventricular valve leaflets
 - None of the above
- All of the following circulatory changes normally occur immediately at birth EXCEPT
 - decreased right atrial pressure
 - increased blood flow through the lungs
 - increased left atrial pressure
 - reversal of flow through the ductus arteriosus
 - reversal of flow through the foramen ovale
- Which of the following statements best describes the teres major muscle?
 - It contributes to the stability of the posterior part of the shoulder joint
 - It divides the axillary artery into three parts
 - It inserts on the humerus just distal to the infraspinatus muscle
 - It is active in adduction of the shoulder joint
 - It is innervated by the same nerve that supplies the deltoid muscle
- Which of the following arteries frequently arises as a branch of the external iliac or inferior epigastric artery, instead of as a branch of the internal iliac artery?
 - Internal pudendal
 - Obturator
 - Superior vesical
 - Umbilical
 - Uterine

9. Infection may spread from the nasal cavity to the meninges along the olfactory nerves. Olfactory fibers pass from the mucosa of the nasal cavity to the olfactory bulb via the

- (A) anterior and posterior ethmoidal foramina
- (B) cribriform plate of the ethmoid bone
- (C) hiatus semilunaris
- (D) nasociliary nerve
- (E) sphenopalatine foramen

10. The muscles of the back receive motor innervation from

- (A) dorsal primary rami
- (B) dorsal roots
- (C) posterior branches of the lateral perforating nerves
- (D) ventral primary rami
- (E) none of the above

11. Bilateral lumbar sympathectomy does not affect autonomic control of the descending colon because

- (A) the descending colon receives its parasympathetic innervation from the pelvic splanchnics
- (B) the descending colon receives its parasympathetic innervation from the vagus nerve
- (C) the descending colon receives its sympathetic innervation from thoracic splanchnic nerves
- (D) lumbar splanchnics innervate the pelvic viscera via the hypogastric nerve
- (E) only presynaptic sympathetic fibers are severed

12. Femoral hernias pass deep (inferior) to the inguinal ligament. A segment of small intestine in this instance is in direct contact with the

- (A) falx inguinalis
- (B) lacunar ligament
- (C) parietal peritoneum
- (D) transversus abdominis muscle
- (E) transversalis fascia

13. The tendon of which of the following muscles is involved when the tuberosity of the fifth metatarsal bone is avulsed (pulled off) in a sprain?

- (A) Abductor digiti minimi
- (B) Peroneus brevis
- (C) Peroneus longus
- (D) Tibialis anterior
- (E) Tibialis posterior

14. Which of the following joints has only one degree of freedom (a one-arc joint)?

- (A) Humeroulnar
- (B) Metacarpophalangeal
- (C) Radiocarpal
- (D) Radiohumeral
- (E) Sternoclavicular

15. Which of the following statements best characterizes the tunica dartos of the scrotum?

- (A) It contains striated muscle fibers
- (B) It is a continuation of the two layers of the superficial fascia
- (C) It is involved in the cremaster reflex
- (D) It is invested with adipose tissue
- (E) It responds to cold temperature by lowering the scrotum away from the body

16. A characteristic of the intercostal neurovascular bundle that makes it particularly susceptible to injury from a fractured rib is that it lies

- (A) behind the superior border of the rib
- (B) beneath the inferior border of the rib
- (C) between external and internal intercostal layers
- (D) directly behind the midpoint of the rib
- (E) halfway between two adjacent ribs

17. If cell bodies in the geniculate ganglion are damaged, you would expect the symptoms to be

- (A) loss of sensation of pain from the face
- (B) loss of sensation of touch from the anterior two-thirds of the tongue
- (C) loss of taste from the anterior two-thirds of the tongue
- (D) partial facial paralysis
- (E) none of the above

