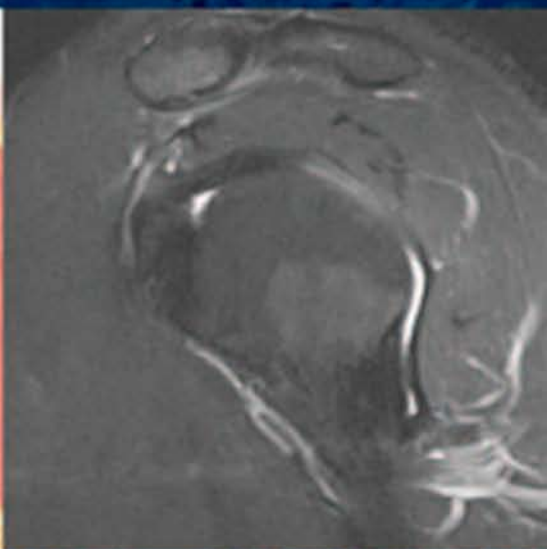
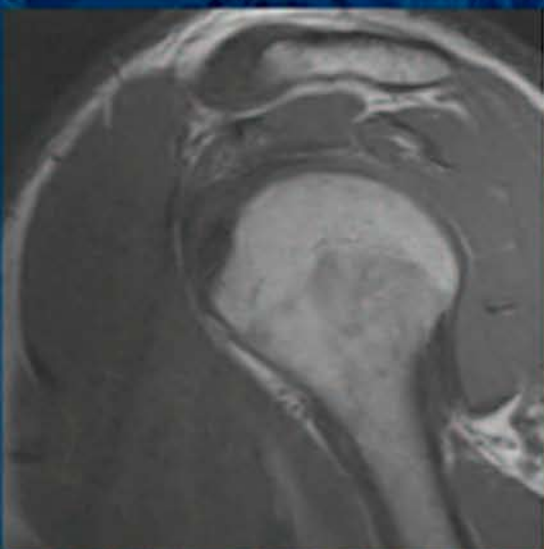


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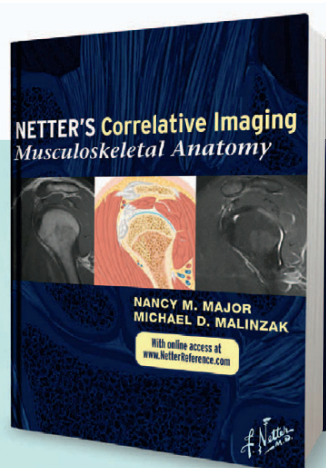
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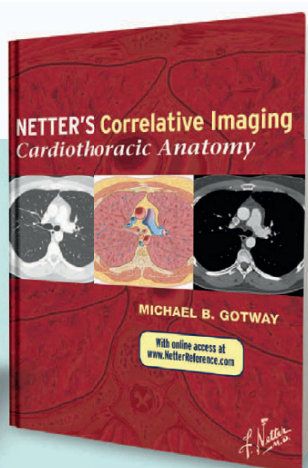
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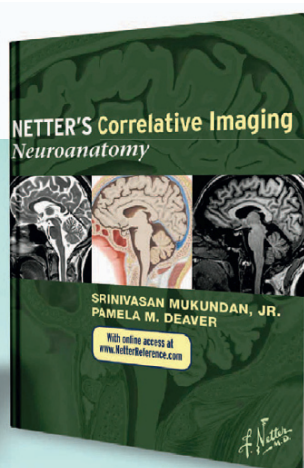
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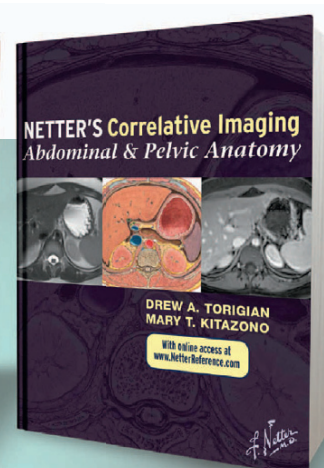
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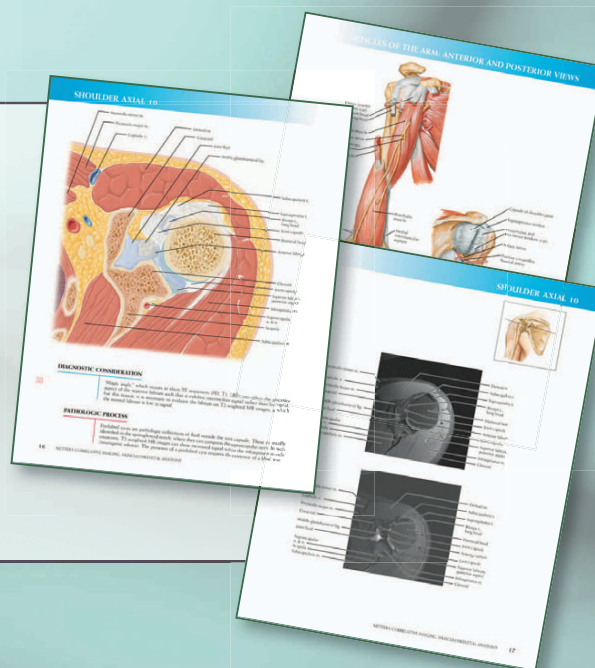


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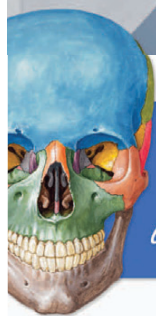
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Correlative Imaging:

Musculoskeletal

Anatomy

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ISBN: 978-1-4377-0012-1

Acquisitions Editor: Elyse O'Grady
Developmental Editor: Marybeth Thiel
Publishing Services Manager: Patricia Tannian
Senior Project Manager: John Casey
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*This book is dedicated to those who will have
the opportunity to affect patient care with its use.*

To Austin Michael Helms, who inspires me every day.
NMM

For my wife, for being generous with my time
MDM

About the Artists

FRANK H. NETTER, MD

Frank H. Netter was born in 1906 in New York City. He studied art at the Art Student's League and the National Academy of Design before entering medical school at New York University, where he received his MD degree in 1931. During his student years, Dr. Netter's notebook sketches attracted the attention of the medical faculty and other physicians, allowing him to augment his income by illustrating articles and textbooks. He continued illustrating as a sideline after establishing a surgical practice in 1933, but he ultimately opted to give up his practice in favor of a full-time commitment to art. After service in the United States Army during World War II, Dr. Netter began his long collaboration with the CIBA Pharmaceutical Company (now Novartis Pharmaceuticals). This 45-year partnership resulted in the production of the extraordinary collection of medical art so familiar to physicians and other medical professionals worldwide.

In 2005, Elsevier purchased the Netter Collection and all publications from Icon Learning Systems. There are now over 50 publications featuring the art of Dr. Netter available through Elsevier (in the United States: www.us.elsevierhealth.com/Netter; outside the United States: www.elsevierhealth.com).

Dr. Netter's works are among the finest examples of the use of illustration in the teaching of medical concepts. The 13-volume *Netter Collection of Medical Illustrations*, which includes the greater part of the more than 20,000 paintings created by Dr. Netter, became and remains one of the most famous medical works ever published. *The Netter Atlas of Human Anatomy*, first published in 1989, presents the anatomical paintings from the Netter Collection. Now translated into 16 languages, it is the anatomy atlas of choice among medical and health professions students the world over.

The Netter illustrations are appreciated not only for their aesthetic qualities, but, more important, for their intellectual content. As Dr. Netter wrote in 1949, "... clarification of a subject is the aim and goal of illustration. No matter how beautifully painted, how delicately and subtly rendered a subject may be, it is of little value as a *medical illustration* if it does not serve to make clear some medical point." Dr. Netter's planning, conception, point of view, and approach are what inform his paintings and what makes them so intellectually valuable.

Frank H. Netter, MD, physician and artist, died in 1991.

Learn more about the physician-artist whose work has inspired the Netter Reference collection: <http://www.netterimages.com/artist/netter.htm>

CARLOS MACHADO, MD

Carlos Machado was chosen by Novartis to be Dr. Netter's successor. He continues to be the primary artist contributing to the Netter collection of medical illustrations.

Self-taught in medical illustration, cardiologist Carlos Machado has contributed meticulous updates to some of Dr. Netter's original plates and has created many paintings of his own in the style of Netter as an extension of the Netter collection. Dr. Machado's photorealistic expertise and his keen insight into the physician/patient relationship informs his vivid and unforgettable visual style. His dedication to researching each topic and subject he paints places him among the premier medical illustrators at work today.

Learn more about his background and see more of his art at: <http://www.netterimages.com/artist/machado.htm>

KRISTEN WIENANDT MARZEJON, MS, MFA

Kristen Wienandt Marzejon is a certified medical illustrator with a master's degree from the University of Illinois at Chicago's Biomedical Visualization graduate program. Her passion for both art and science from an early age makes her perfectly suited to this gratifying profession. She started her career as a staff illustrator at Rush University Medical Center in Chicago, and then committed to self-employed status in 2001. She offers medical illustration and graphic design services to a variety of clients in the medical arena.

The work of Frank Netter has been a valuable part of Kristen's medical library throughout her 20-year career. That said, she is honored to continue the Netter tradition by producing work authentic to his distinctive style.

About the Editors

Nancy M. Major, MD, began her career as an MSK radiologist at Duke University Medical Center. After completing her fellowship training at Duke, she remained on faculty for 13 years. Her research interest is musculoskeletal imaging with a concentration in sports-related injuries, musculoskeletal tumors, and biomechanics associated with injuries. During her tenure at Duke, she educated residents, fellows, and medical students about the nuances of musculoskeletal radiology. She prepared the Duke University radiology residents for their board exams, was Director of Medical Student Radiology Education, and has been voted "Teacher of the Year" at Duke University School of Medicine multiple times. Her involvement in medical student education and anatomy instruction led to the interest in putting together this volume of the Netter anatomy series.

Dr. Major is a co-editor of the extremely successful Musculoskeletal MR and a number of other radiology texts and references including *Fundamentals of Body CT*, *Radiology Core Review*, and *A Practical Approach to Radiology*. She is well-published in peer-reviewed journals.

Currently, Dr. Major is Professor and Chief of MSK Radiology with a joint appointment in Orthopaedics at the University of Pennsylvania. She continues to educate residents, fellows, and medical students and lectures nationally and internationally about MSK radiology.

Michael D. Malinzak, MD, PhD, graduated from Washington and Lee University with bachelor's degrees in biology and chemistry. After entering medical school, he became interested in applying medical imaging to the study of physical anthropology. He graduated in 2010 from Duke University with an MD and with a PhD from the Department of Biological Anthropology and Anatomy. For his graduate work, he studied the relationship between semi-circular canal morphology, as quantified by high-resolution CT, and locomotor head movements in primates. He has authored several chapters and abstracts. His work has been supported by a Nanaline Duke Scholarship, a James B. Duke Fellowship, and an NSF Dissertation Improvement Grant.

Mike lives in Durham, NC, with his wife, Elizabeth. He is currently an intern at Duke University Hospital, where he will begin radiology residency in 2011.

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Preface

Anatomy atlases are wonderful companions to practicing radiologists and students of radiology. As magnetic resonance imaging becomes more widely used, the level of anatomic resolution available for radiographic interpretation becomes finer as well.

Many anatomy textbooks and websites are available. We created this cross-sectional anatomy series, of which *Musculoskeletal Anatomy* is the first title, because there are relatively few books that include both T1-weighted and T2-weighted imaging, and because we believe there is something special about the Netter style of illustration. Whereas a cadaveric cross-section can appear flat and distractingly busy, a cartoon of a cross-section is often an over-simplification of reality. A radiologist reading an MRI develops a mental representation of the anatomy that is something between a cadaveric cross-section and a cartoon; it is an internal illustration in which clinically relevant details are brought to light; it is something quite close to a Netter drawing.

Another aspect that makes this book unique is the inclusion of cross-sections from the mid-portions extremities—humerus, forearm, femur, lower leg—in addition to the joints. This book also achieves heightened clinical relevance by including the imaging planes and sequences that are most commonly used in practice. Our hope is to communicate both the nuances of the anatomy imaged, as well as which sequence best shows the most relevant structures.

Each chapter begins with a composite drawing that shows the slice numbers and locations for all cross-sections in the chapter. The slices are identified by the number listed in the color bar at the header of each page. This should make the text user-friendly, because it provides the reader with a 3-dimensional notion of each slice's location and orientation.

Opening to any page will reveal three representations of the same anatomic cross-section: a T1-weighted image at the top, a matched T2-weighted image below, and the corresponding artist's illustration on the opposite page. When appropriate, clinical pearls concerning normal anatomy, normal variants, diagnostic considerations, or pathologic processes are included below the artist's illustration.

The anatomic drawings that accompany the images are beautifully depicted and reminiscent of Netter quality. These drawings capture well a commonly encountered problem with cross-sectional imaging, that of volume averaging. Even within the anatomic sketches in this book, the averaging of adjacent structures is well-depicted, making it clear for the user exactly which structures compose the "averaged" image.

Structures are labeled using the most commonly accepted language for radiologists and orthopaedic surgeons. Occasionally, you will encounter a phrase in parentheses; this reflects anatomic terms that are used interchangeably in the orthopaedic, radiologic, and anatomic literature.

This book and the subsequent three titles in this Netter's Correlative Imaging series—*Cardiothoracic Anatomy*, *Neuroanatomy*, and *Abdominal and Pelvic Anatomy*—have been designed with several goals in mind. The first goal is to demonstrate high-quality imaging, allowing for clear identification of important anatomic structures, and including body parts that are often excluded from cross-sectional atlases. Second, the books are intended to be user-friendly anatomy references for commonly employed imaging techniques. Finally, the text is not meant to be inclusive of all pathology. Instead, when appropriate, the books provide succinct insights about commonly encountered diagnoses and imaging challenges.

It is our hope that you will find this text useful on a daily basis. We welcome your feedback so that we can continue to make your day at the PACS unit that much easier.

Nancy M. Major
Michael D. Malinzak

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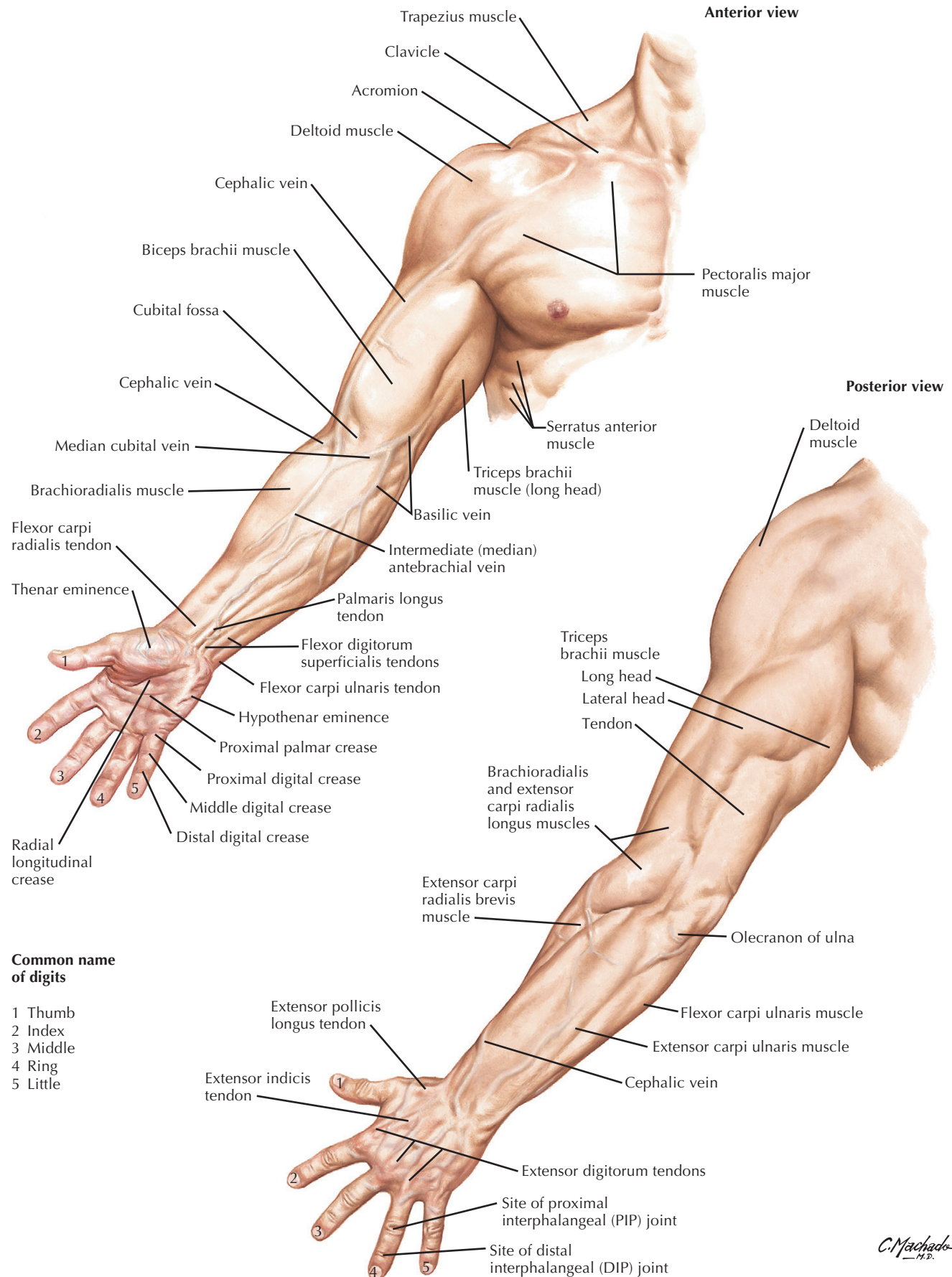
Chapter

1

OVERVIEW OF UPPER LIMB

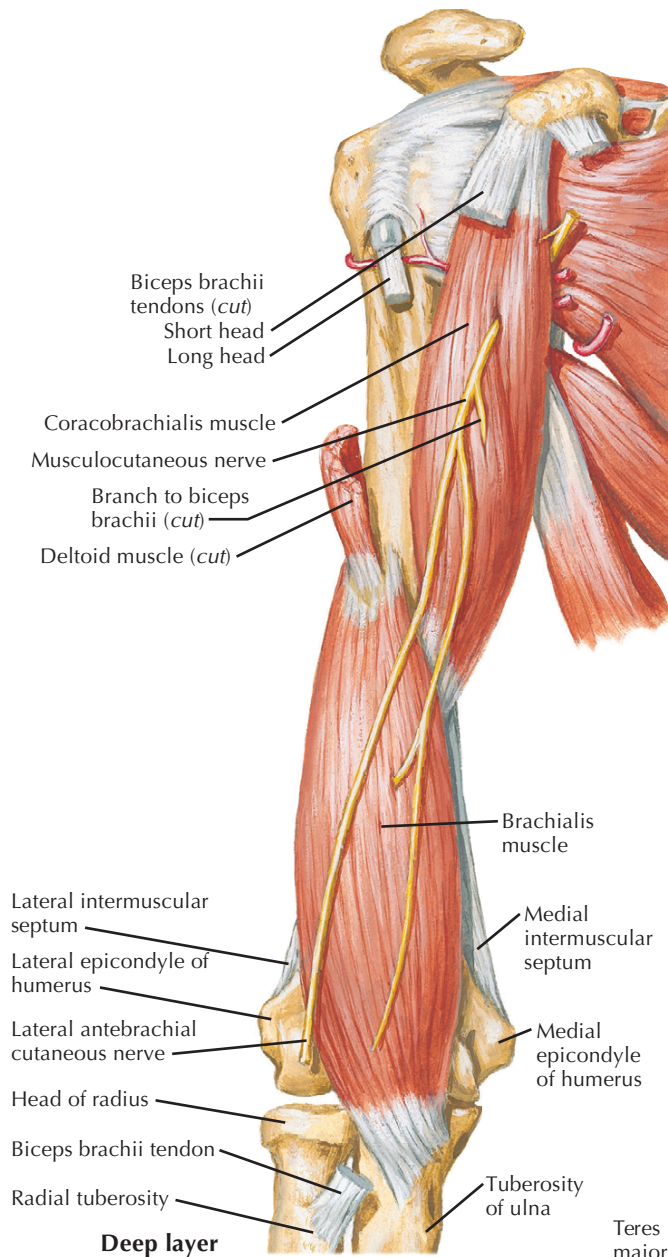


SURFACE ANATOMY OF THE UPPER LIMB

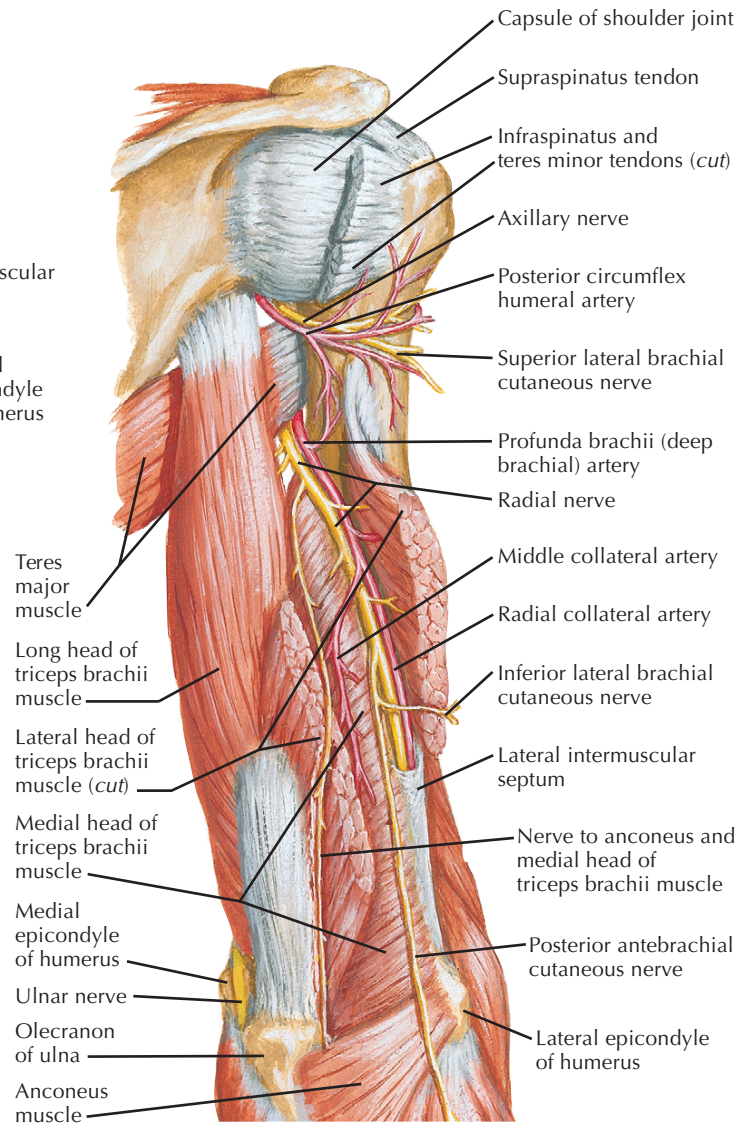


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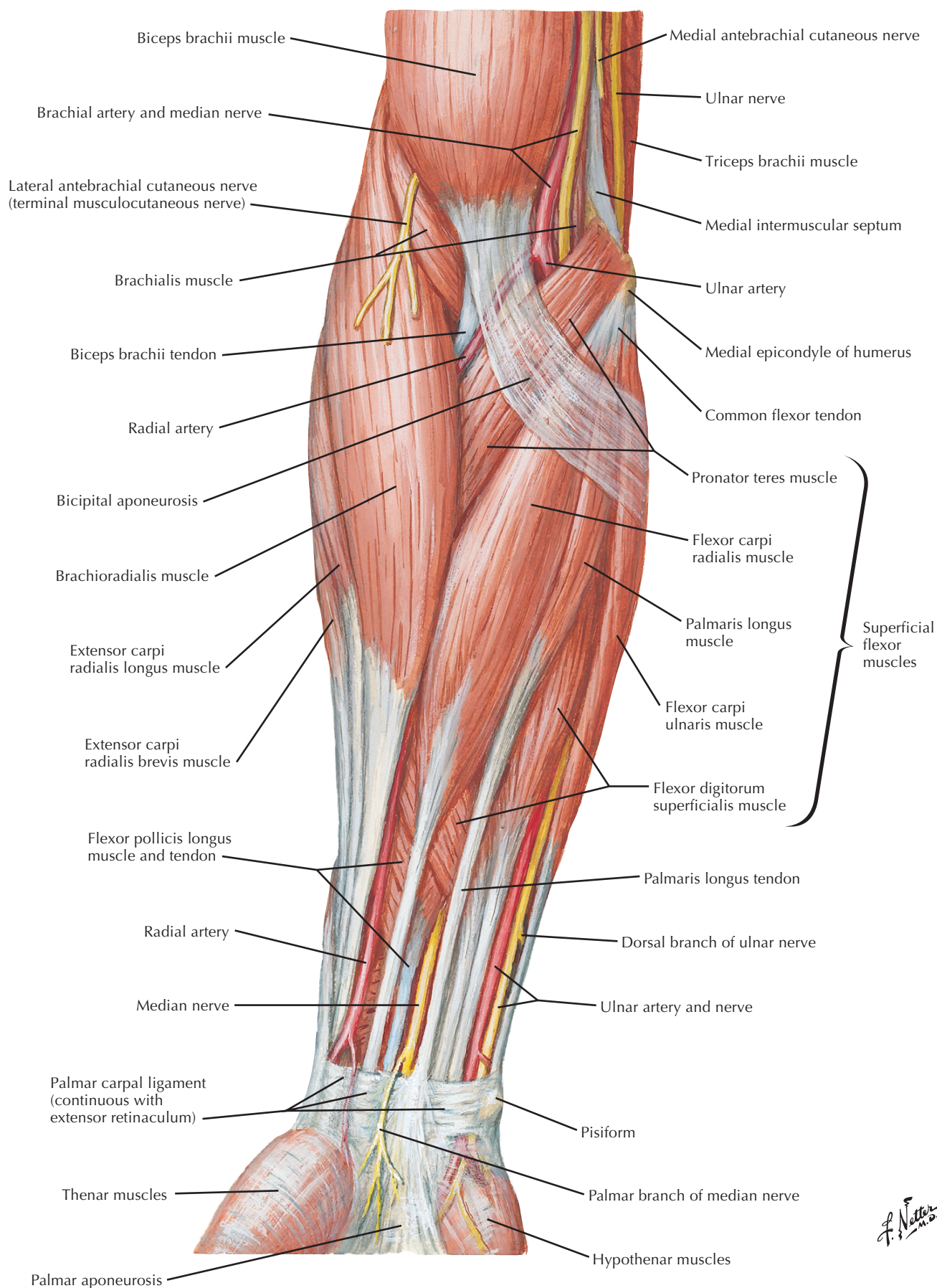
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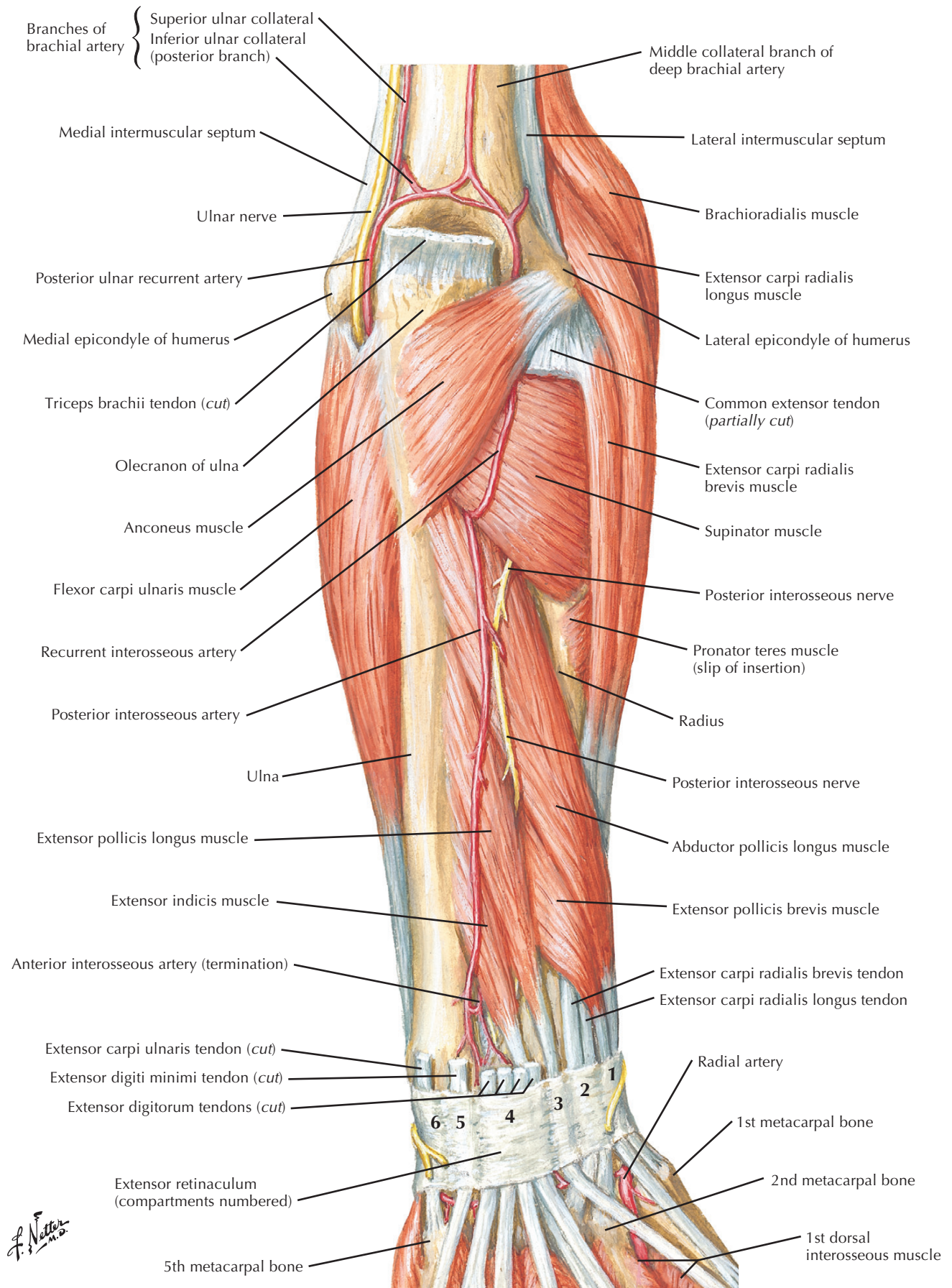
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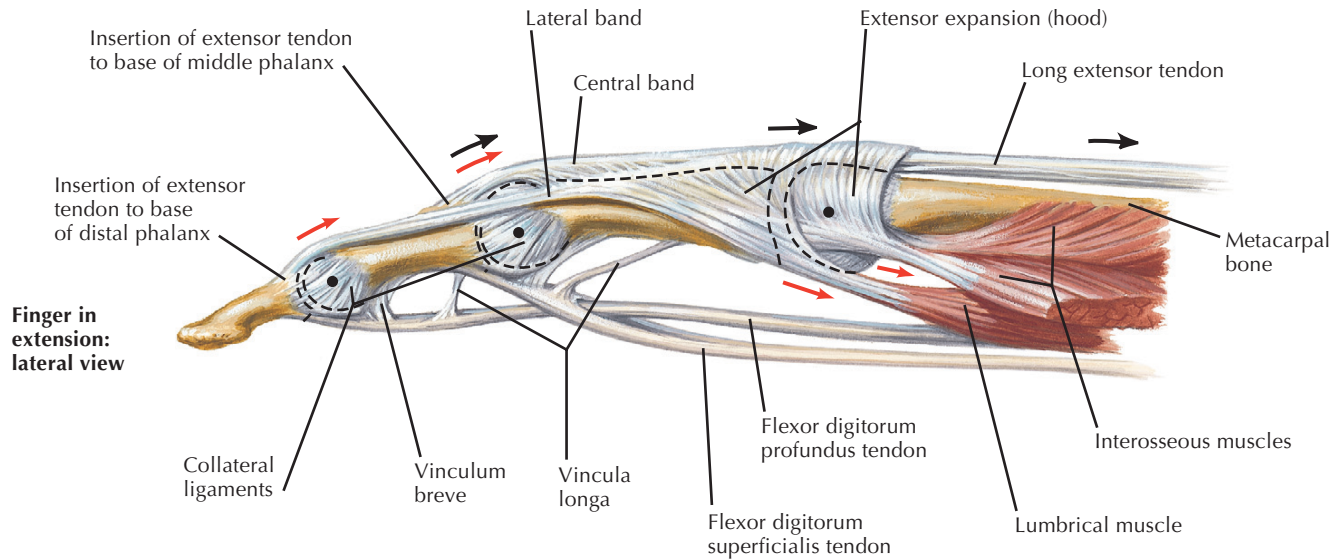
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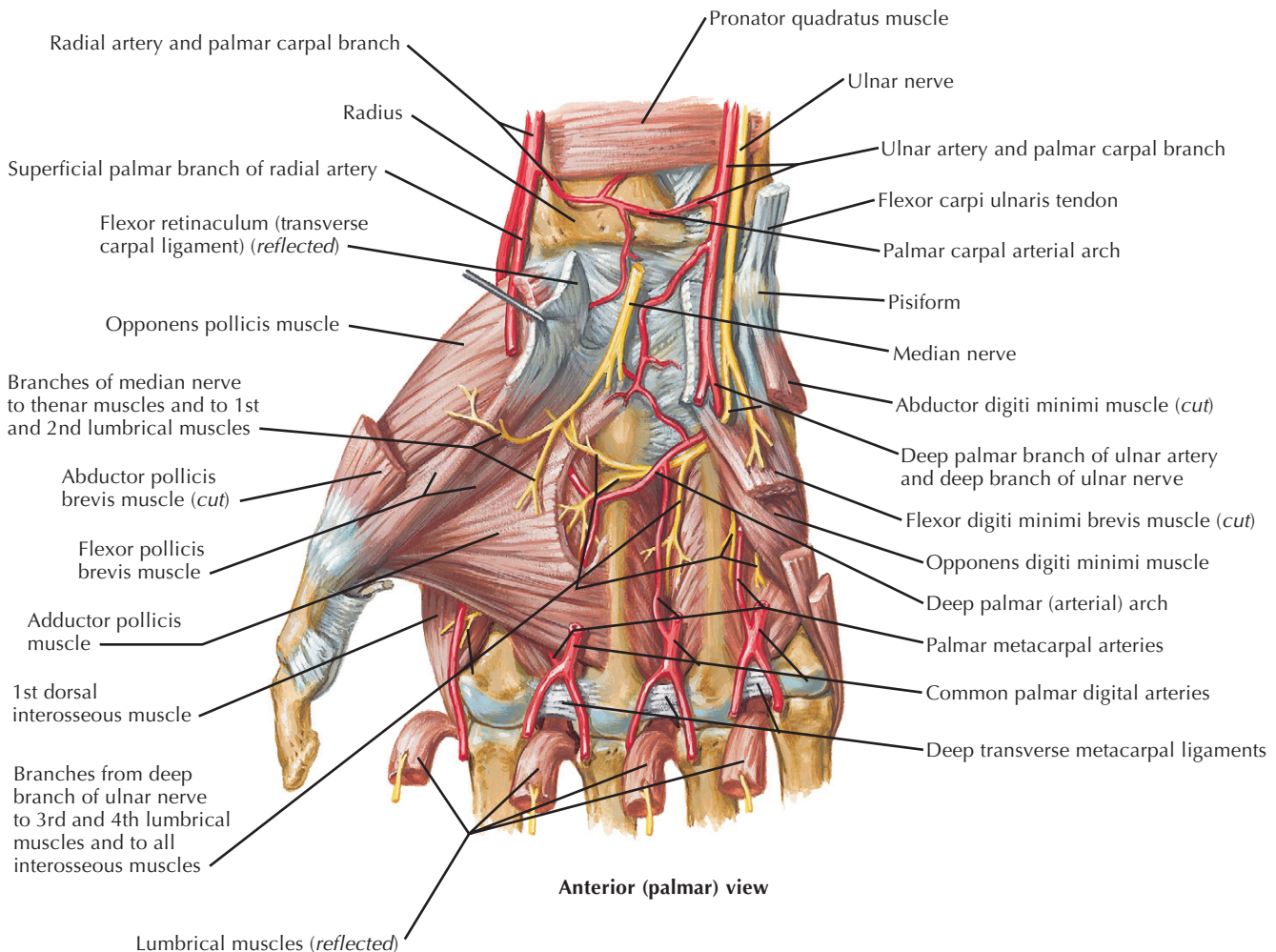
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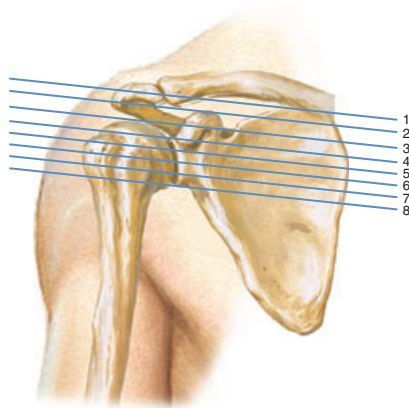
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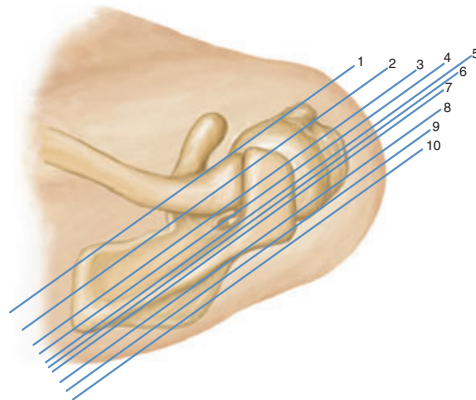
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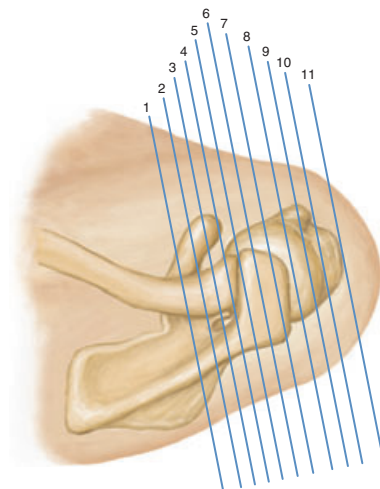
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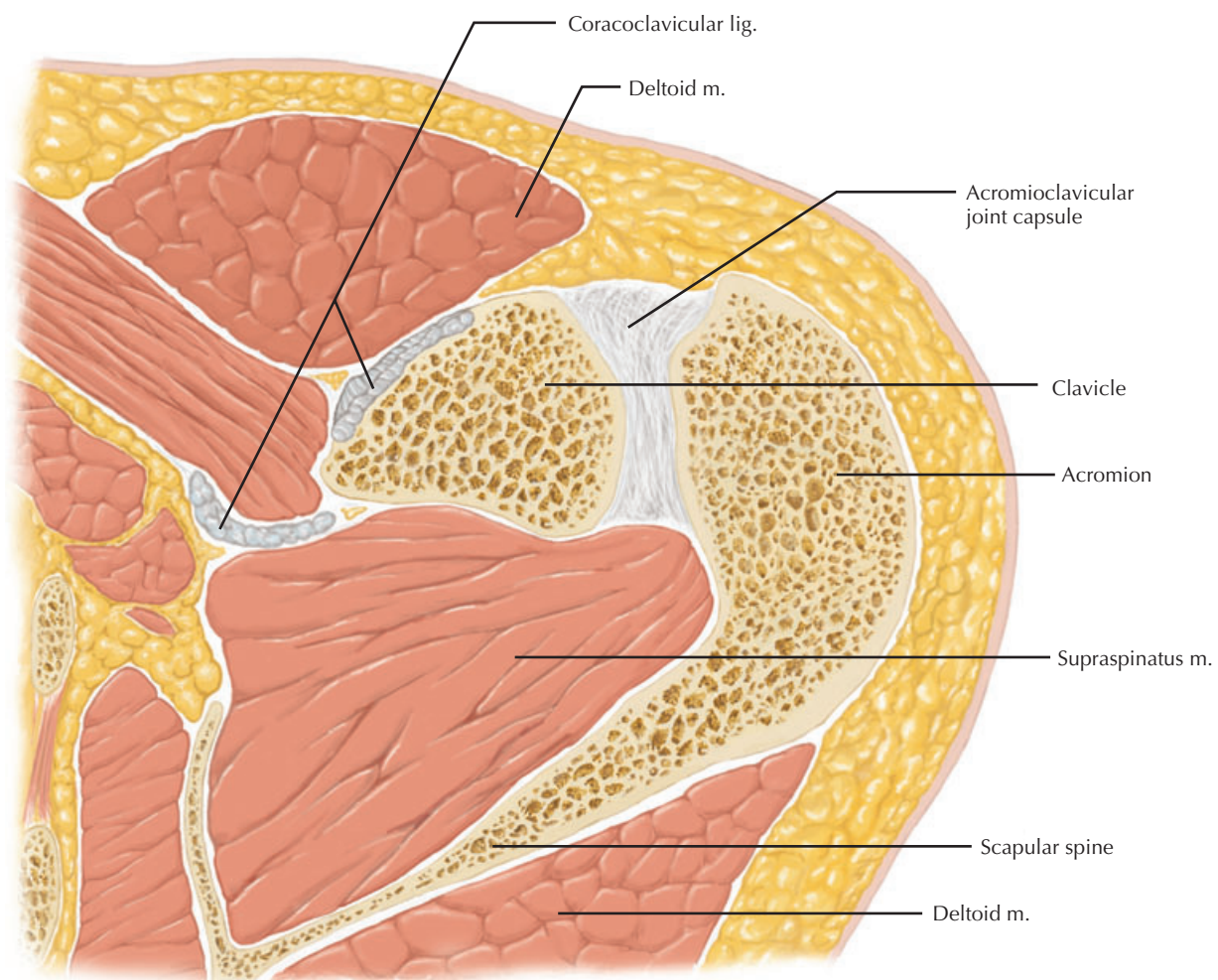
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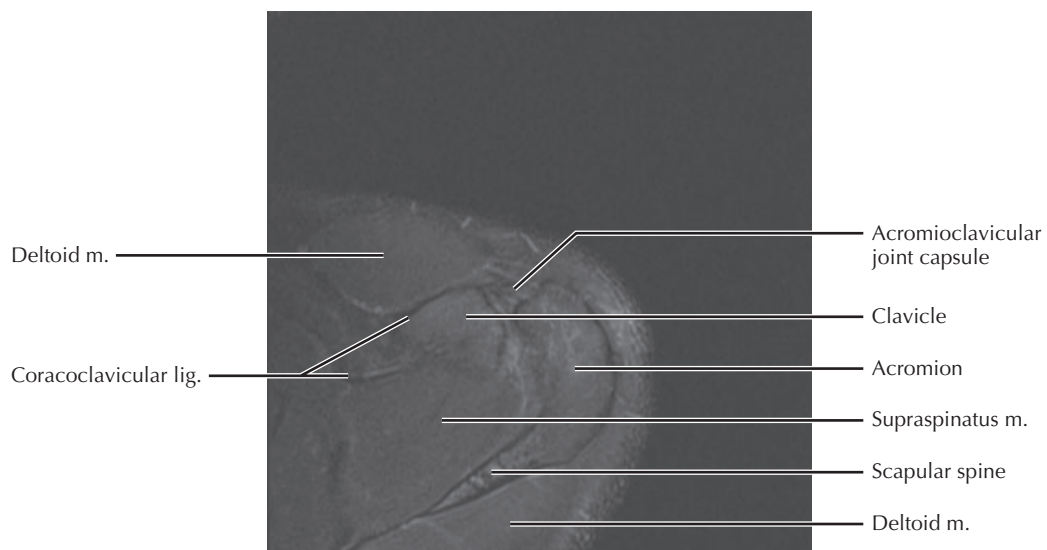
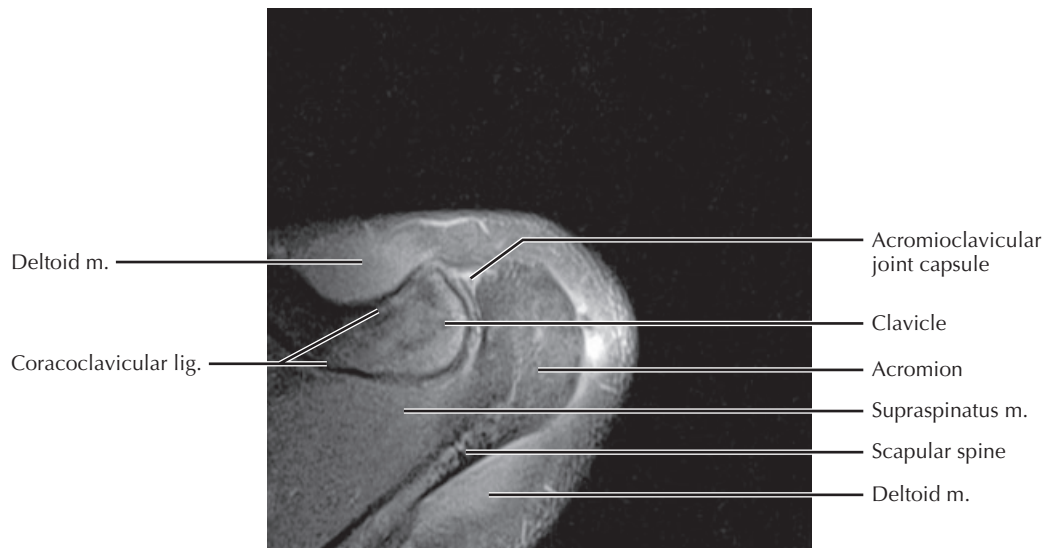
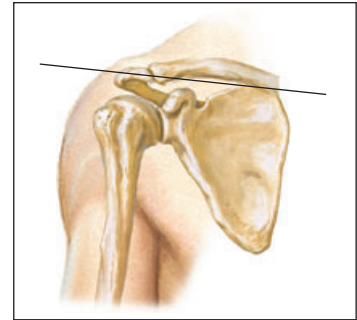