18. Occlusion of the inferior mesenteric artery usually does not cause necrosis of the rectal mucosa because the

- (A) arterial supply from the left colic artery compensates, via anastomoses across Sudeck's point
- (B) inferior rectal artery, a major branch of the external iliac artery, also supplies the rectum
- (C) major arterial supply to the rectum is from anastomotic connections with the superior mesenteric artery
- (D) middle rectal artery, a major branch of the internal iliac artery, also supplies the rectum
- (E) supply from the inferior mesenteric artery to the rectum is insignificant

19. All of the following structures pass deep to the flexor retinaculum EXCEPT the
- flexor digitorum profundus to the little finger
 - flexor digitorum superficialis
 - flexor pollicis longus
 - median nerve
 - ulnar artery
20. All of the following extrinsic extraocular muscles have a posterior site of attachment in the orbit EXCEPT the
- inferior oblique
 - inferior rectus
 - lateral rectus
 - levator palpebrae superioris
 - superior oblique
21. The anterior longitudinal ligament has which of the following characteristics?
- It anchors the emerging spinal nerves in place
 - It limits the direction of nucleus pulposus extrusion during disk herniation
 - It narrows anterior to the intervertebral disk
 - It resists kyphosis
 - None of the above
22. The ulnar nerve innervates which of the following muscles of the thumb?
- Abductor pollicis brevis
 - Abductor pollicis longus
 - Deep head of the flexor pollicis brevis
 - Opponens pollicis
 - Superficial head of the flexor pollicis brevis
23. The median umbilical fold is created by the
- falx inguinalis
 - inferior epigastric arteries
 - lateral borders of the rectus sheath
 - obliterated umbilical arteries
 - urachus
24. Which of the following muscles may be involved in flexion of the hip joint?
- Gluteus maximus
 - Gluteus medius
 - Gluteus minimus
 - Piriformis
 - Tensor fasciae latae
25. The cerebrospinal fluid enters the venous system
- at arachnoid granulations
 - at the cisterna magna
 - through subarachnoid veins
 - via capillaries in the ependyma
 - by none of the above routes
26. The external urethral sphincter functions to maintain urinary continence and
- has identical anatomic structure in both the male and female
 - is a portion of the pelvic diaphragm
 - is under involuntary control
 - receives innervation by the pudendal nerve
 - surrounds the prostatic portion of the urethra in the male
27. Intramuscular injections in the superomedial gluteal quadrant may injure which of the following nerves?
- Inferior gluteal
 - Posterior femoral cutaneous
 - Pudendal
 - Sciatic
 - Superior gluteal
28. The gallbladder, which stores and concentrates bile, is located
- between the right and caudate lobes of the liver
 - between the right and quadrate lobes of the liver
 - in the coronary ligament
 - in the falciform ligament
 - in the lesser omentum
29. The arterial supply to the maxillary and mandibular teeth comes from
- a single branch of the maxillary artery
 - branches of the internal carotid artery
 - branches of the maxillary and sublingual artery, respectively
 - the maxillary and facial arteries
 - separate branches of the maxillary artery
30. Which of the following portions of the gastrointestinal tract become predominantly secondarily retroperitoneal during development?
- Appendix
 - First part of the duodenum
 - Liver
 - Sigmoid colon
 - Uncinate process of the pancreas

Directions: Each question below contains four suggested answers of which one or more is correct. Choose the answer

- A if 1, 2, and 3 are correct
- B if 1 and 3 are correct
- C if 2 and 4 are correct
- D if 4 is correct
- E if 1, 2, 3, and 4 are correct

31. The pectoralis minor muscle is a useful landmark structure that is characterized by which of the following statements?

- (1) It is located at the level of the cords of the brachial plexus
- (2) It is attached to the acromion process
- (3) It divides the axillary artery into three portions
- (4) It is innervated by the middle subscapular nerve

32. Structures that drain into the submandibular lymph nodes include the

- (1) pinna of external ear
- (2) nasal mucosa
- (3) parotid gland
- (4) teeth and gingivae

33. Correct statements describing the pelvic diaphragm include which of the following?

- (1) It is comprised of the levator ani and coccygeus muscles and their fasciae
- (2) It functions to suspend and support pelvic organs
- (3) It does not share the same plane with the urogenital diaphragm
- (4) It is innervated on its perineal surface by twigs from the pudendal nerve

34. Characteristics of external hemorrhoids, which develop in branches of the inferior hemorrhoidal vein, include which of the following?