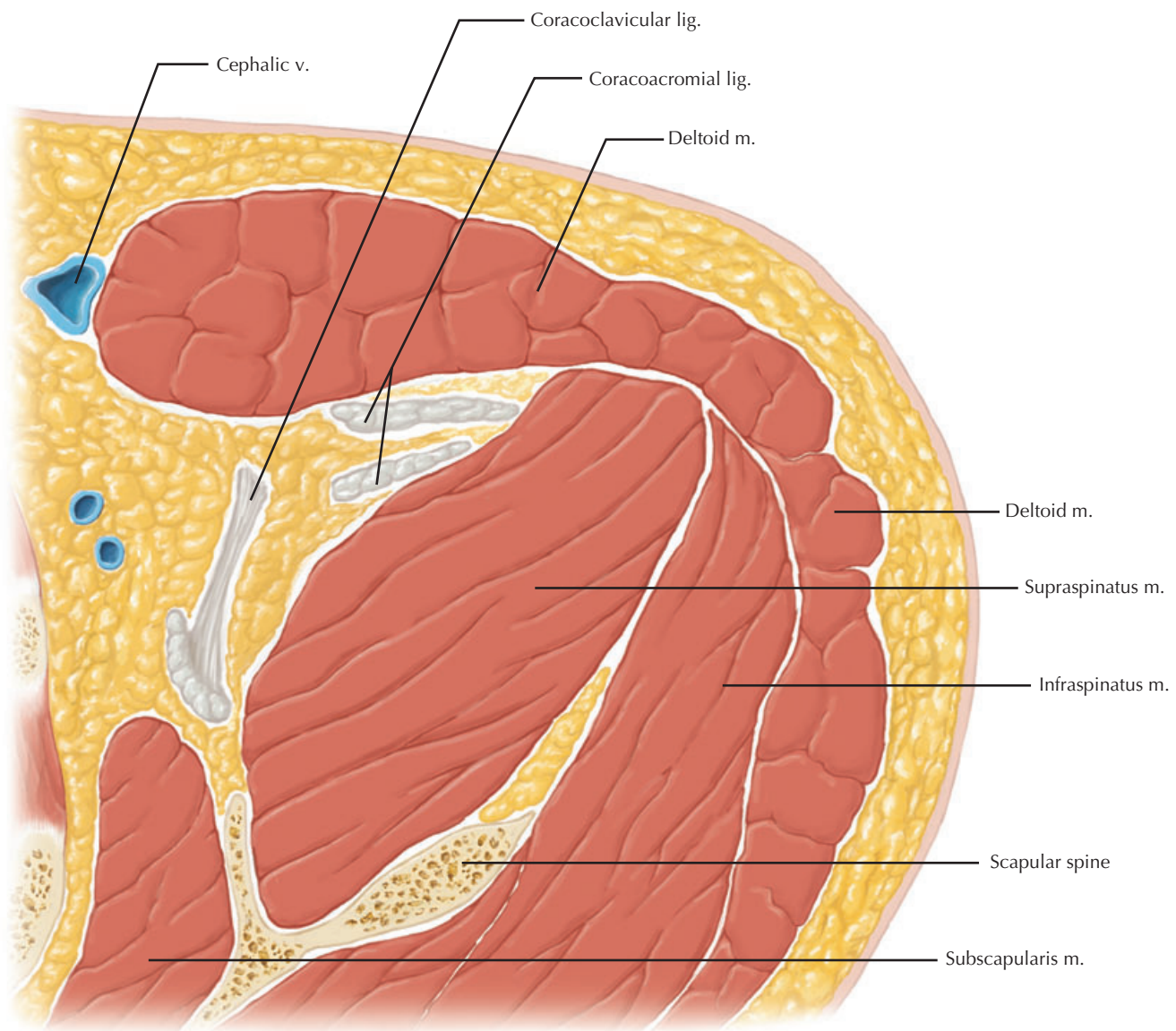
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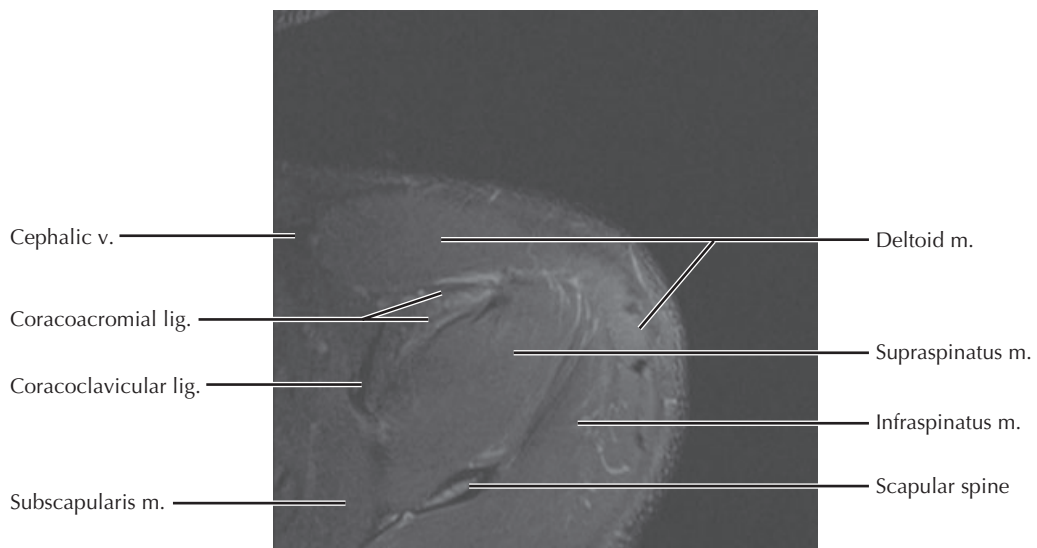
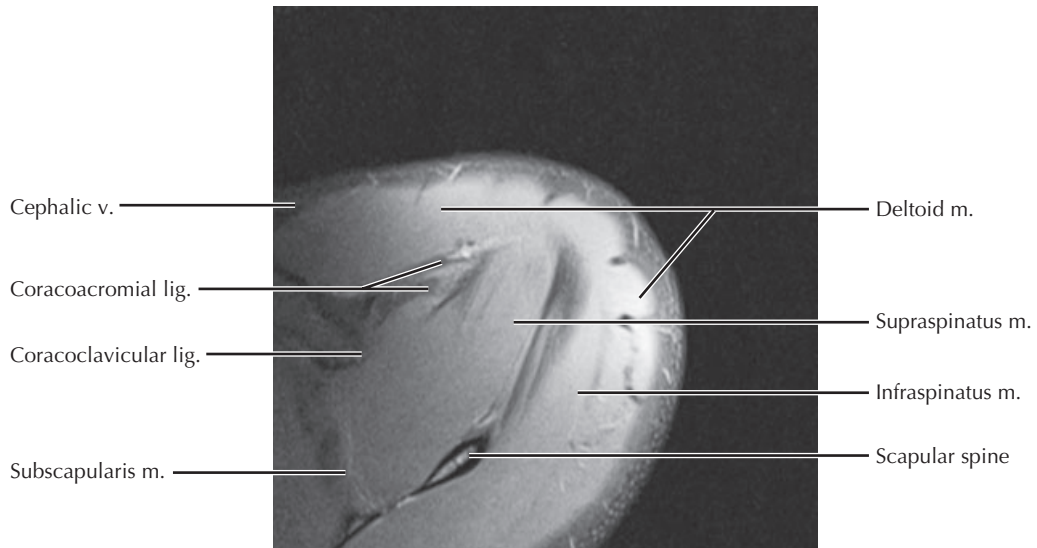
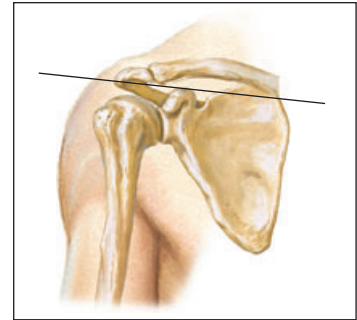


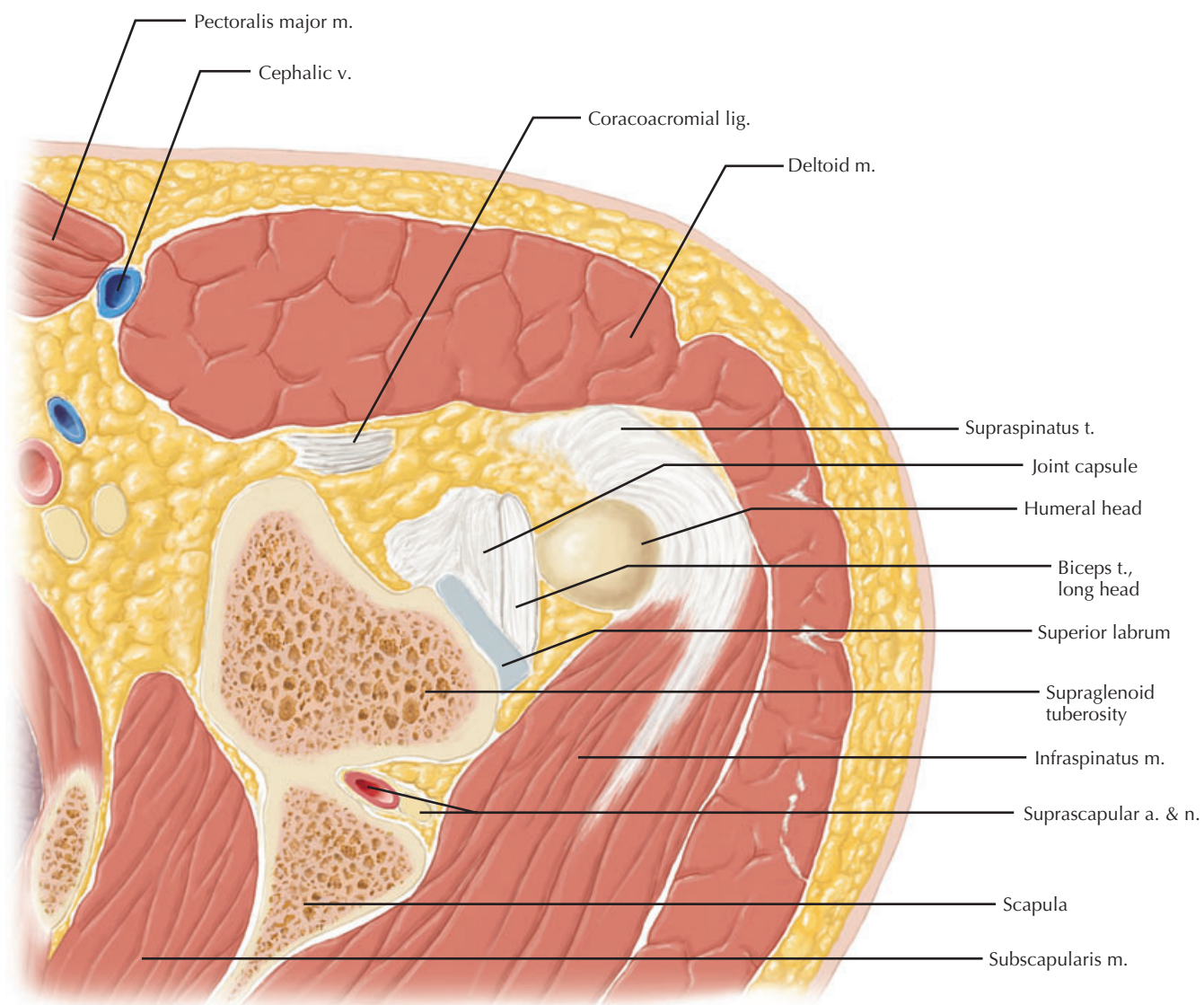
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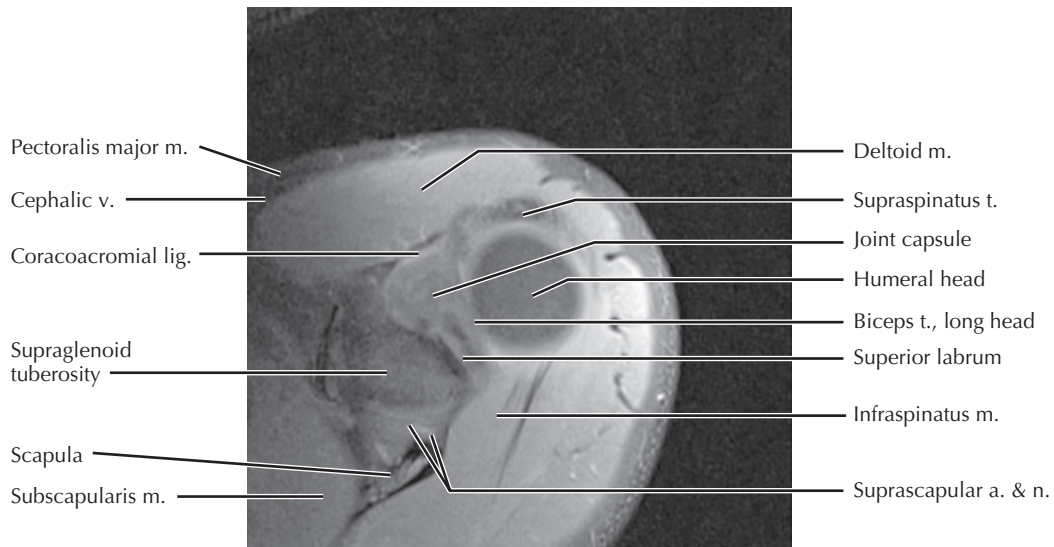
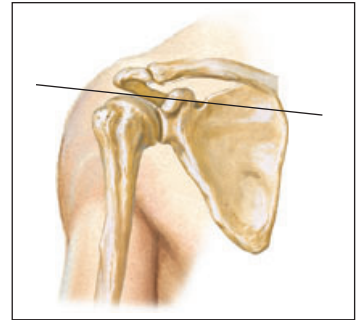


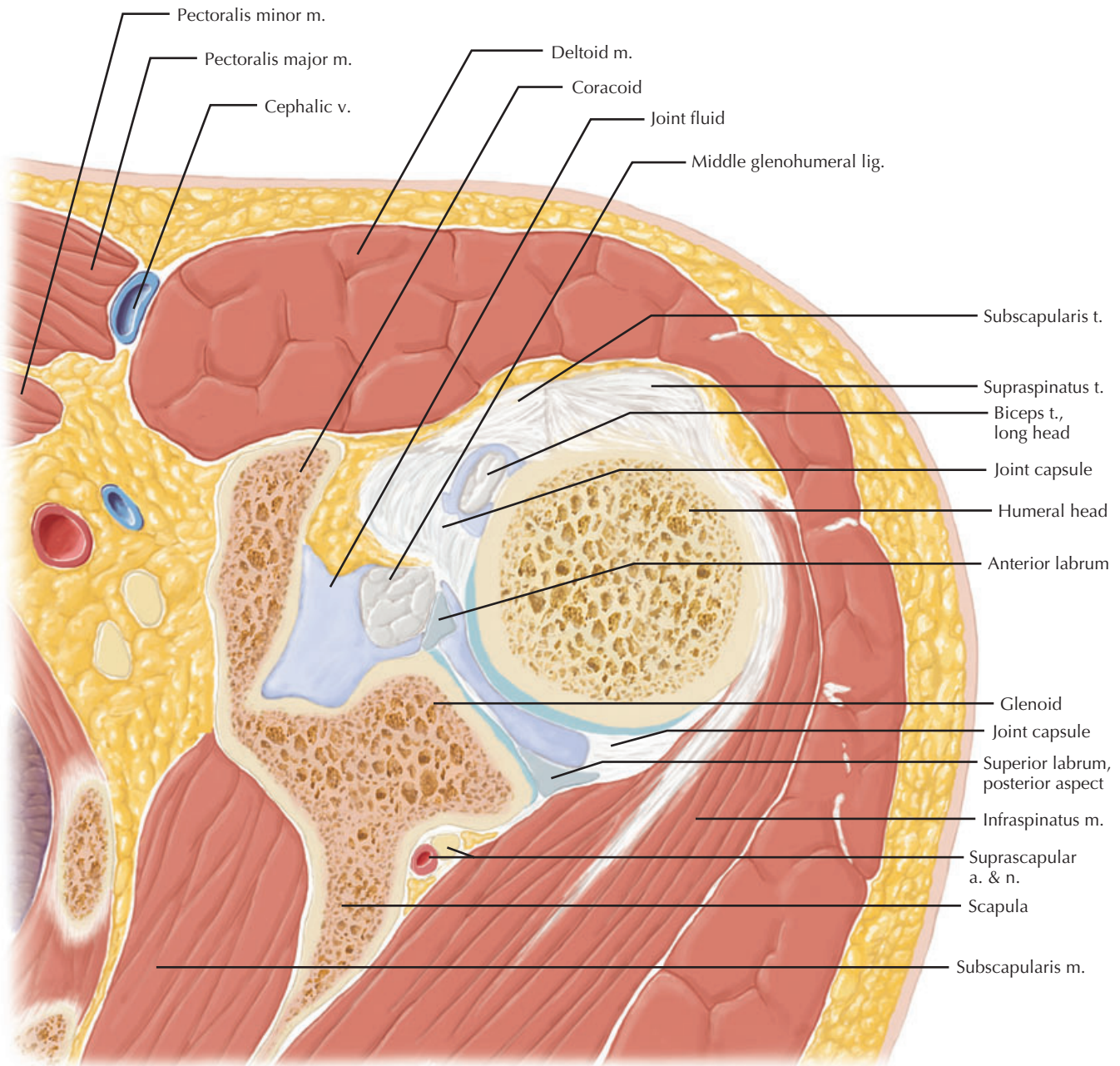










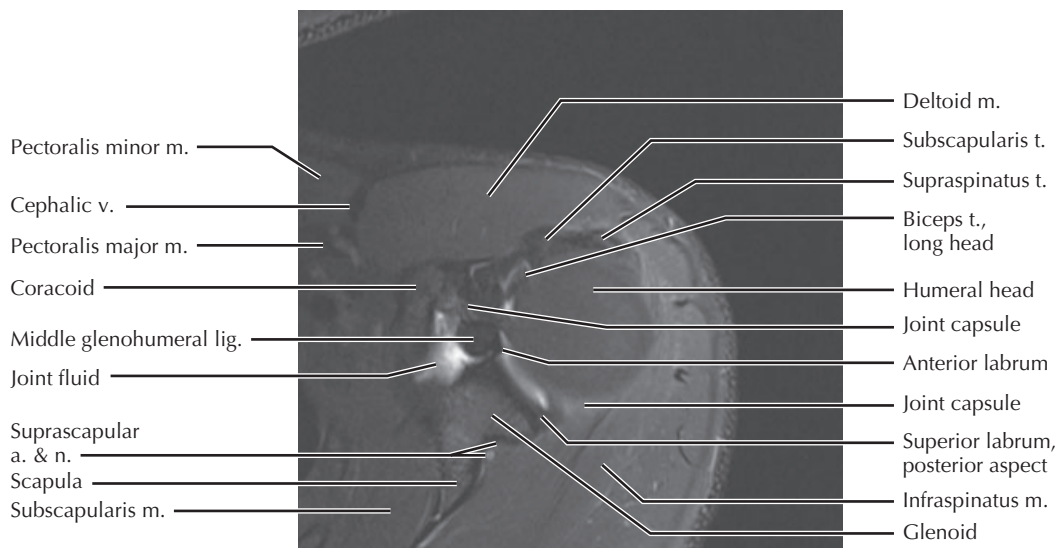
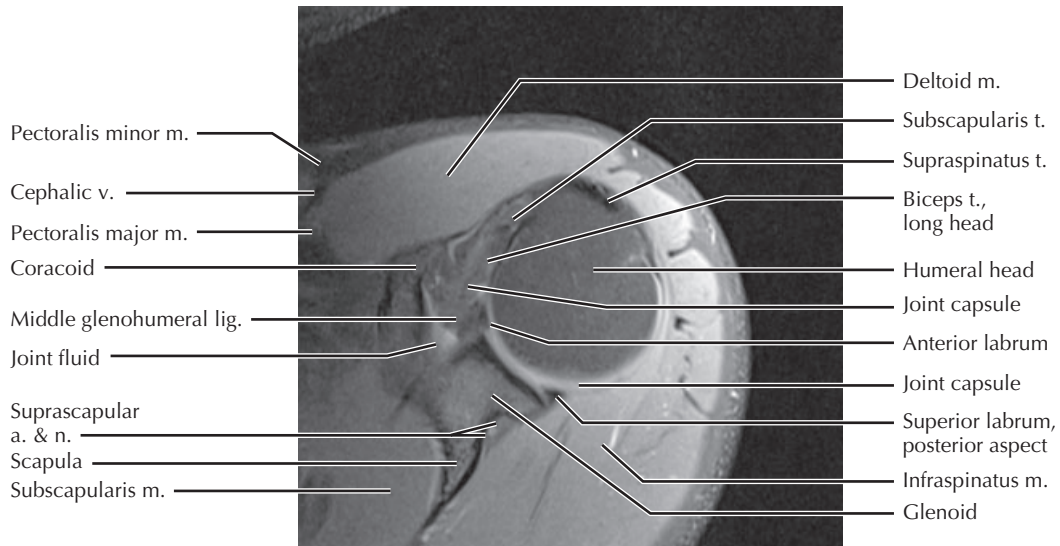
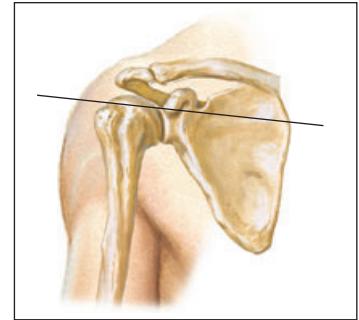


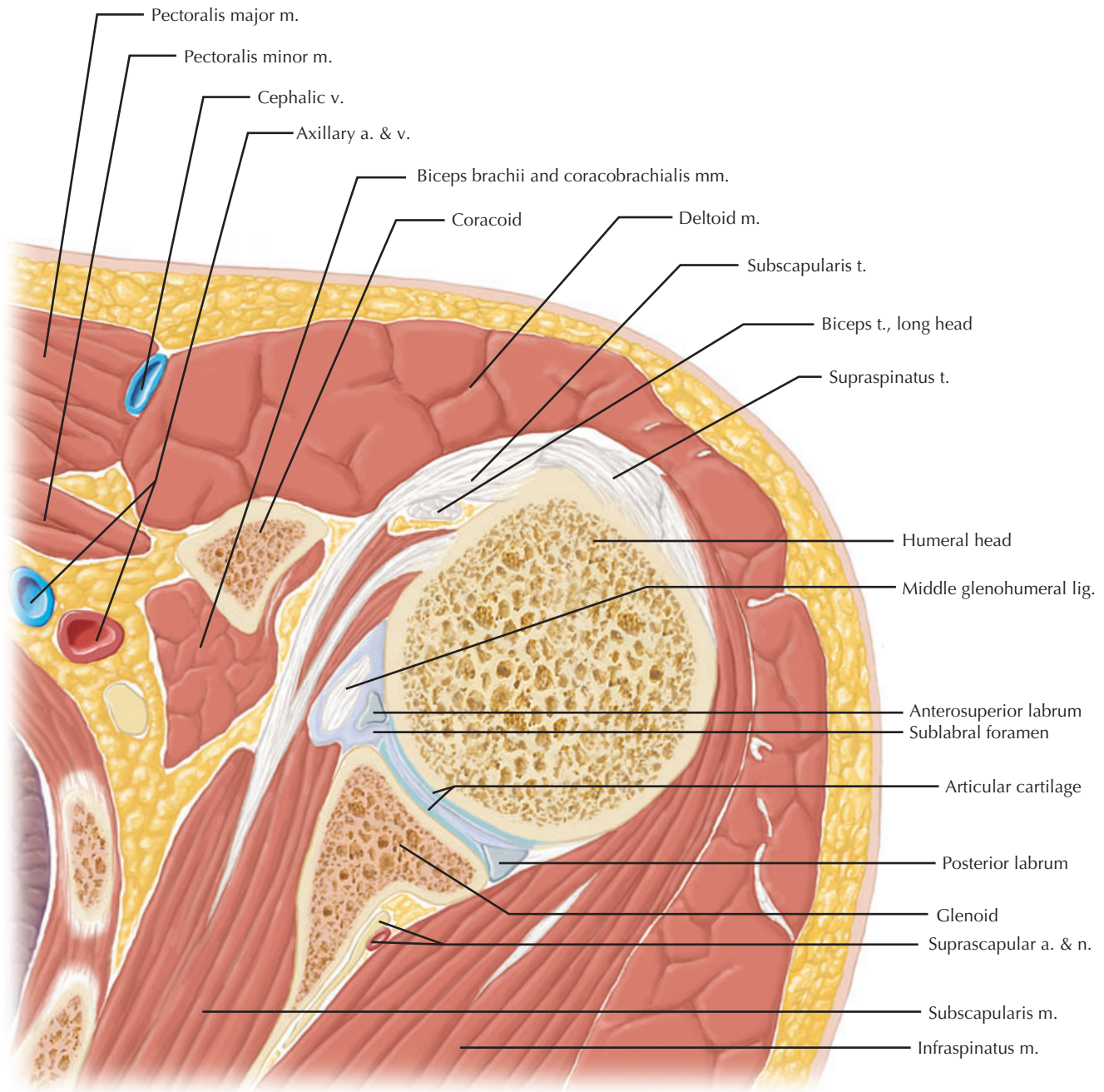
DIAGNOSTIC CONSIDERATION

"Magic angle," which occurs in short-TE sequences (PD, T1, GRE), can affect the posterior aspect of the superior labrum such that it exhibits intermediate signal rather than low signal. For this reason, it is necessary to evaluate the labrum on T2-weighted MR images, in which the normal labrum is low in signal.

PATHOLOGIC PROCESS

Perilabral cysts are pathologic collections of fluid outside the joint capsule. These are usually identified in the spinoglenoid notch, where they can compress the suprascapular nerve. In such situations, T2-weighted MR images can show increased signal within the infraspinatus muscle (neurogenic edema). The presence of a perilabral cyst requires the existence of a labral tear.

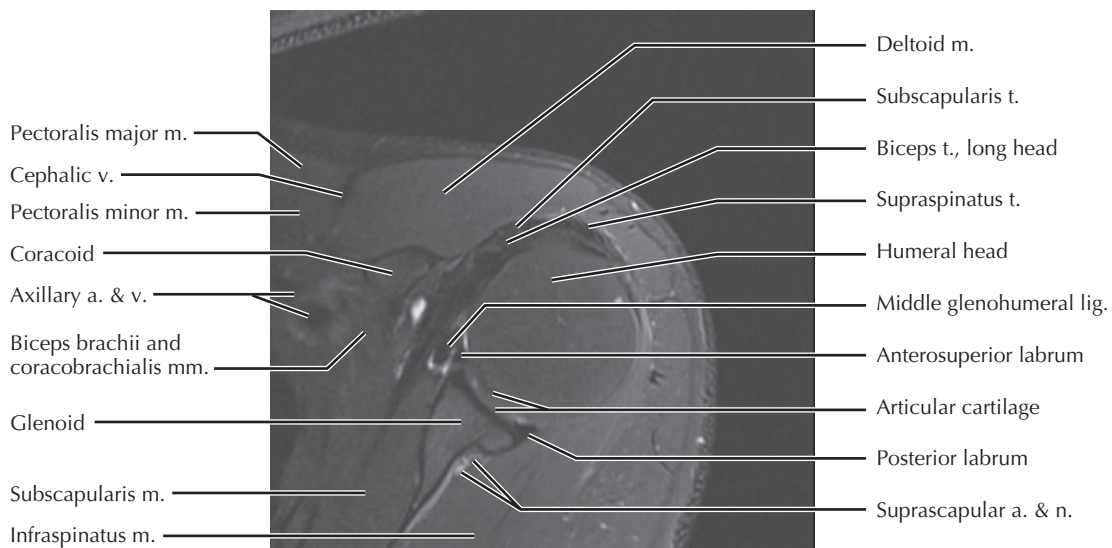
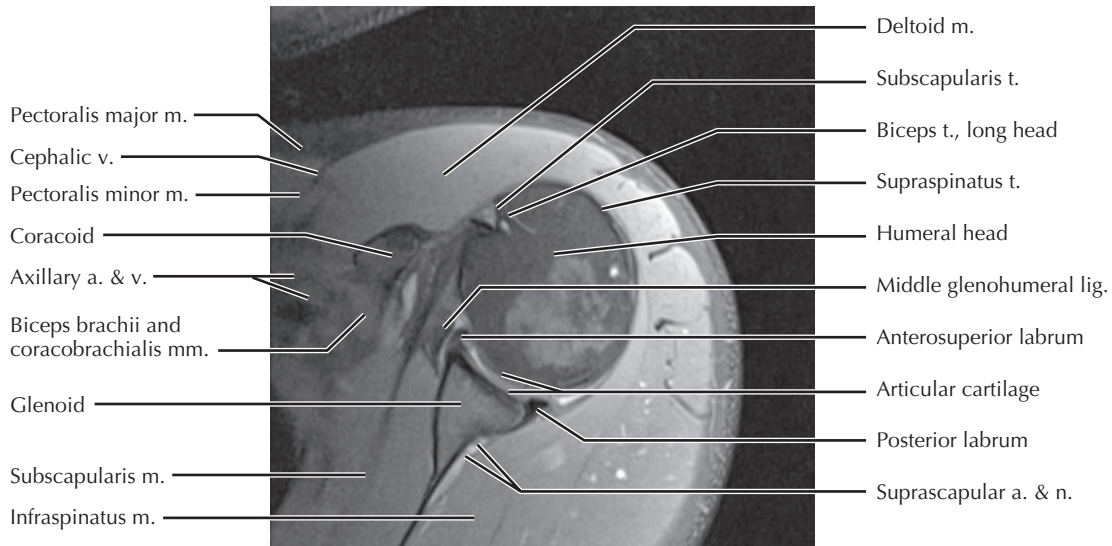
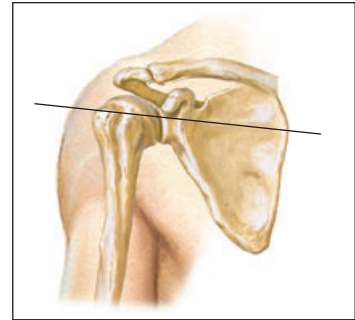


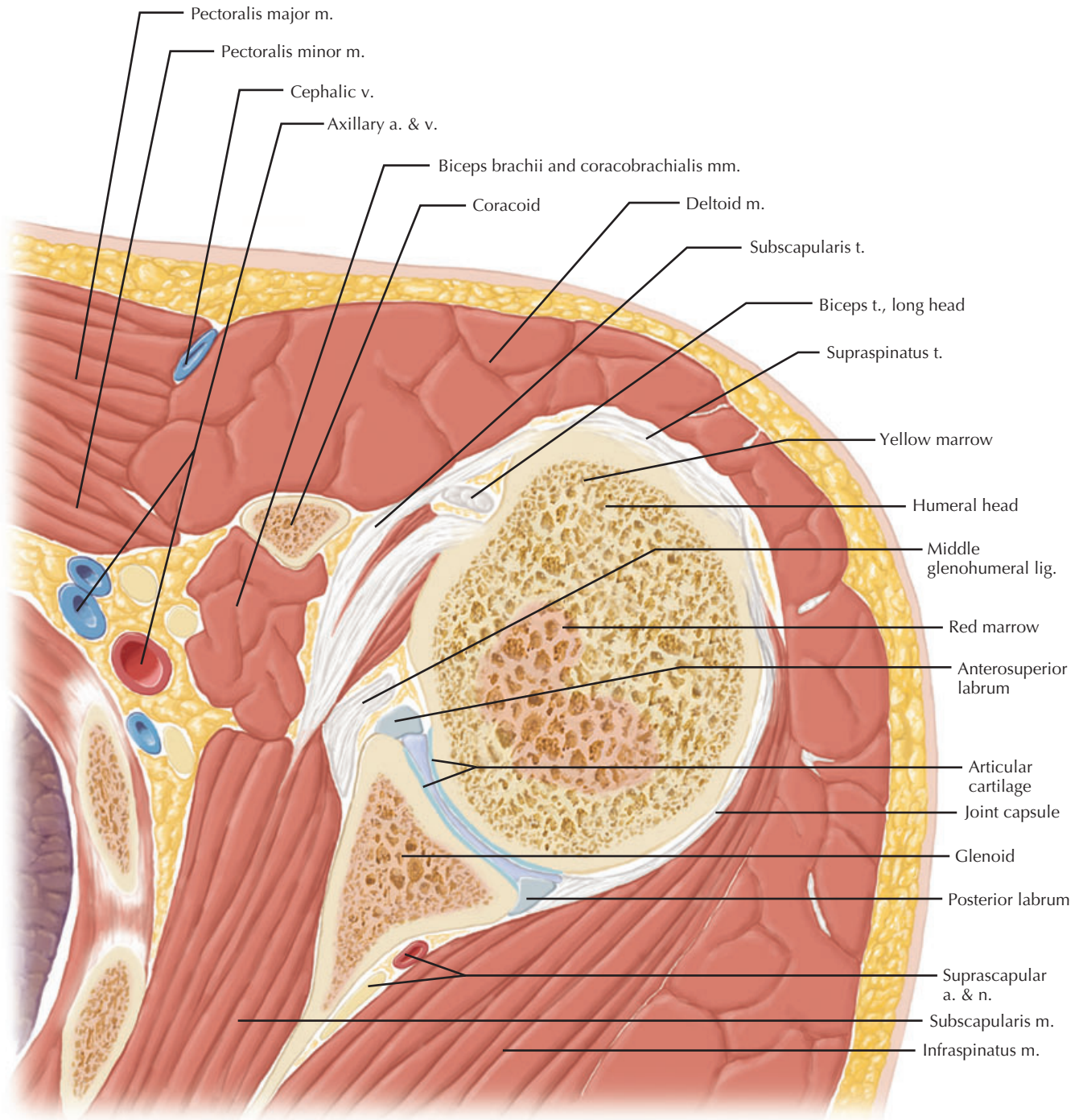


NORMAL VARIANTS

A sublabral foramen (or sublabral hole) is a normal variant in which the anterosuperior labrum is congenitally unattached to the adjacent glenoid. It is found in approximately 15% of the population and can simulate a labral tear on MR images.

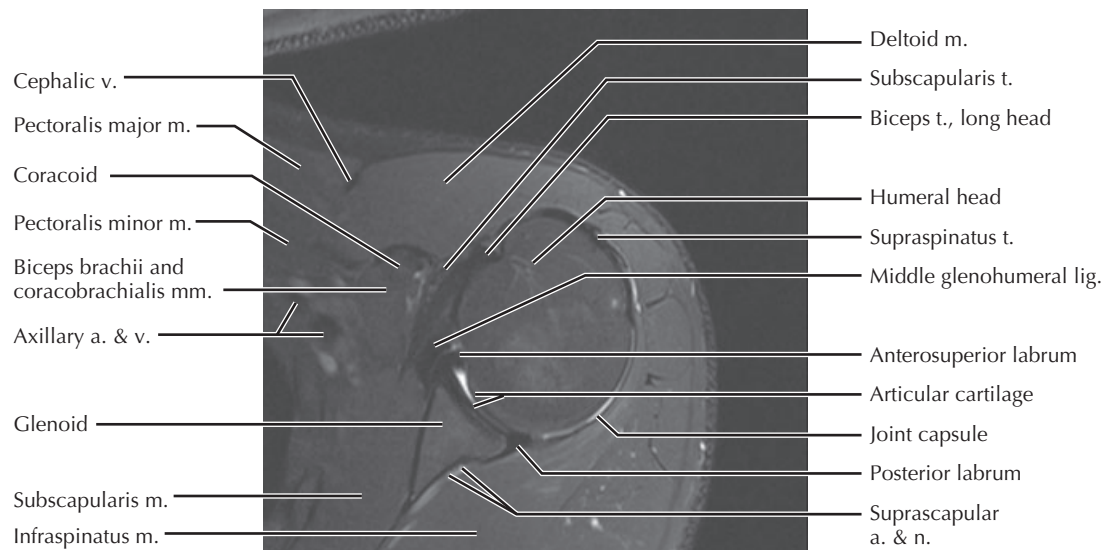
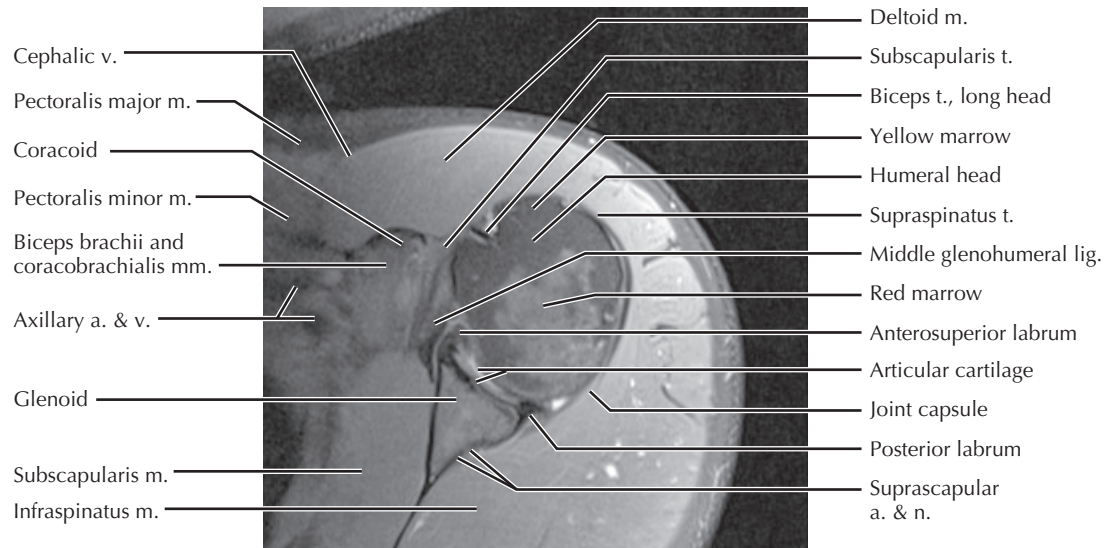
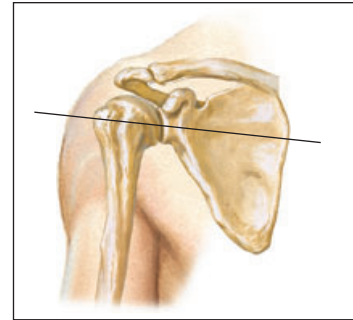
A Beauford complex is a normal variant of the glenoid labrum present in approximately 2% of individuals. It is defined as absence of the anterosuperior labrum and presence of a thick, cord-like middle glenohumeral ligament that originates from the superior labrum near the long head of biceps tendon attachment. Beauford complex is easily identified by injecting fluid into the joint space to distend the joint capsule away from the labrum.

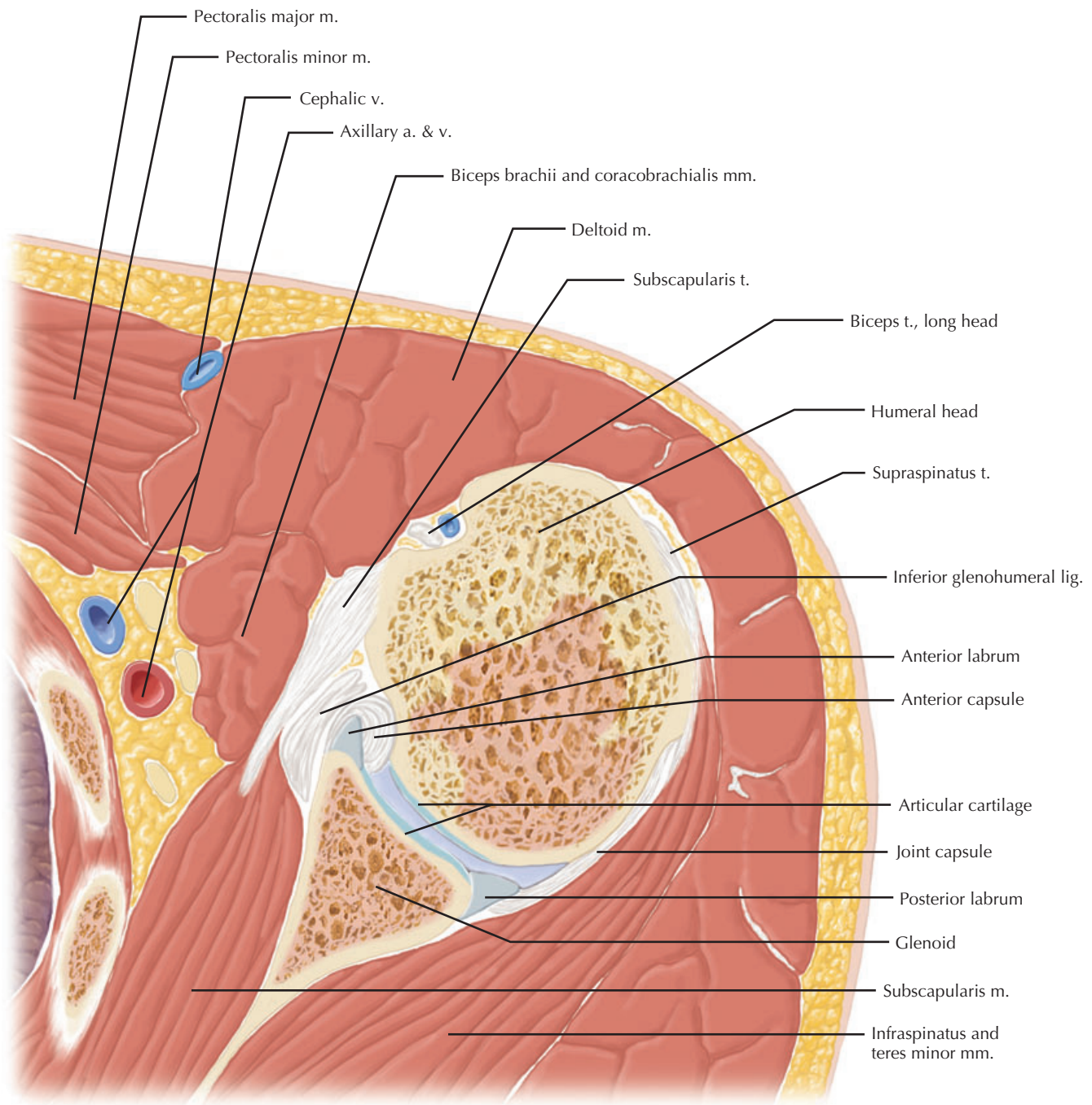




PATHOLOGIC PROCESS

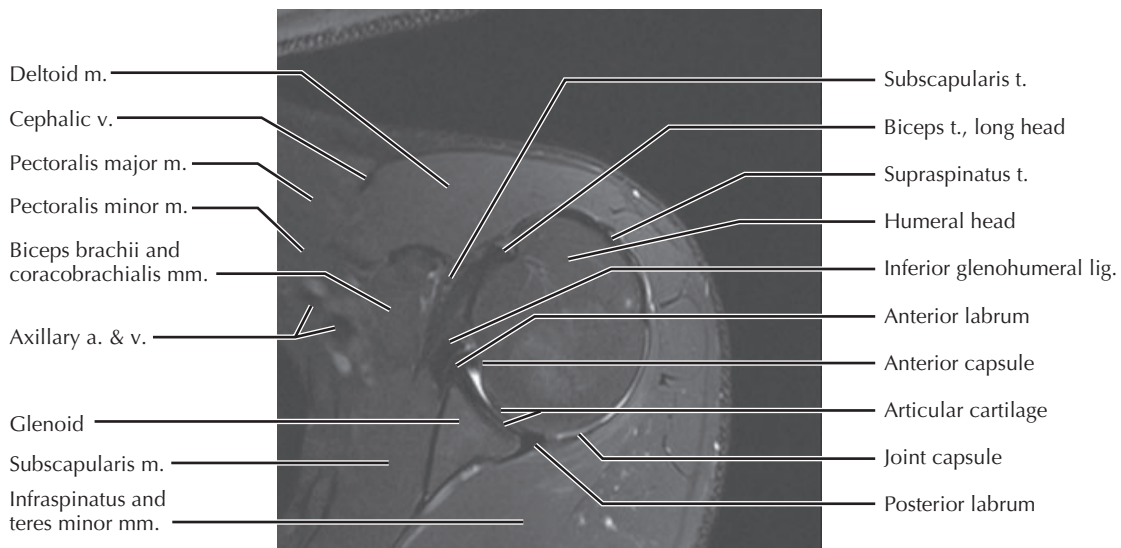
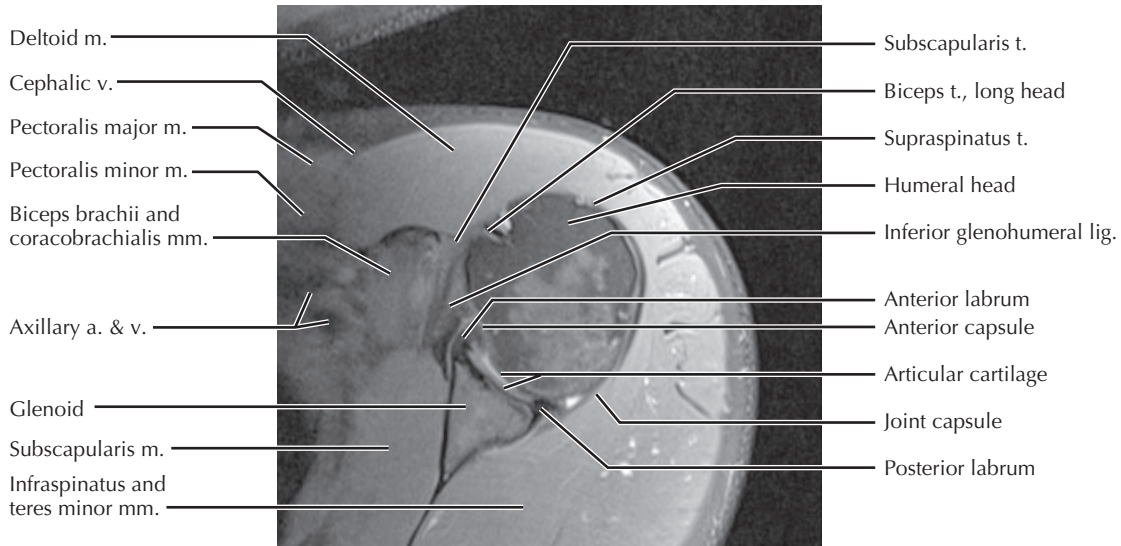
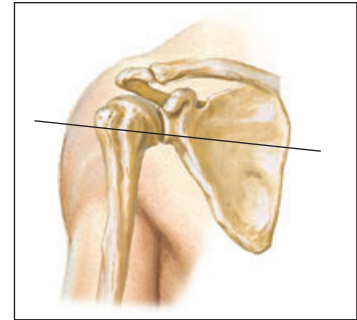
In a patient with a biceps tendon dislocation, a concomitant subscapularis tendon disruption must exist. The subscapularis tendon disruption allows the long head of the biceps tendon to move out of the intertubercular groove and relocate deep to, within, or superficial to the torn subscapularis tendon.

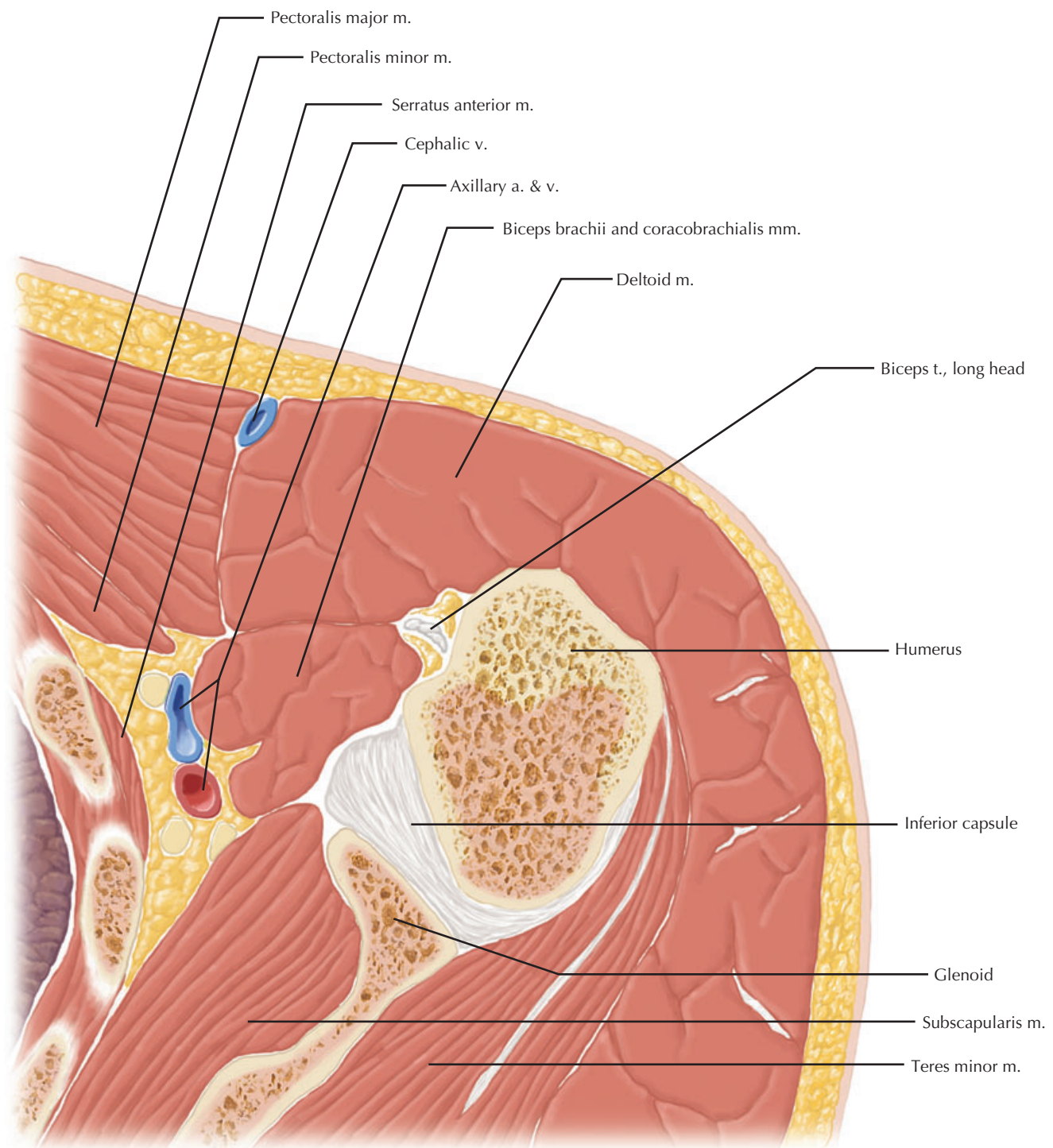


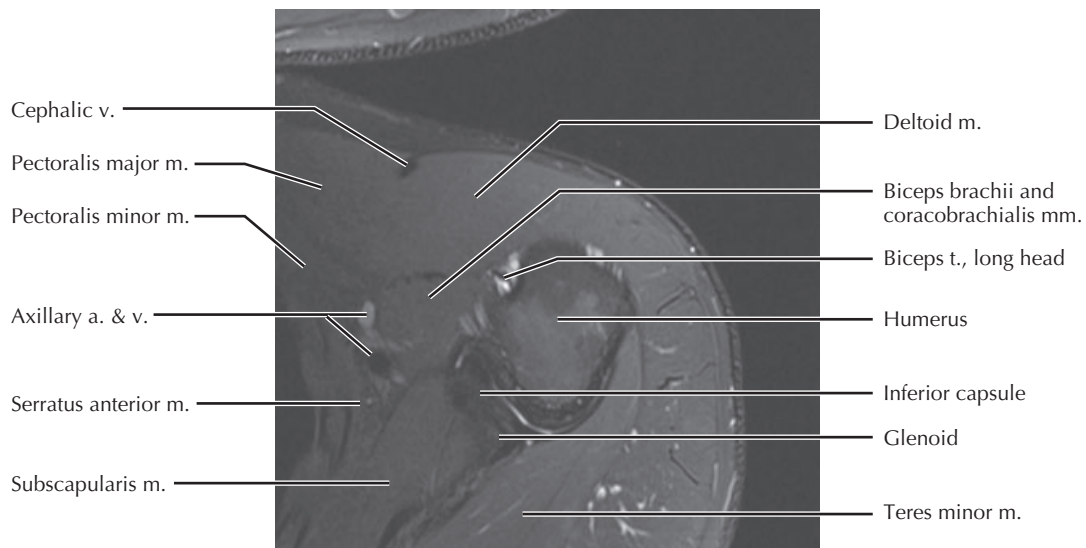
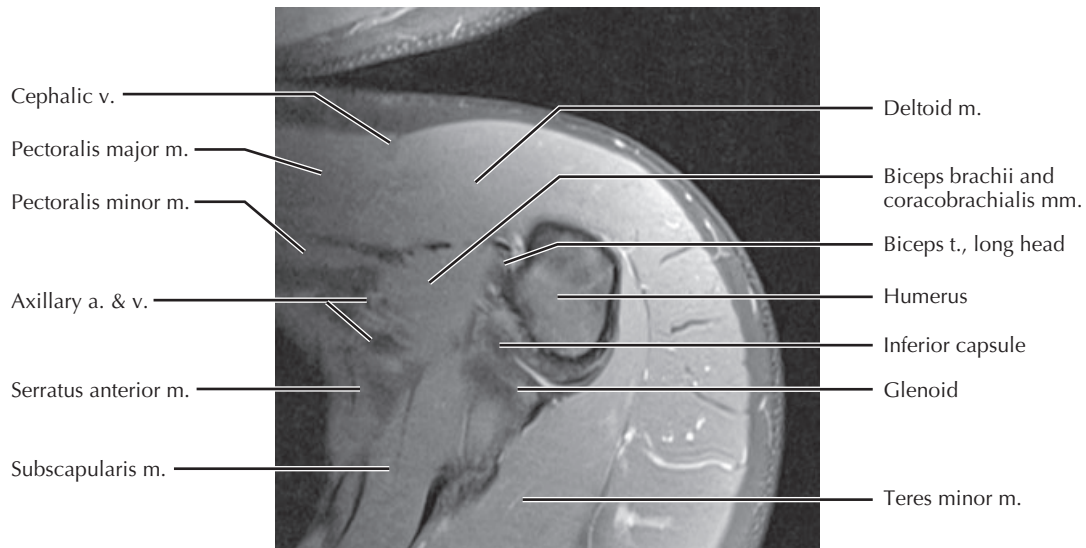
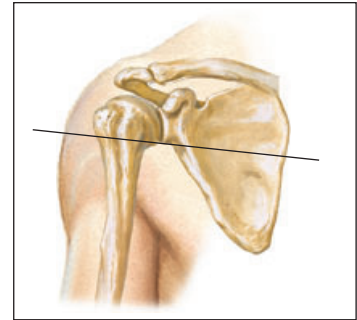