- (1) They appear in the rectum
- (2) They are painful
- (3) They are superior (proximal) to the pectinate line
- (4) They lie underneath the mucosa

35. Cell bodies that are located in the superior cervical ganglion have which of the following functions?

- (1) They prevent ptosis (drooping) of the eyelid
- (2) They contribute to the greater superficial petrosal nerve
- (3) They dilate the pupil
- (4) They contract the ciliary muscle

36. Blood is returned to the left side of the heart via which of the following vessels?

- (1) Anterior cardiac veins
- (2) Thebesian veins
- (3) Coronary sinus
- (4) Pulmonary veins

37. Which of the following structures pass through the lesser sciatic foramen?

- (1) Tendon of the obturator internus muscle
- (2) Piriformis muscle
- (3) Pudendal nerve
- (4) External pudendal artery and vein

38. One annoying symptom of Bell's palsy that affects the facial nerve (CN VII) is hyperacusis, which is caused by involvement of the

- (1) tympanic membrane
- (2) tensor tympani muscle
- (3) cochlear nerve
- (4) stapedius muscle

39. Correct statements describing the lunate bone include which of the following?

- (1) It may produce carpal tunnel syndrome if displaced anteriorly
- (2) It provides an attachment for the flexor retinaculum
- (3) It articulates with a fibrocartilaginous disk
- (4) It is a component of the carpometacarpal joint

40. The perineum is supplied by which of the following nerves?

- (1) Genitofemoral
- (2) Inferior rectal
- (3) Ilioinguinal
- (4) Pudendal

41. To equalize air pressure on both sides of the tympanic membrane, which of the following muscles might contract?

- (1) Salpingopharyngeus
- (2) Tensor veli palatini
- (3) Tensor tympani
- (4) Levator veli palatini

42. Correct statements concerning the kidney include which of the following?

- (1) Nephroptosis produces pain caused by traction on the renal vessels
- (2) Destruction of the sympathetic ganglia associated with levels T10 to L2 produces diuresis secondary to renal vasoconstriction
- (3) The perirenal fascia permits spread of infection along the ureters and between the kidneys and pelvic structures
- (4) Major collateral circulation is provided to the kidney from supernumerary renal arteries when present

43. Respiratory mechanics involve coordinated activity of numerous muscles. Contraction of which of the following muscles contributes to forced expiration?

- (1) Transverse abdominis
- (2) External oblique
- (3) Rectus abdominis
- (4) Internal oblique

44. Infection within the pterygopalatine fossa may track directly into which of the following cavities?

- (1) Nasal cavity
- (2) Middle cranial fossa
- (3) Oral cavity
- (4) Orbital cavity

45. Reposition of the thumb (antagonistic to opponens action) is due to the

- (1) abductor pollicis longus
- (2) extensor pollicis brevis
- (3) extensor pollicis longus
- (4) adductor pollicis

46. The vestibule in the female perineum is characterized by which of the following statements?

- (1) It receives both the urethra and the vagina
- (2) It is bordered by the labia majora
- (3) It receives drainage from the greater vestibular and paraurethral glands
- (4) It receives sensory innervation from the nervi erigentes

47. When the tibial nerve is injured, some flexion may still be possible at the knee joint because of the actions of which of the following muscles?

- (1) Gracilis
- (2) Biceps femoris (long head)
- (3) Biceps femoris (short head)
- (4) Gastrocnemius

48. During a spinal tap, which of the following structures would be penetrated if the needle was inserted precisely in the midline?