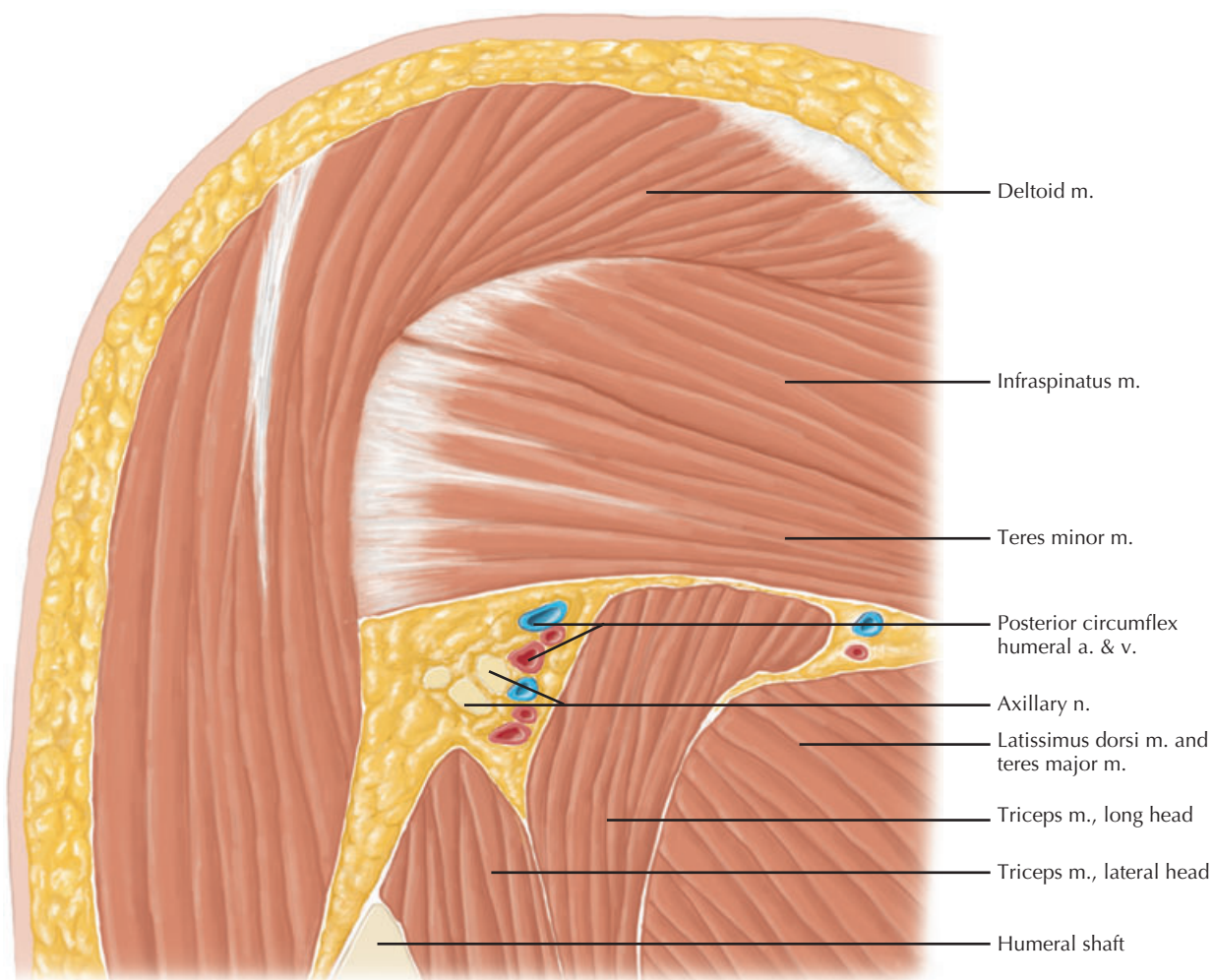
DIAGNOSTIC CONSIDERATION

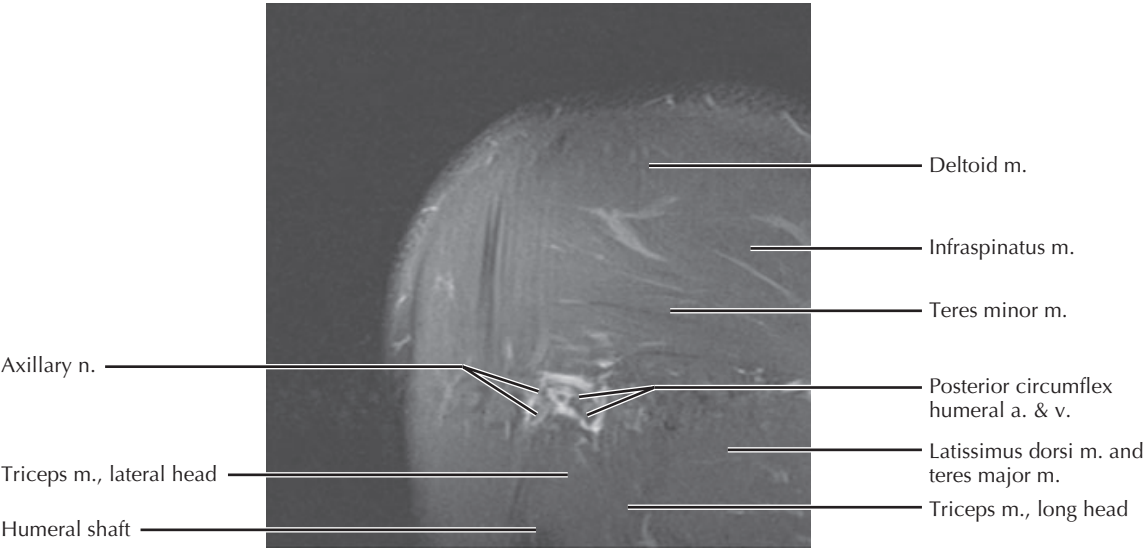
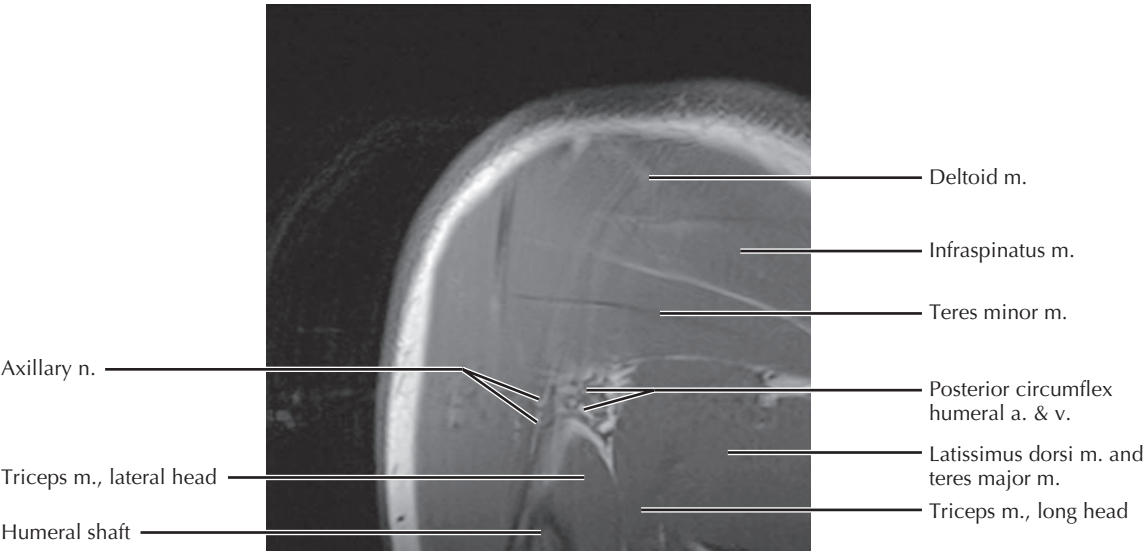
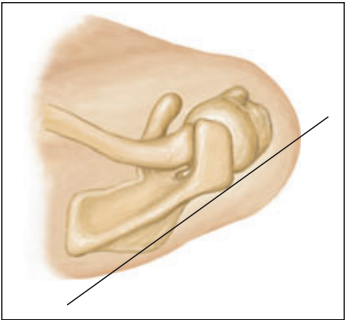
The joint capsule has a dense, fibrous outer layer and thin, synovial inner layer. The thin inner layer reflects around the intra-articular biceps tendon. For this reason, joint fluid can be seen surrounding the intra-articular biceps tendon. The amount of fluid around the biceps tendon should be proportional to the amount of fluid in the glenohumeral joint space. A disproportionate amount of fluid around the biceps tendon would be considered pathologic. The MR image demonstrates physiologic fluid.

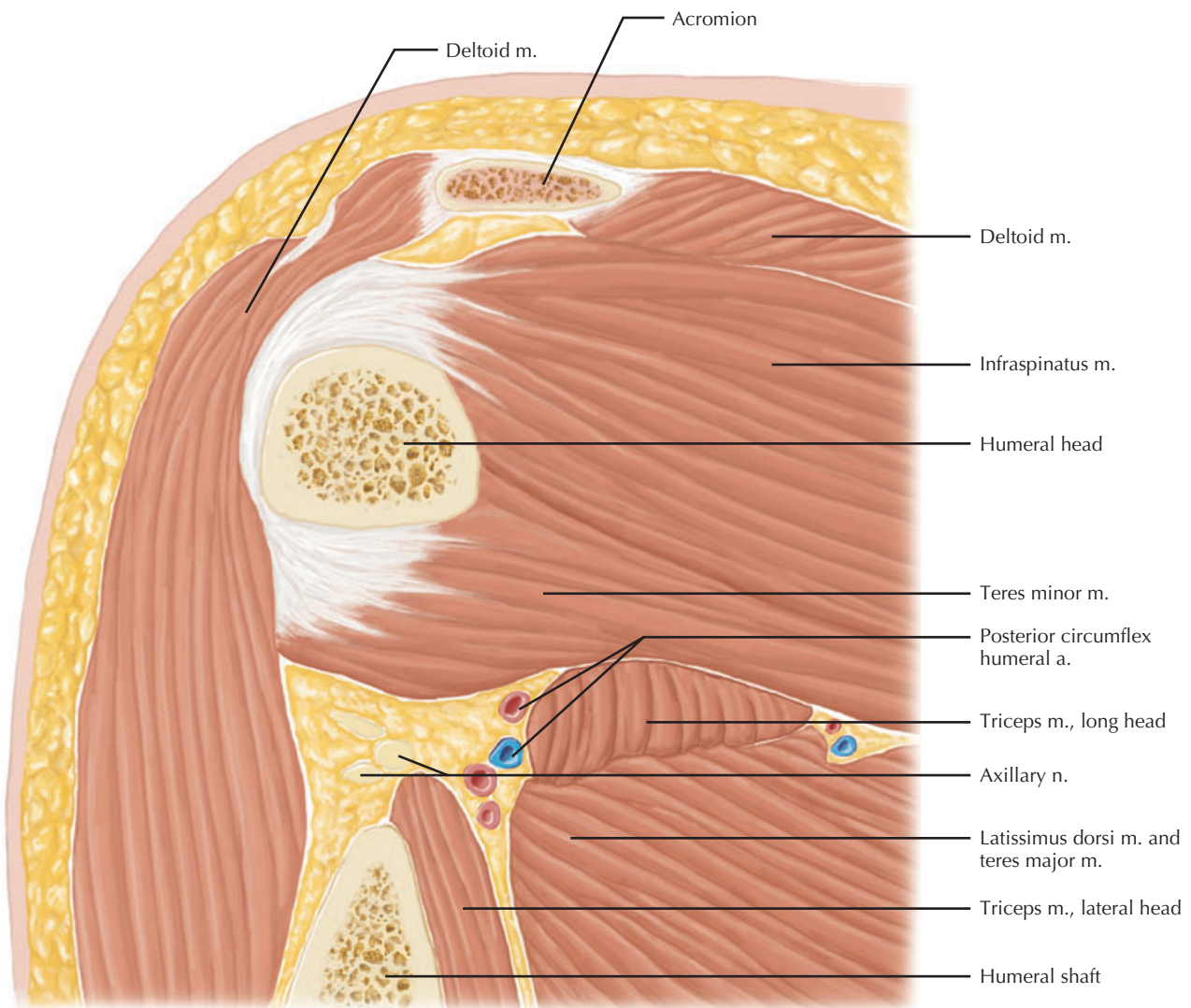


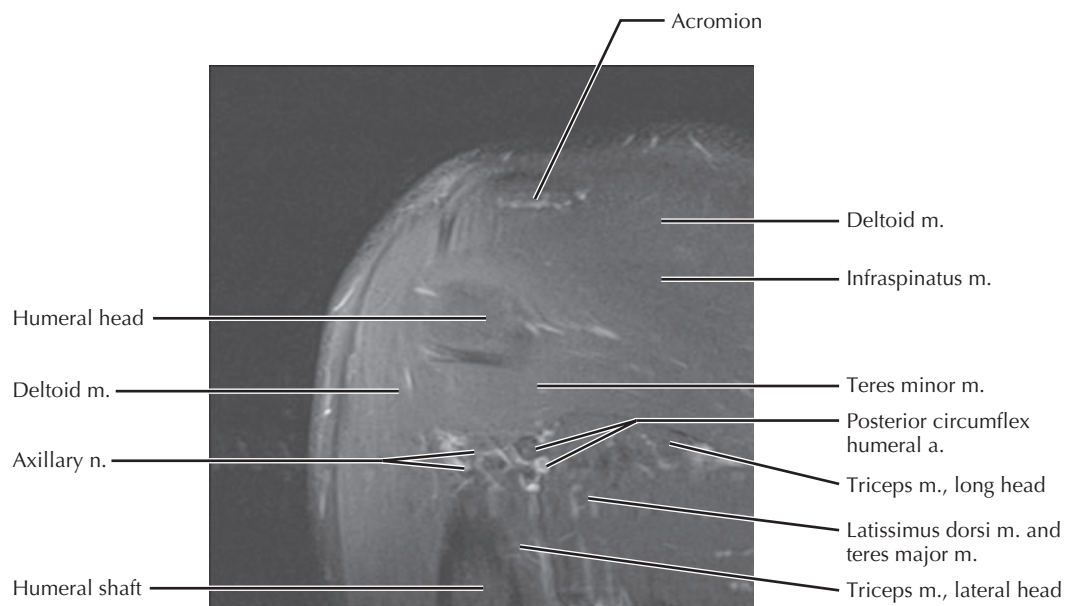
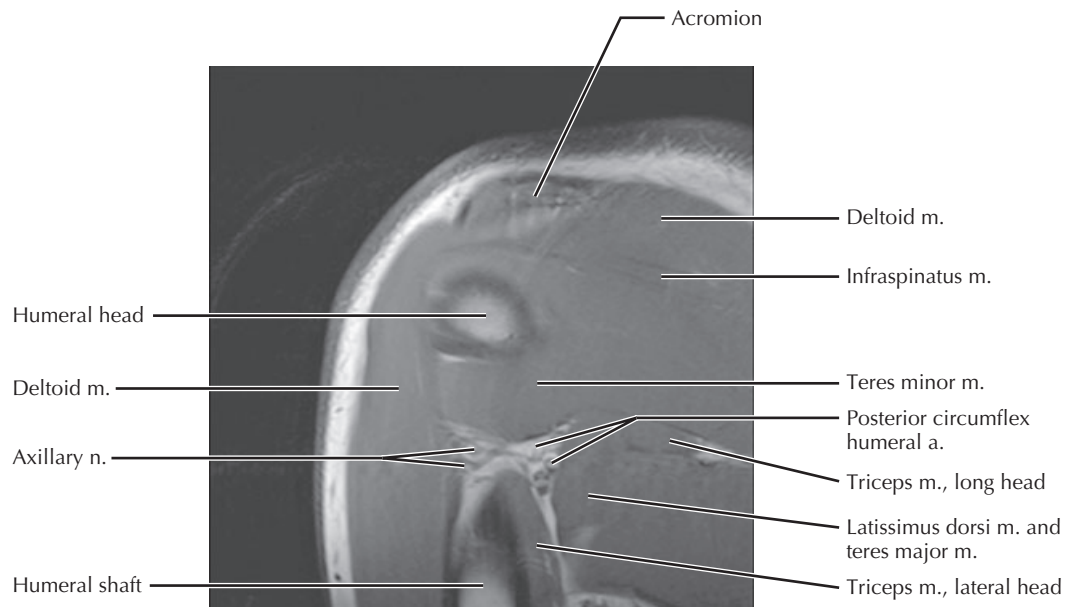
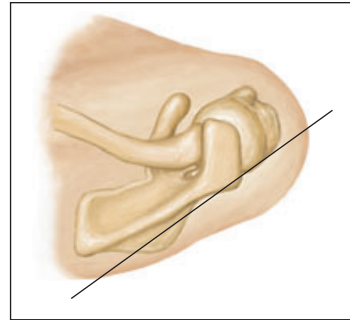


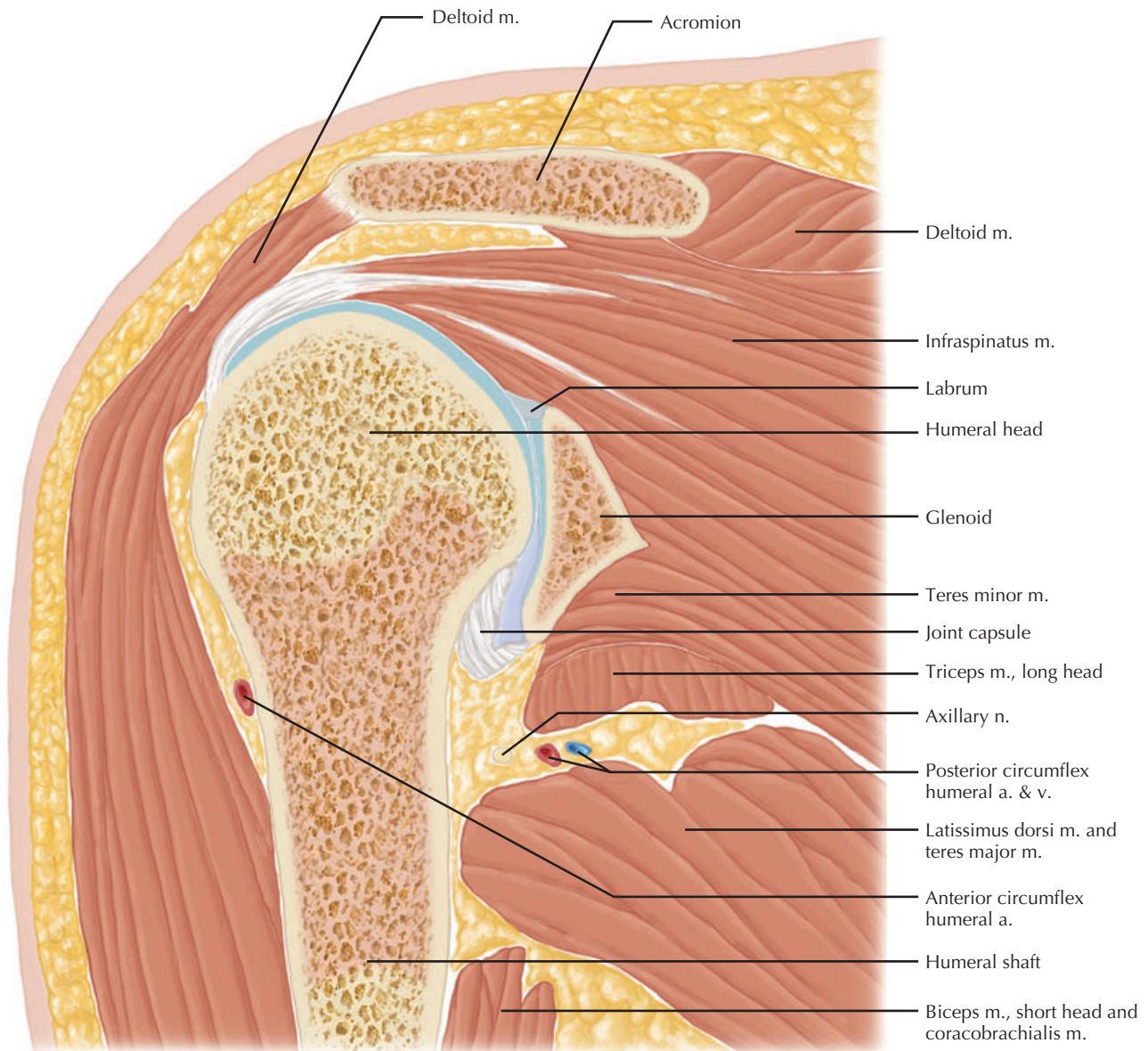


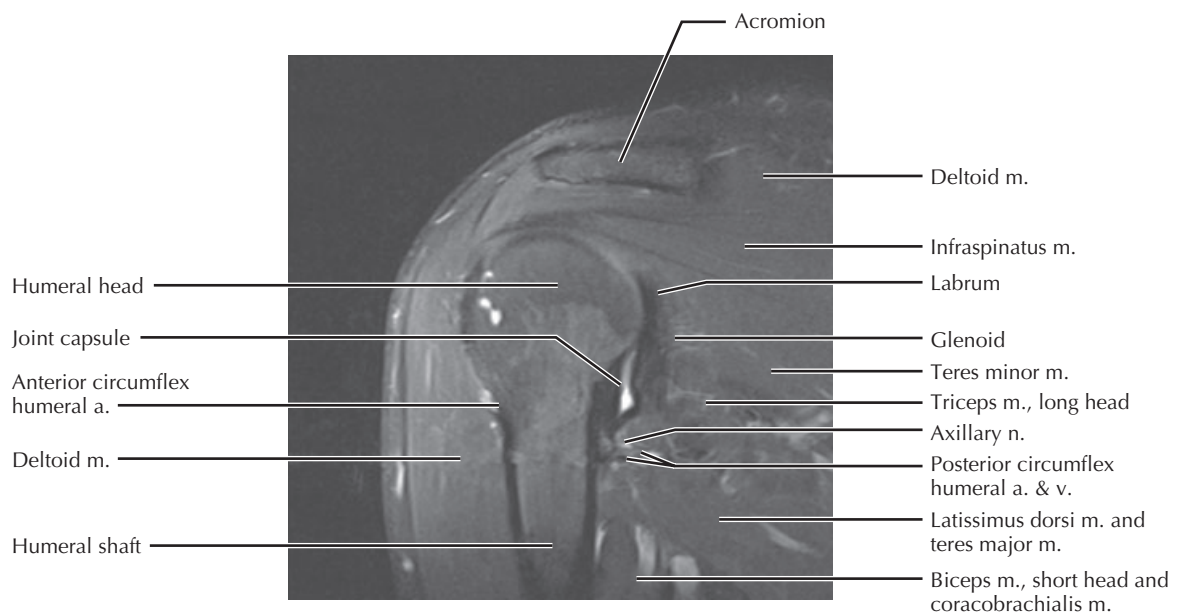
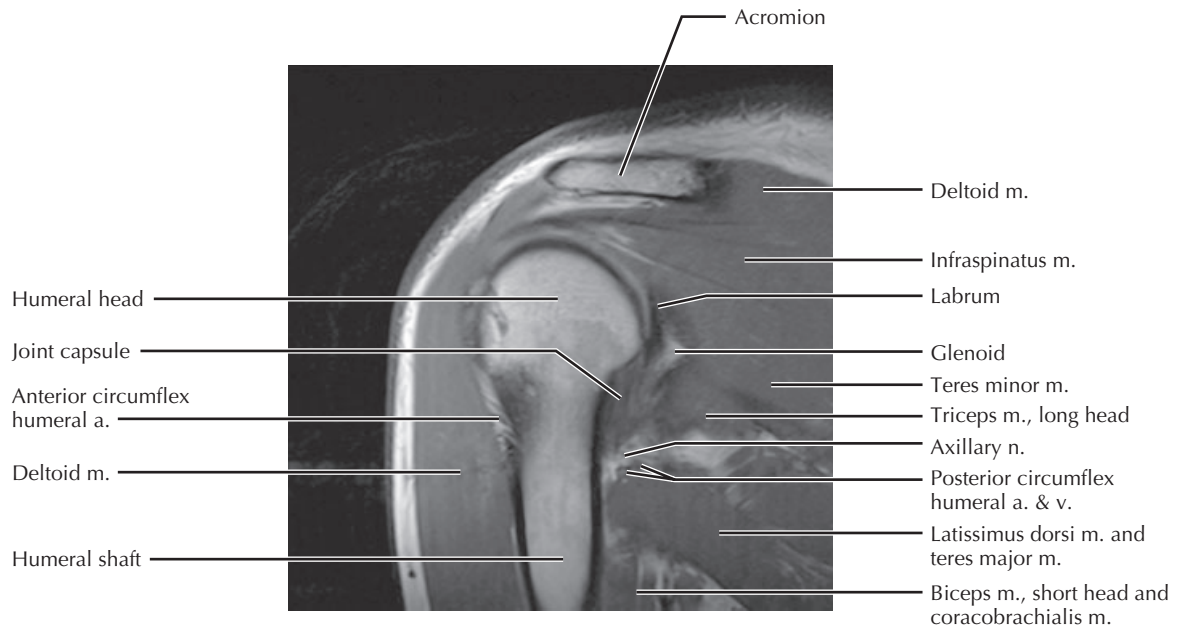
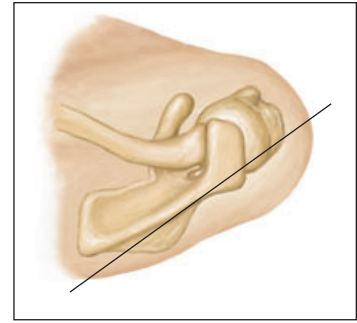