- (1) Dura mater
- (2) Posterior longitudinal ligament
- (3) Supraspinous ligament
- (4) Ligamentum flavum

49. Myocardial infarction limited to the interventricular septum might be expected to produce problems, including

- (1) aortic valvular insufficiency
- (2) tricuspid valve regurgitation
- (3) mitral valve regurgitation
- (4) disturbances of cardiac impulse conduction

50. The superomedial boundary of the popliteal fossa is formed by which of the following muscles?

- (1) Semimembranosus
- (2) Long head of the biceps femoris
- (3) Semitendinosus
- (4) Short head of the biceps femoris

SUMMARY OF DIRECTIONS

A	B	C	D	E
1, 2, 3 only	1, 3 only	2, 4 only	4 only	All are correct

51. Correct statements concerning the superior laryngeal nerve include which of the following?

- (1) It has an internal branch that pierces the thyrohyoid membrane to innervate the laryngeal mucosa
- (2) It produces muscle contraction that lengthens the (true) vocal folds
- (3) It provides the afferent limb of the cough reflex
- (4) It innervates all of the laryngeal musculature by an external branch, except the cricothyroid muscle

52. Structures that transit the diaphragm via the esophageal hiatus include the

- (1) azygos vein
- (2) thoracic duct
- (3) hemiazygos vein
- (4) right vagus nerve

53. Pronounced dilation of a smooth muscular tube in the body generally produces pain. Sensory fibers for pain from the cervix travel to the spinal cord via

- (1) a plexus around the uterine arteries
- (2) the lateral pelvic plexus and inferior hypogastric plexus
- (3) nervi erigentes
- (4) white rami of L1 and L2

54. Structures that are both medial to the biceps tendon and deep to the bicipital aponeurosis include the

- (1) brachial artery
- (2) deep (profunda) brachial artery
- (3) median nerve
- (4) median cubital vein

55. A longitudinal incision just lateral to the medial border of the rectus sheath to gain access to the abdominal cavity will have which of the following results?

- (1) It will spare the blood supply to the rectus muscle
- (2) It will require division of the transversus abdominis muscle
- (3) It will avoid paralysis of the rectus muscle
- (4) It will be parallel to Langer's lines of cleavage

56. In moving the eye outward the lateral rectus as well as the superior and inferior oblique muscles are used. These muscles are innervated by which of the following nerves?

- (1) Abducens nerve
- (2) Inferior division of the oculomotor nerve
- (3) Trochlear nerve
- (4) Superior division of the oculomotor nerve

57. During full active extension of the knee joint, which of the following are tightened?

- (1) Tibial collateral ligament
- (2) Fibular collateral ligament
- (3) Patella tendon
- (4) Anterior cruciate ligament

58. If the motor root of the trigeminal nerve is injured, paralysis occurs in which of the following muscles?

- (1) Posterior belly of the digastric
- (2) Tensor tympani
- (3) Buccinator
- (4) Masseter

59. In angina pain of cardiac origin, the pain radiating across the precordium and perhaps down the arm to the wrist is mediated by increased activity in afferent fibers contained in the

- (1) cervical cardiac nerves
- (2) vagus nerves
- (3) first four thoracic splanchnic nerves
- (4) phrenic nerves

60. A gray ramus communicans, which extends between a sympathetic trunk ganglion and an anterior primary ramus of a spinal nerve, contains

- (1) axons of a preganglionic neuron
- (2) fibers that conduct general somatic afferent impulses
- (3) myelinated fiber
- (4) fibers that activate smooth muscle (erector pili) of the skin