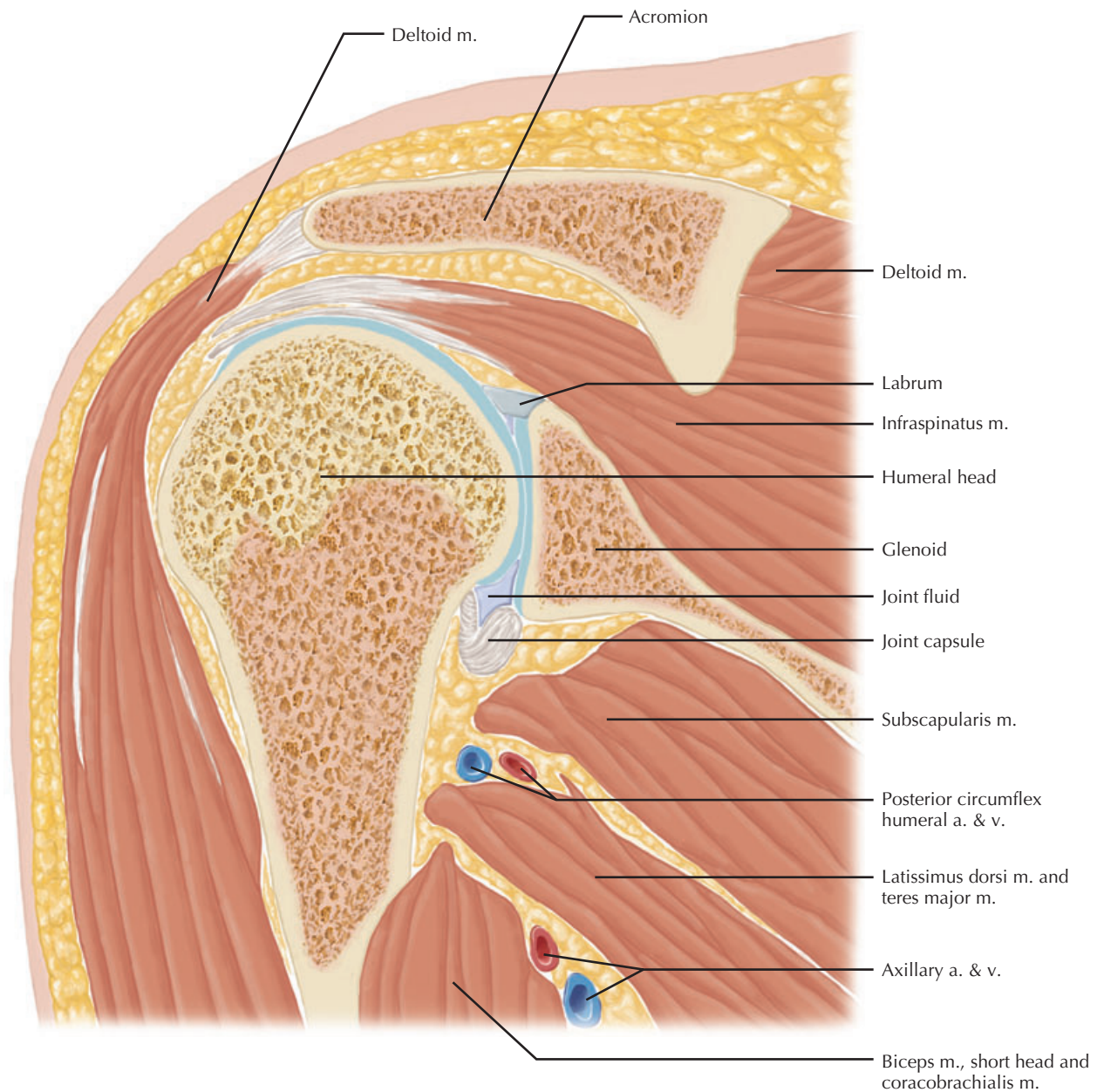


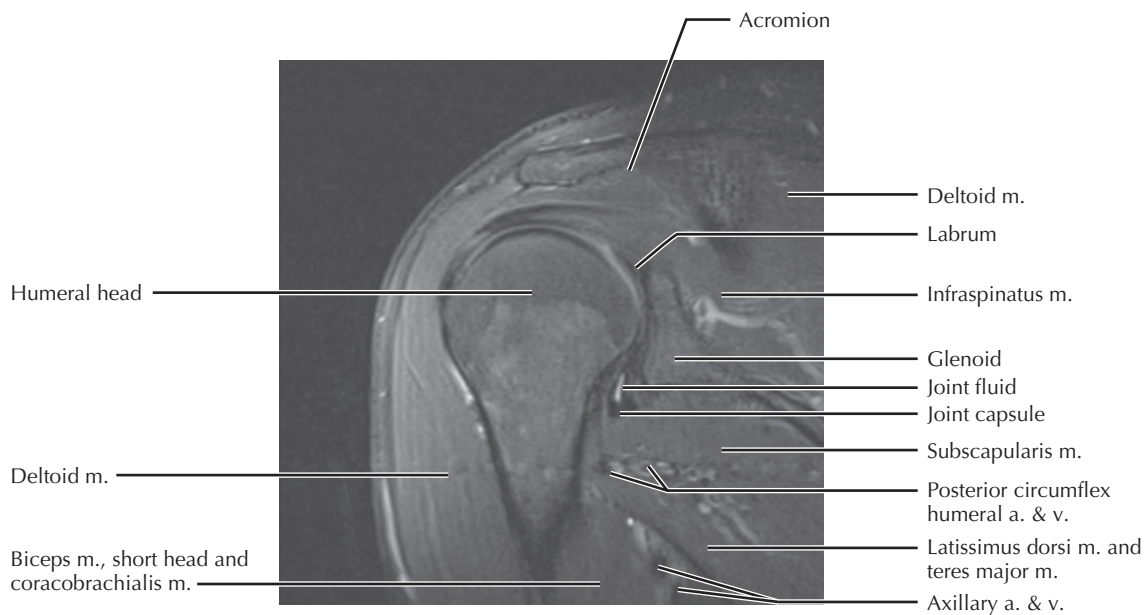
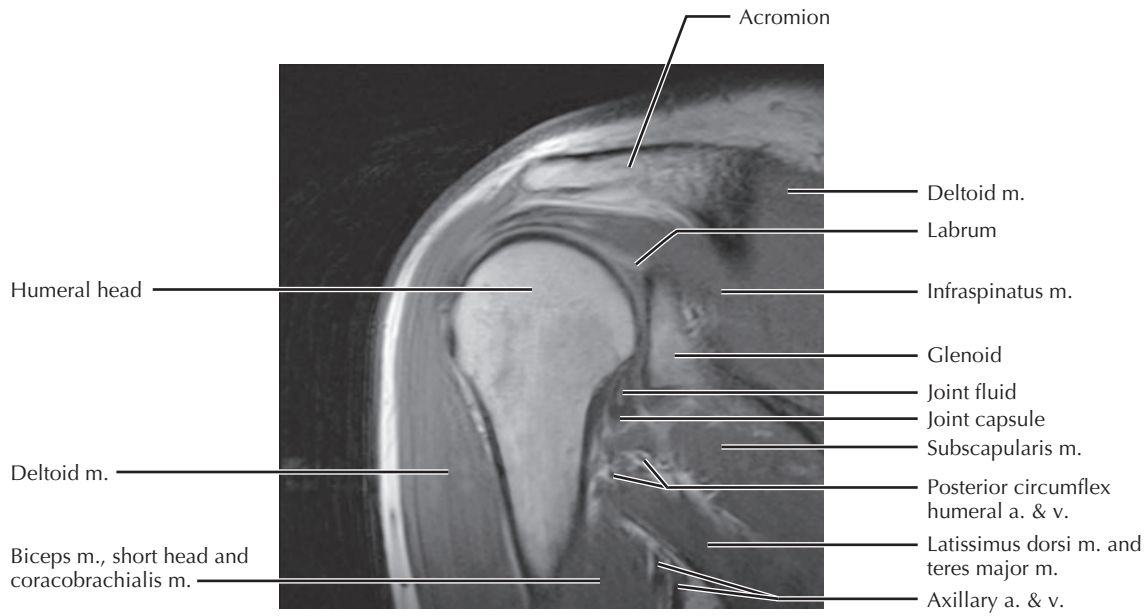
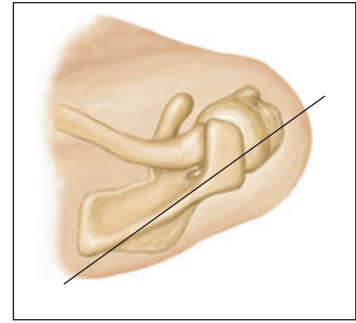


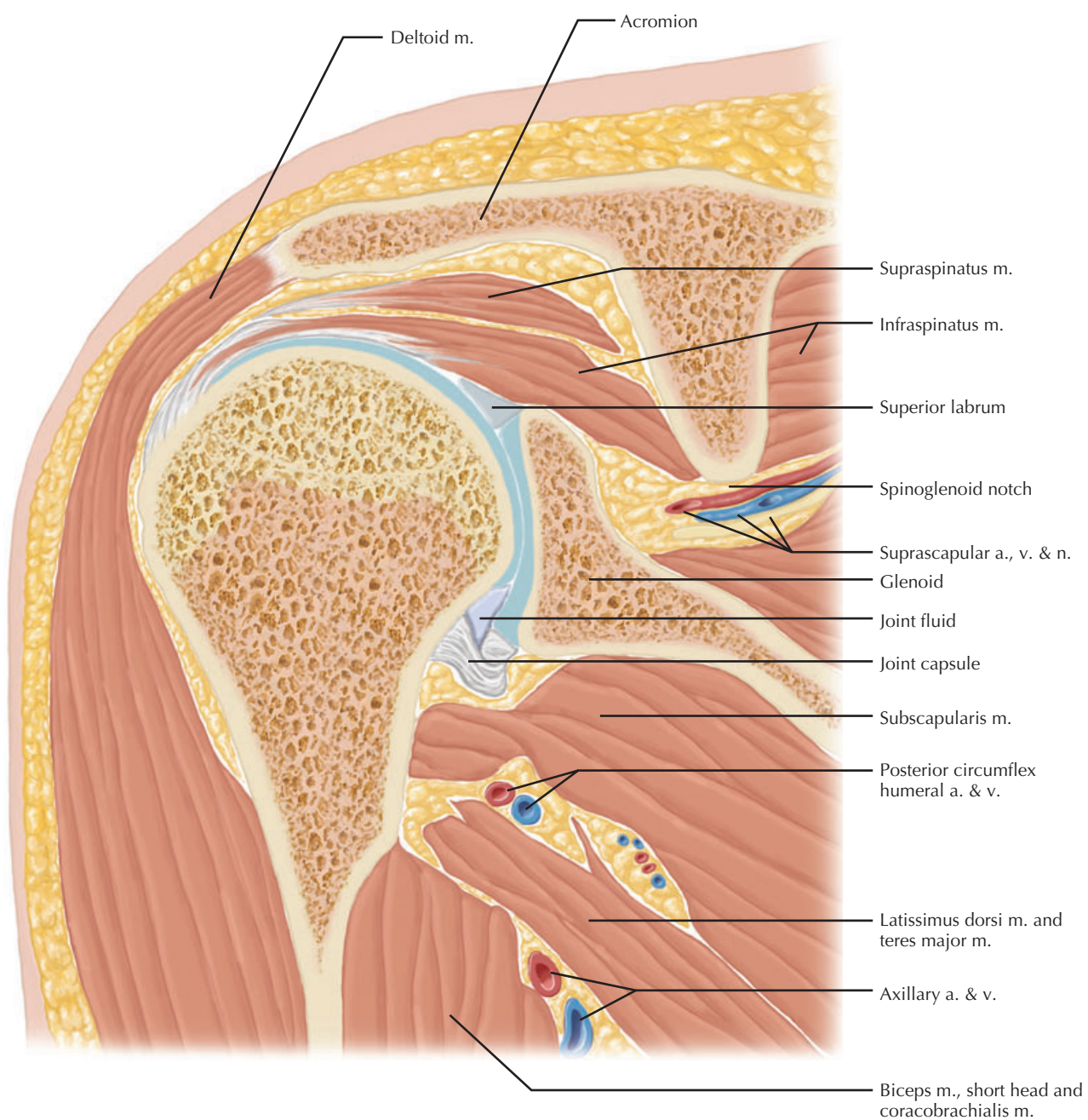


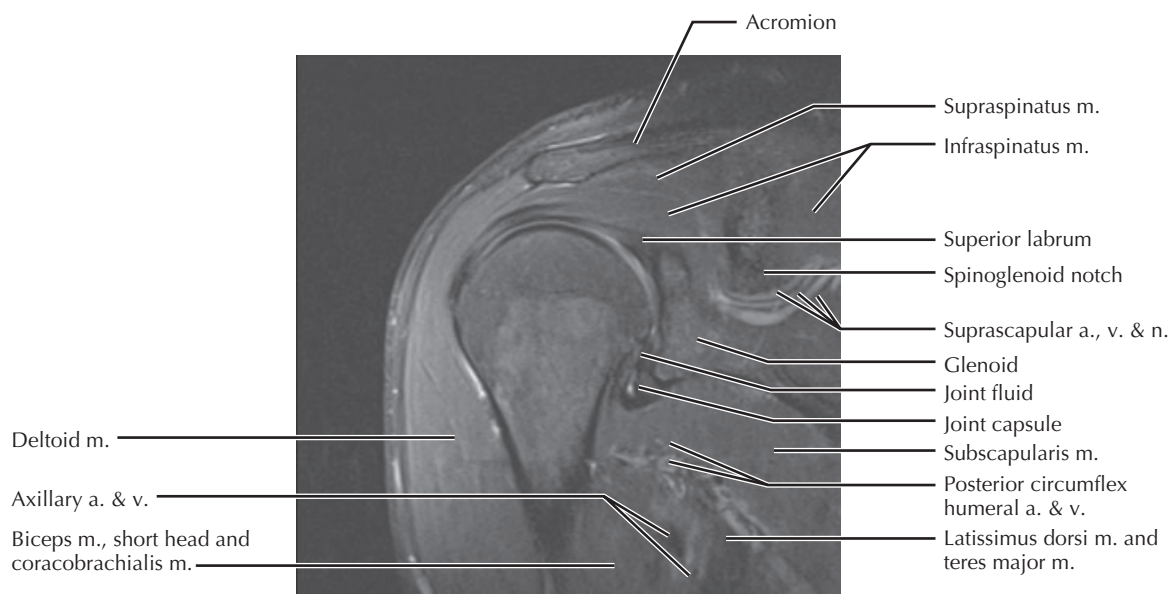
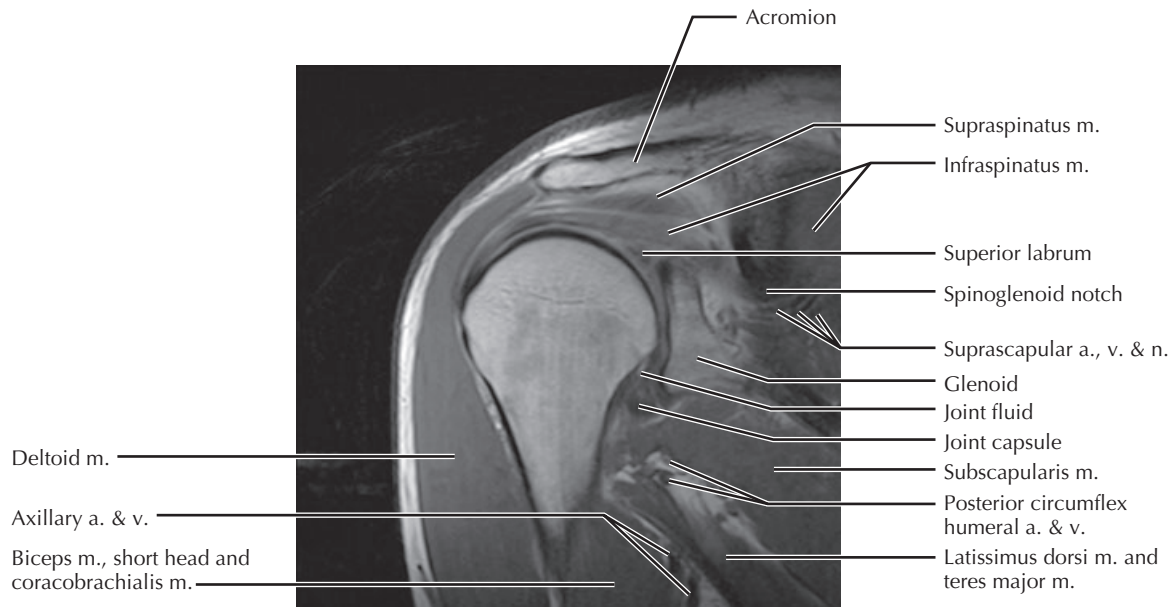
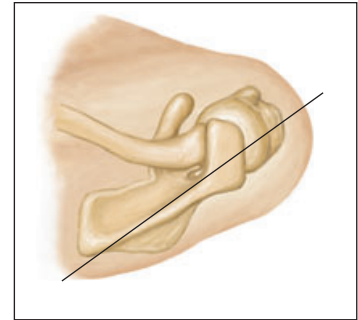


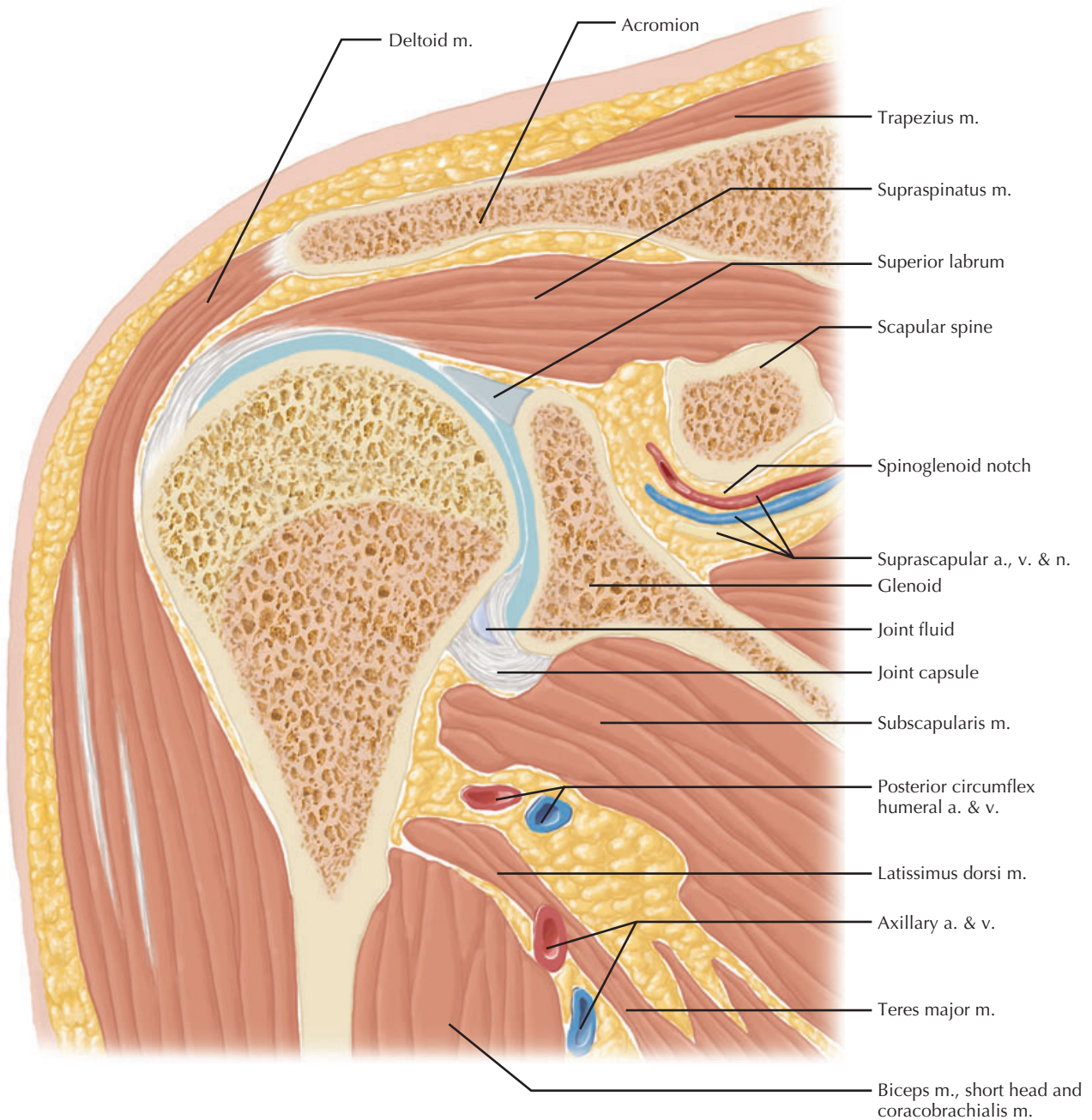






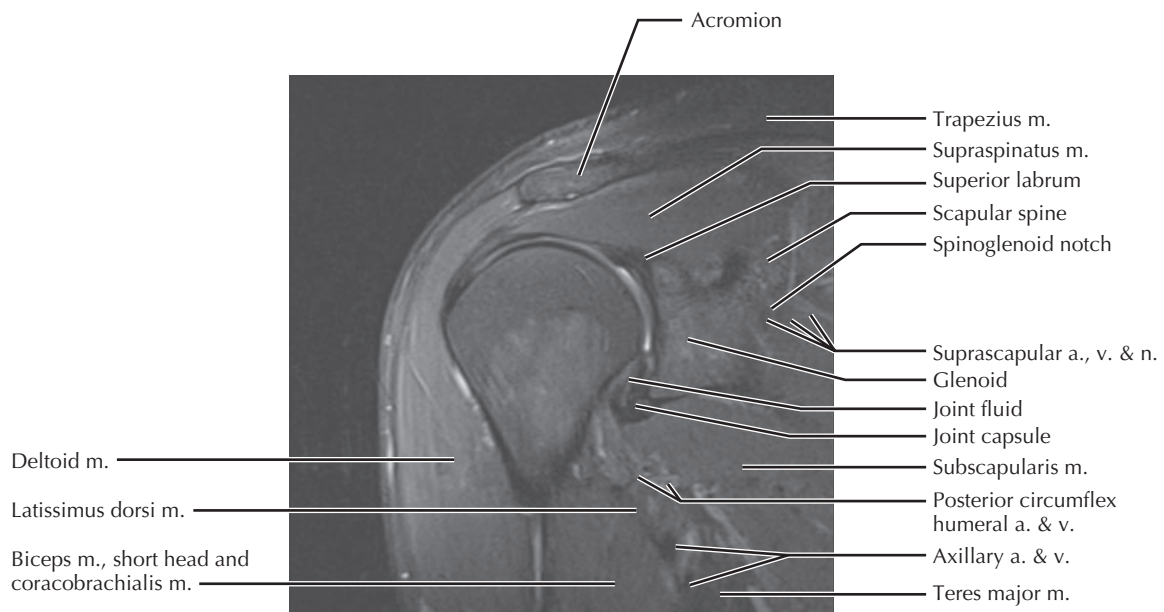
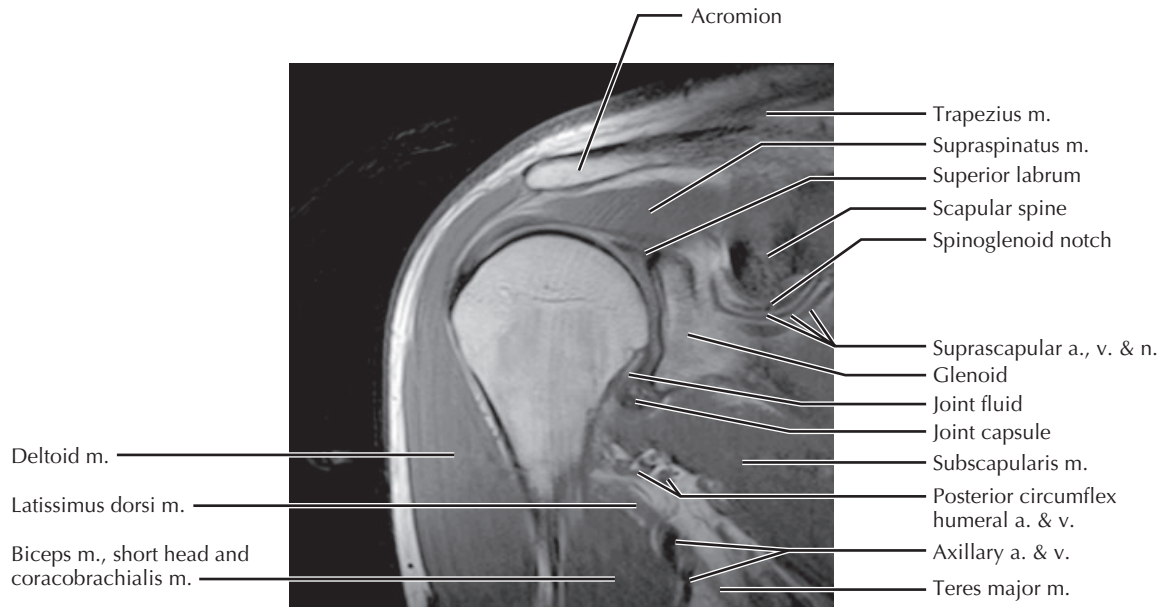
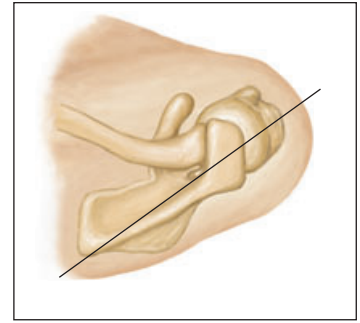


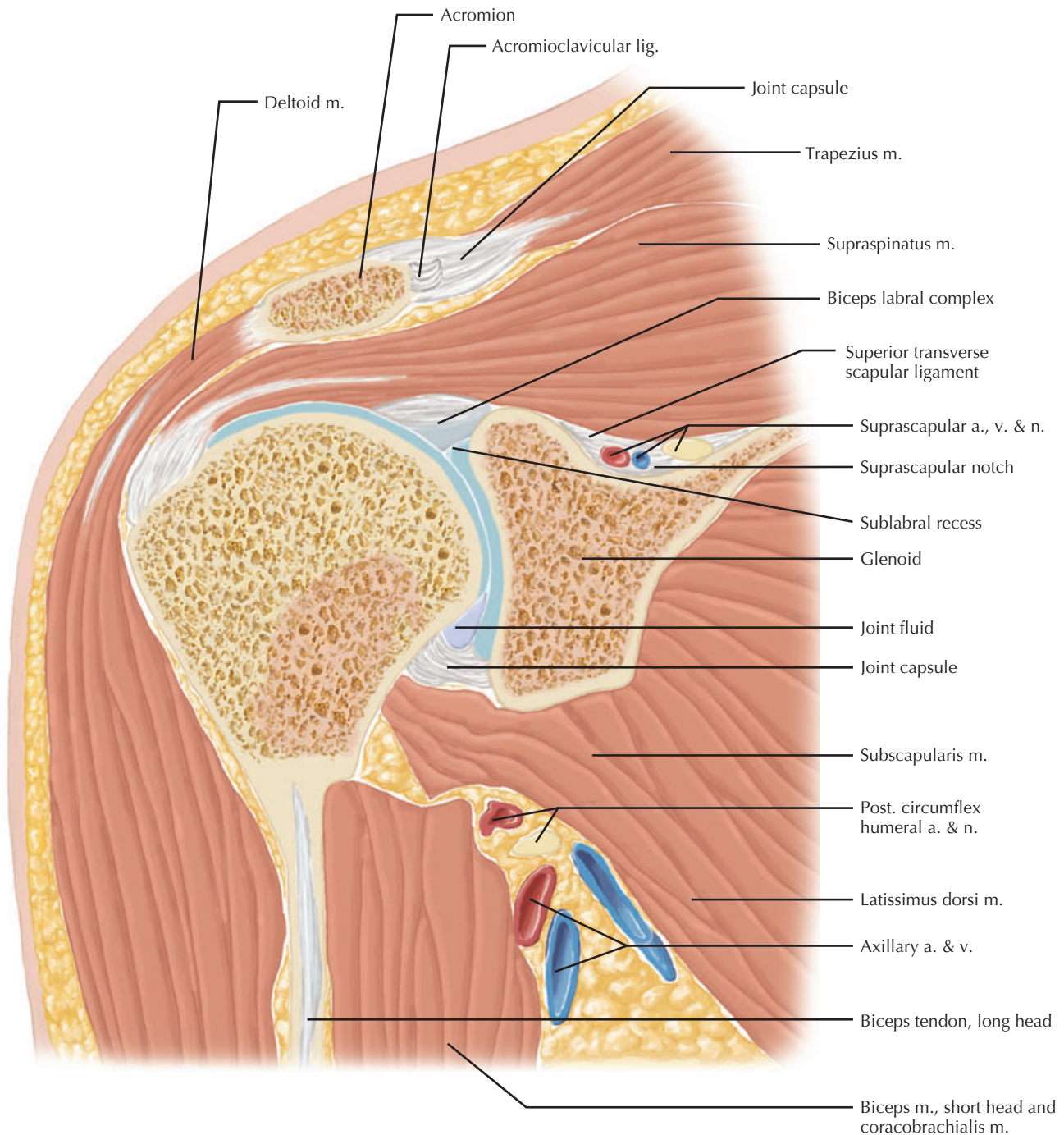




NORMAL ANATOMY

The suprascapular artery and nerve run inferior to the acromion in a groove in the scapula. Although this is a single continuous groove in the bone, it is termed the *spinoglenoid notch* posteriorly and the *suprascapular notch* anteriorly.



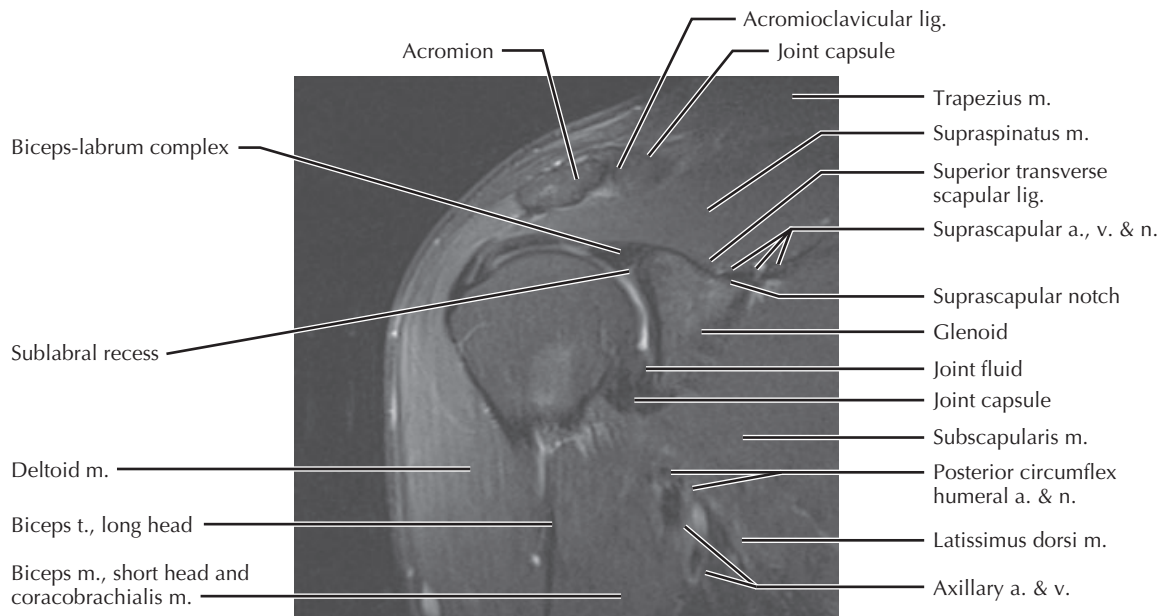
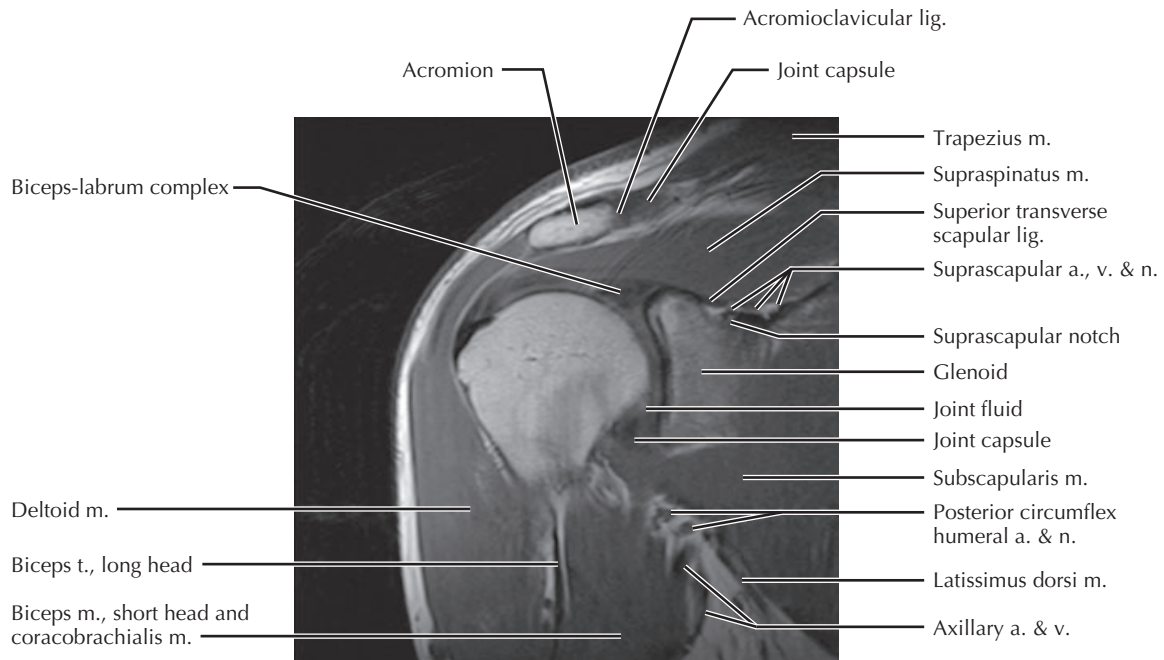
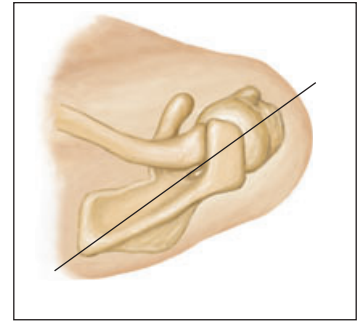


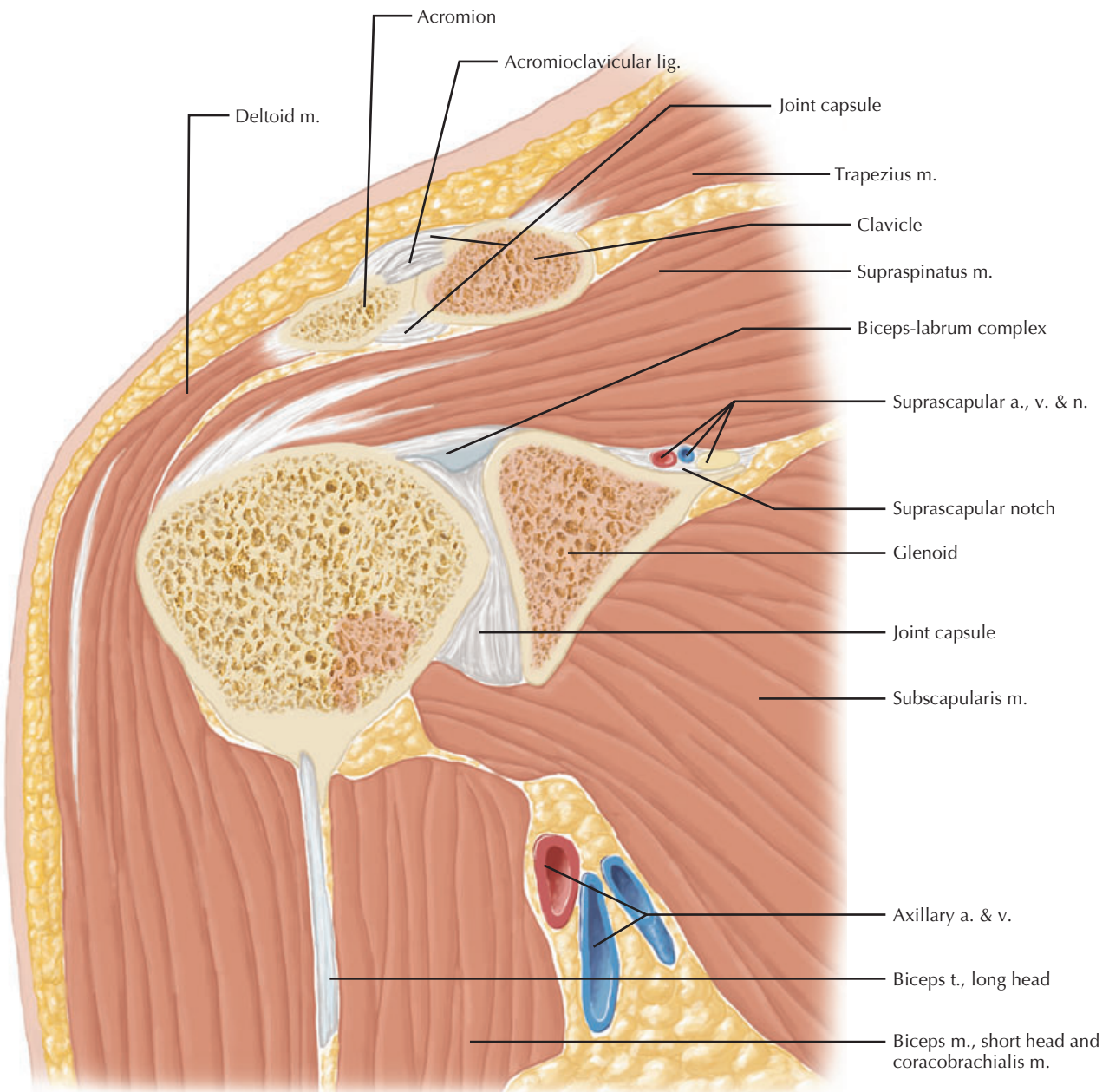
NORMAL VARIANT

The superior labrum is normally more loosely attached and mobile than the rest of the labrum. This normal laxity can lead to diagnostic difficulty in identifying superior labral tears. A sublabral recess (or sulcus) is a normal variant found in approximately 75% of individuals. It is a variably present space between the biceps-labrum complex and the superior portion of the glenoid cartilage and is seen best on coronal MR images. Presence of fluid in a sublabral recess can mimic a superior labral tear on MRI.

PATHOLOGIC PROCESS

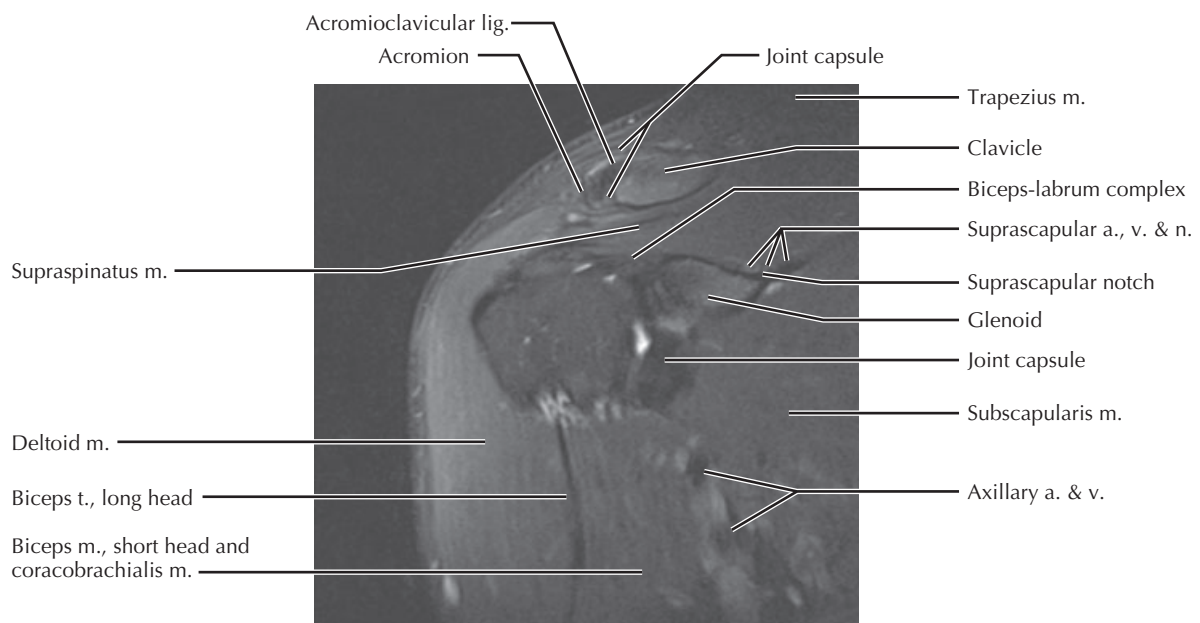
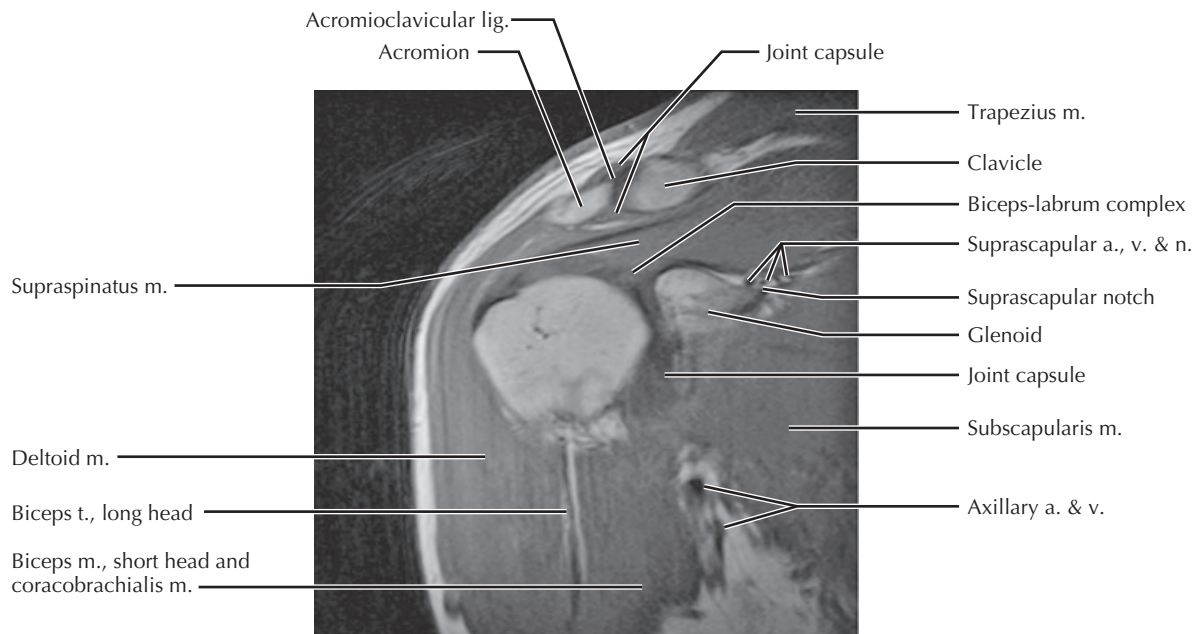
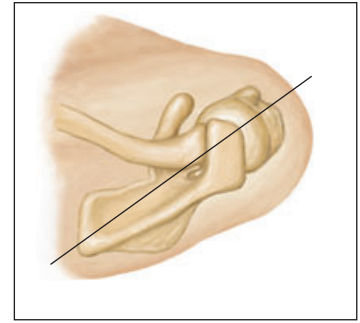
The supraspinatus tendon inserts as a "footprint" on the greater tuberosity. "Rim rent" tears of the supraspinatus and infraspinatus tendons occur when the articular side of the tendon peels away from its insertion at the tuberosity, and the superficial bursal side remains attached.