ANSWERS AND EXPLANATIONS

1. The answer is D. (Chapter 33 II B 3-4) The nasolacrimal duct drains into the inferior meatus of the nose. The maxillary, frontal, and anterior ethmoidal sinuses drain into the middle meatus. The sphenoidal sinus drains into the superior meatus.
2. The answer is D. [Chapter 22 VI D 2 i (2)] The ureters, which course through the deep pelvis, lie in the transverse cardinal ligament beneath the uterine arteries. Ligation of the uterine arteries during hysterectomy must be accomplished with care so that the ureters are not injured.
3. The answer is E. [Chapter 19 I C, D 1 c (2)] Transverse foramina are characteristic of cervical vertebrae. These foramina are formed by a partial fusion of the transverse and costal processes of the cervical vertebrae. Except for the seventh cervical vertebra, the transverse foramina contain the vertebral artery as it passes toward the foramen magnum.
4. The answer is E. (Chapter 25 I C 1 g; Chapter 26 II A 2 c) The tibialis posterior tendon is palpable just posterior to the medial malleolus. Adjacent to this tendon is the tendon of the flexor digitorum longus and the posterior tibial artery. The posterior tibial pulse may be palpated here. The peroneus longus and brevis course posterior to the lateral malleolus, whereas the tibialis anterior is on the dorsum of the foot.
5. The answer is E. [Chapter 13 VI B 3 b (2) (a)] The papillary muscles attach the chordae tendineae of the atrioventricular valve cusps to the walls of the ventricular chambers. Contraction of the papillary muscles prevents eversion of the valve cusps as the ventricular chambers decrease in volume during the second (ejection) phase of systole.
6. The answer is E. (Chapter 13 X C 1-3) At birth major circulatory changes occur on expansion of the lungs. The resultant increased blood flow through the pulmonary vascular bed lowers the pressure within the right chambers of the heart. The pressure within the right atrium becomes less than that of the left atrium, thereby causing the valve of the foramen ovale to close. A brief reversal of flow through the ductus arteriosus occurs before this structure constricts as a result of elevated levels of prostaglandins in the blood circulation.
7. The answer is D. (Chapter 6 Table 6-2) The prime action of the teres major muscle is adduction of the humerus at the shoulder joint. Because this muscle inserts on the lesser tubercle of the humerus, it also acts as a medial rotator and, to a lesser degree, an extensor.
8. The answer is B. [Chapter 15 X F 2 e; Chapter 20 IV C 4 c (3)] The obturator artery, usually a branch of the internal iliac artery, may arise instead from the inferior epigastric artery or even from the external iliac artery. An aberrant obturator artery crosses the femoral ring, where it may become involved in a femoral hernia or complicate the repair of such a hernia.
9. The answer is B. [Chapter 28 III C 2 b (1) (b) (iii); Chapter 29 VA 1 d; VI B 2 b] The cribriform plate of the ethmoid bone provides the passageways for the olfactory nerves from the olfactory mucosa of the superior nasal meatus to the olfactory bulb of the brain. Infection may track along these nerves and thereby spread to the meninges. Fracture of the ethmoid bone may result in leaking of cerebrospinal fluid through the nose.
10. The answer is A. (Chapter 4 III C 4 a, b; Chapter 19 III C 3 a, b) The muscles of the back are innervated by dorsal primary rami of the spinal nerves. The ventral primary rami, giving off lateral and ventral perforating branches, innervate the lateral and ventral regions of the body wall. The dorsal roots are sensory.
11. The answer is A. [Chapter 17 X D 8; XV A 2 b (4) (b)] The control of peristalsis is primarily a function of parasympathetic innervation. The descending colon receives parasympathetic innervation from the pelvic splanchnic nerves, which arise from levels S2 to S4. Bilateral lumbar sympathectomy for the relief of intractable visceral pain, therefore, has little effect on the motility of the descending colon.
12. The answer is C. (Chapter 15 X F 2 b, c) A femoral hernia passes through the femoral ring, where it is surrounded by the inguinal ligament (anteriorly and superiorly), the lacunar ligament (medially), the pectineal ligament (posteriorly and inferiorly), and the femoral vein (laterally). The hernial sac is in contact with peritoneum, which is covered by attenuated transversalis fascia.
13. The answer is B. (Chapter 25 III C 1 b (2); Table 25-1) The peroneus brevis muscle, a plantar flexor and pronator of the foot, inserts into the tuberosity of the fifth metatarsal bone. The peroneus longus inserts onto the first metatarsal; the tibialis posterior, onto the navicular bone; the tibialis anterior, onto the first cuneiform bone and first metatarsal; and the abductor digiti minimi, onto the first phalanx of the fifth toe.