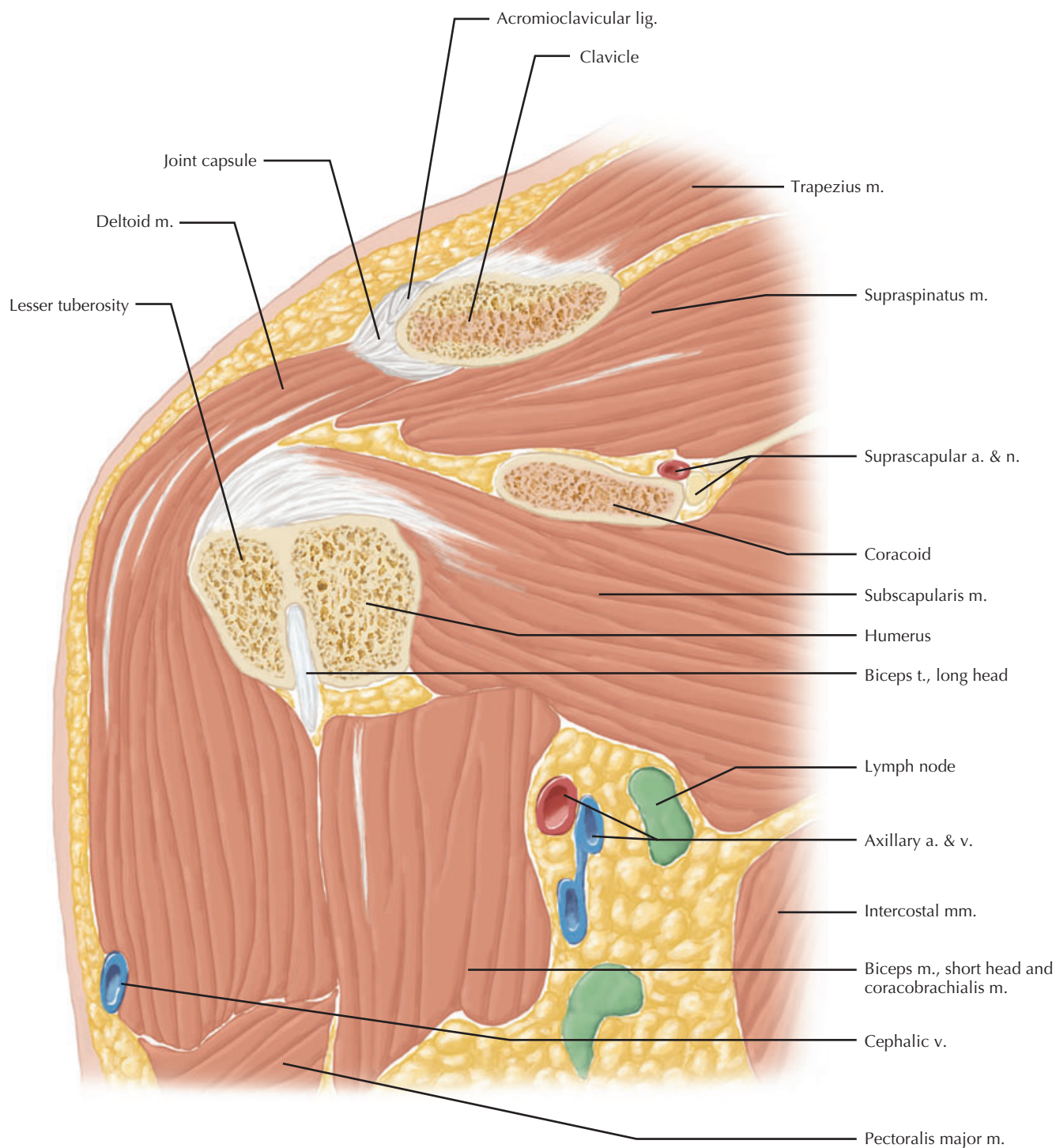




NORMAL ANATOMY

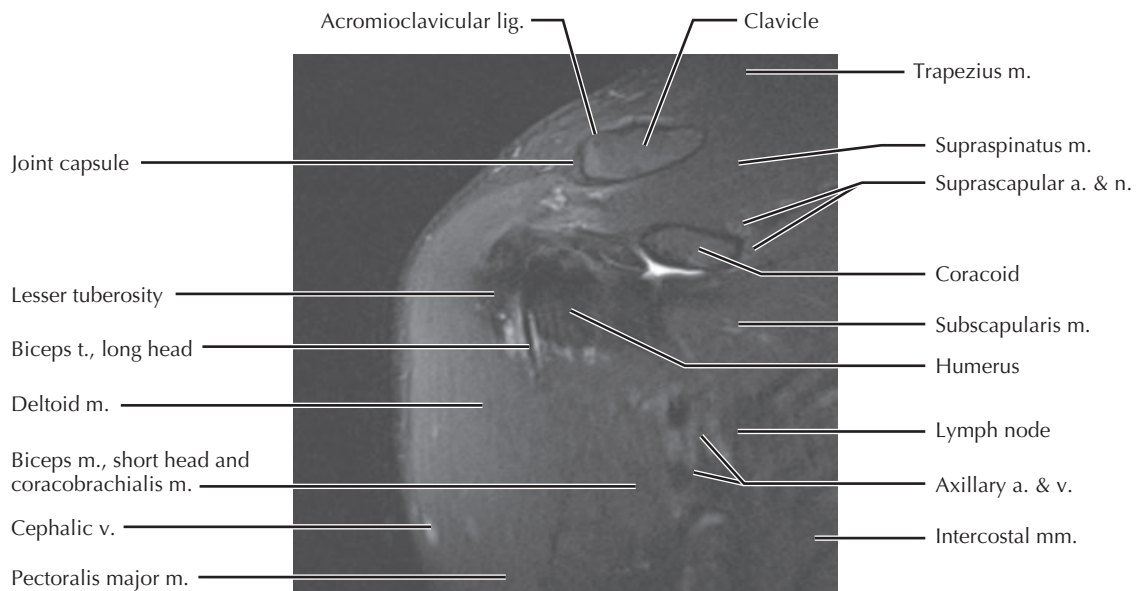
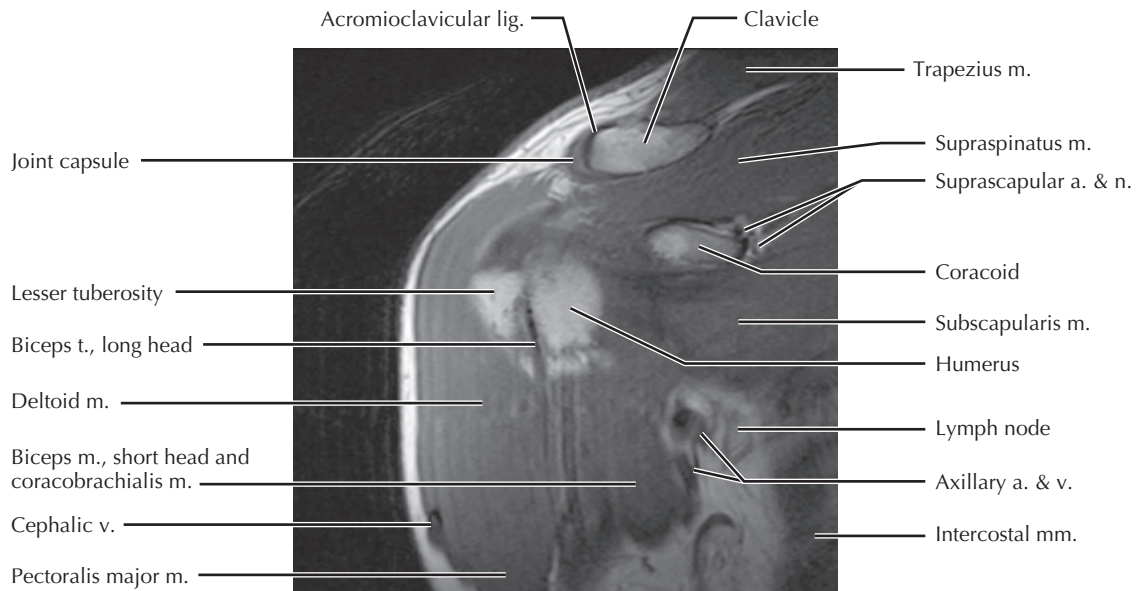
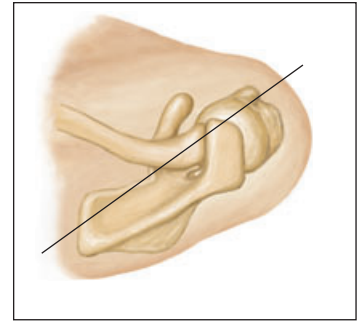
The suprascapular artery and nerve run inferior to the acromion in a groove in the scapula. This is a single continuous groove in the bone, although it is termed the *spinoglenoid notch* posteriorly and the *suprascapular notch* anteriorly.

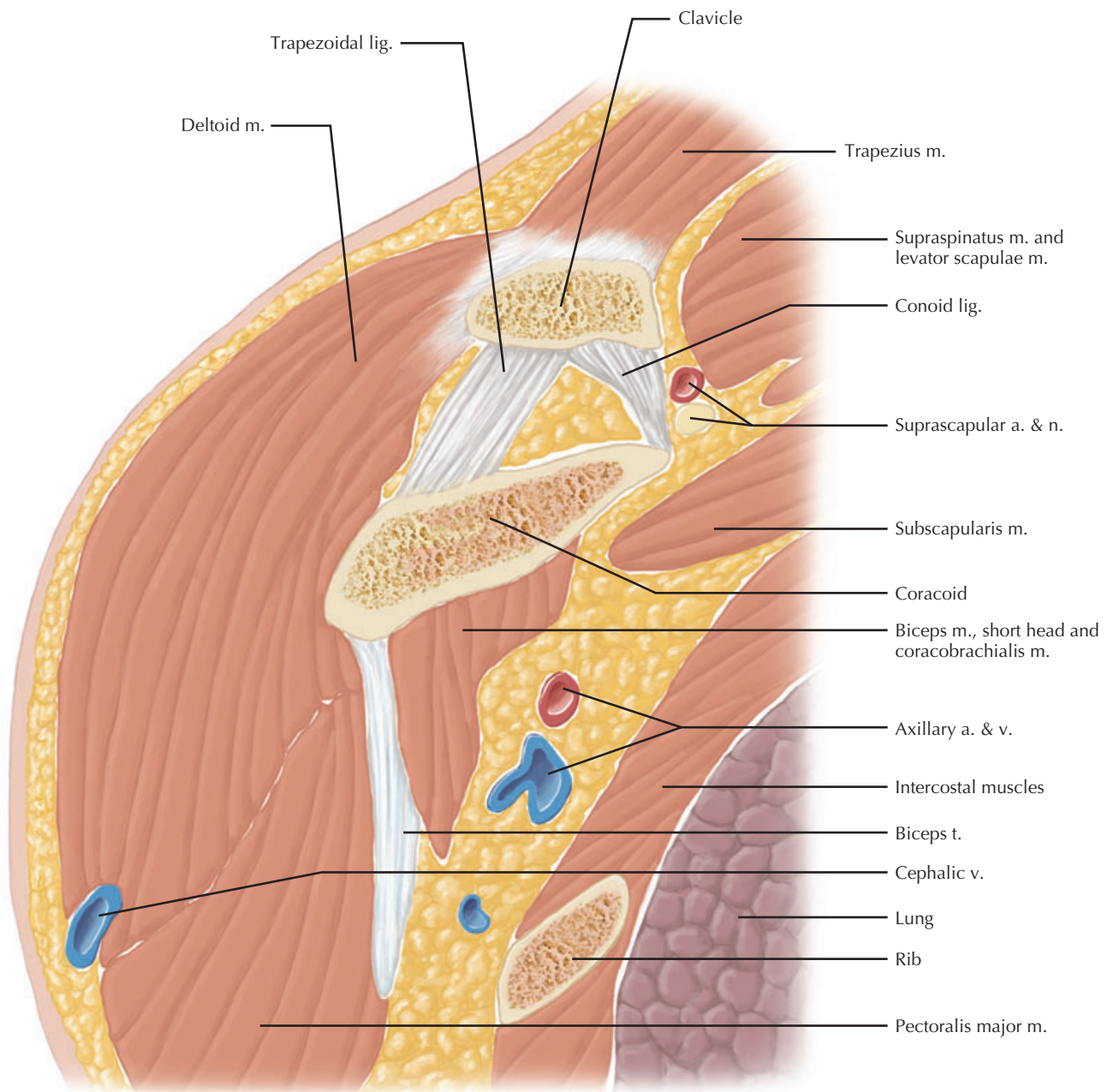


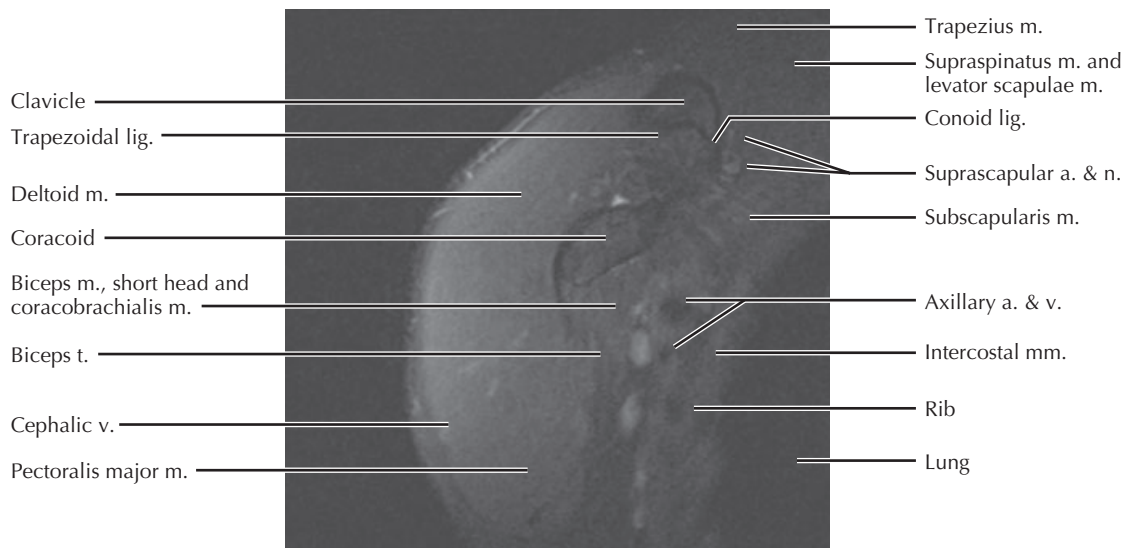
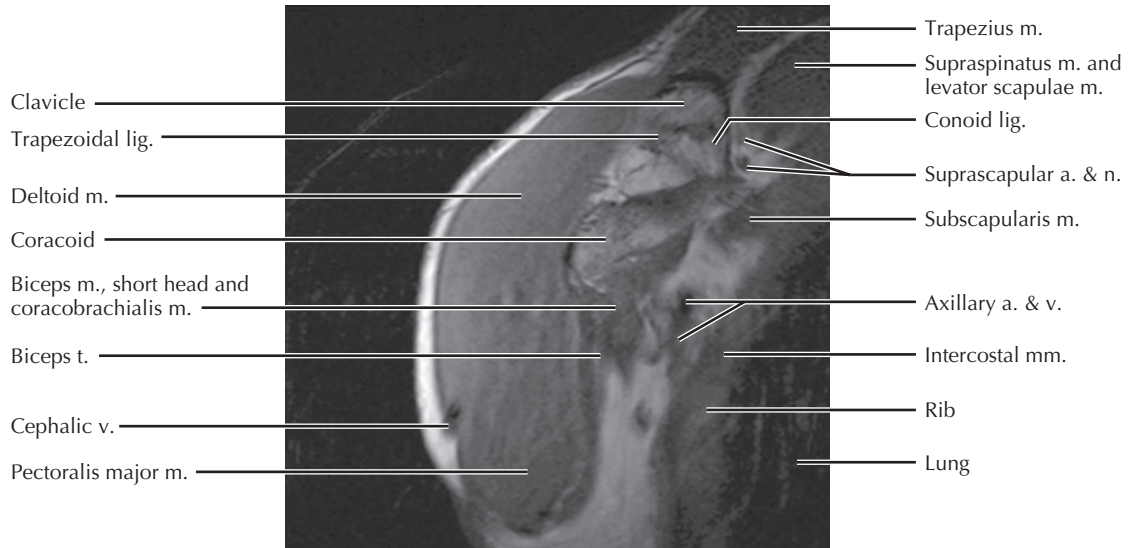
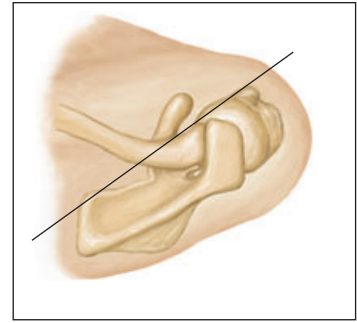


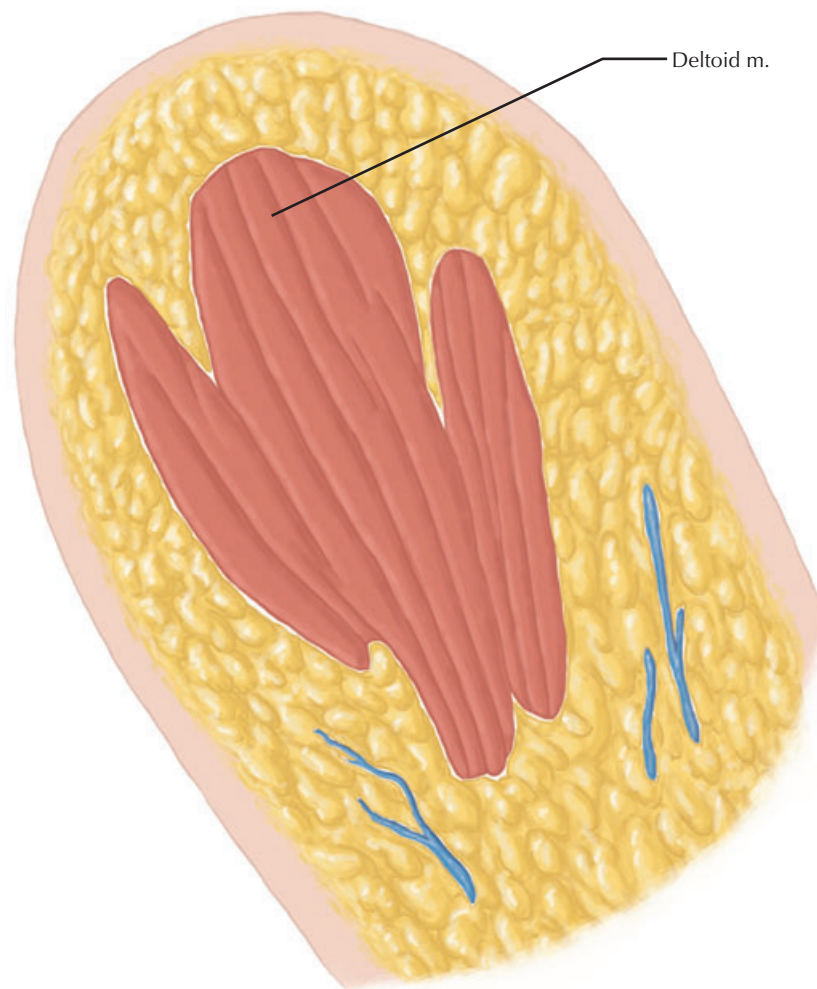
NORMAL ANATOMY

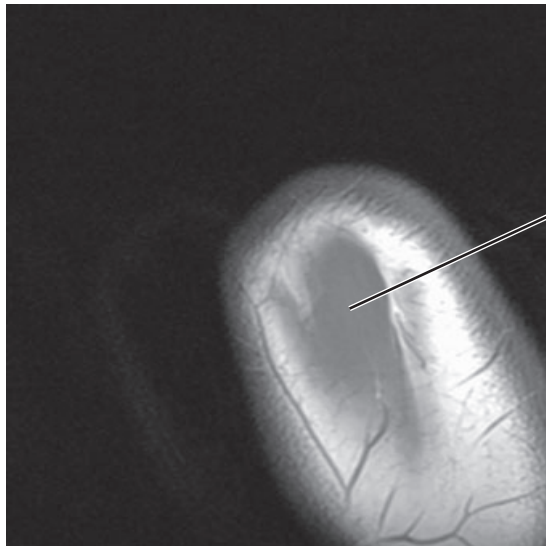
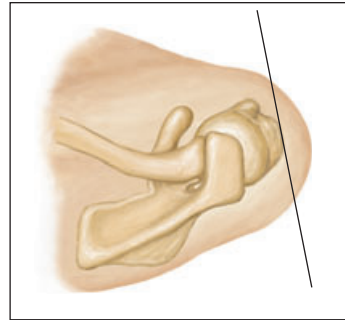
The glenohumeral ligaments are thickened bands of the joint capsule that strengthen the capsule anteriorly.



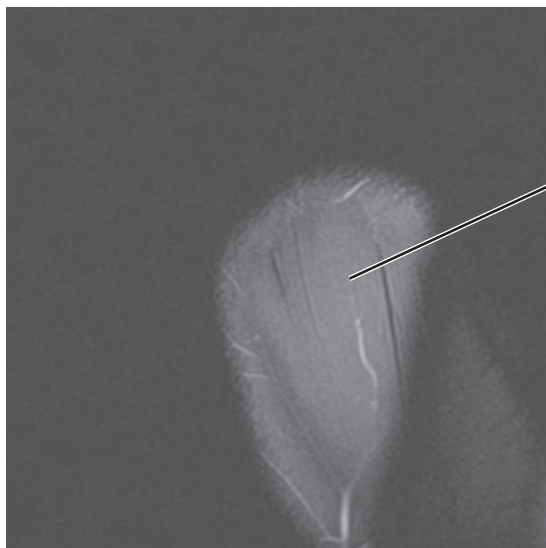




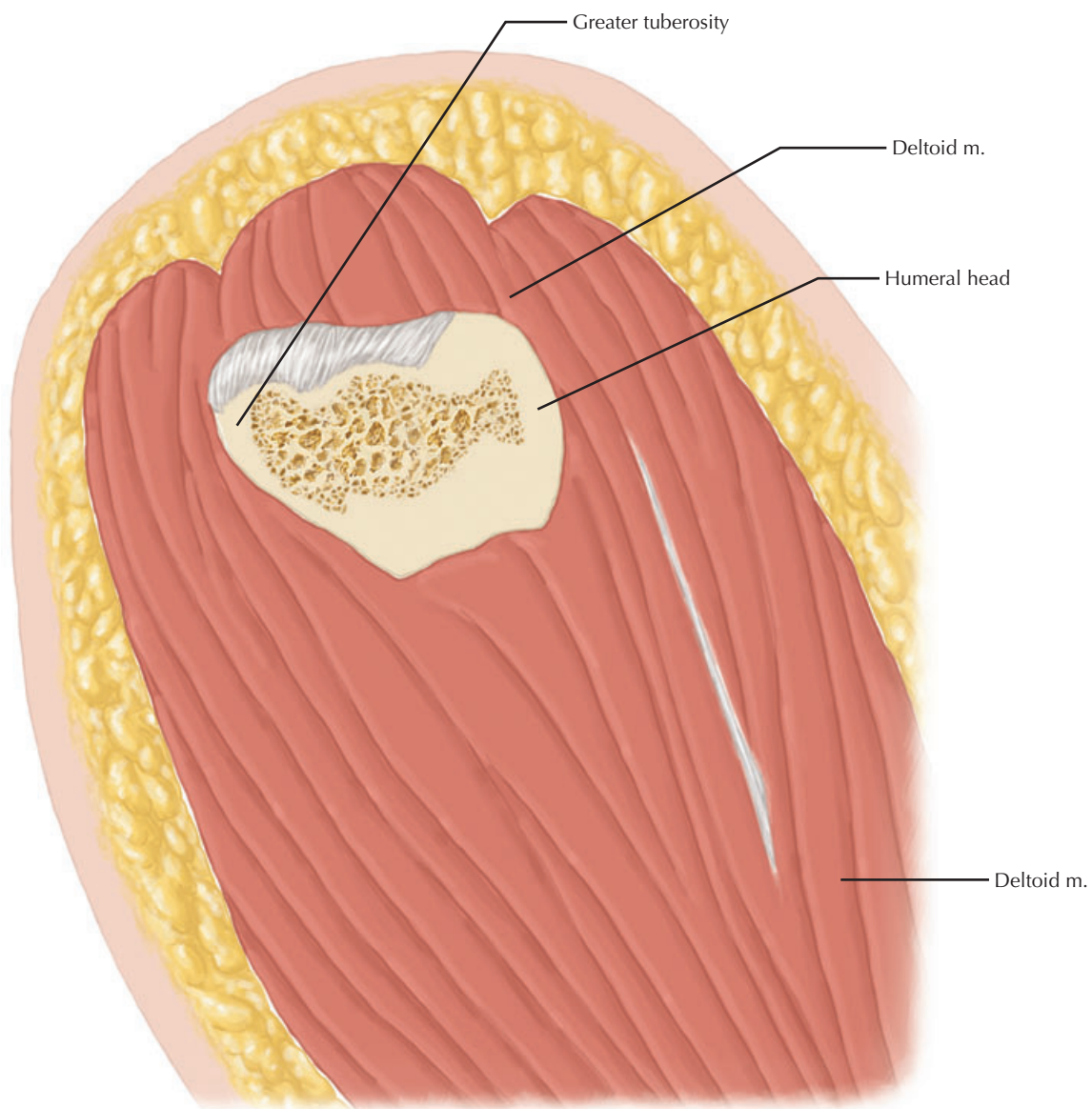


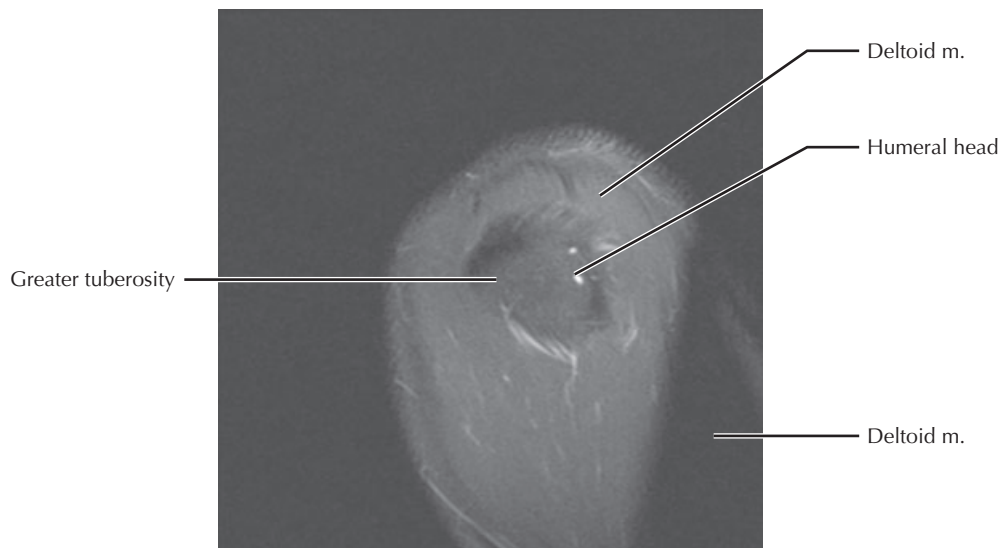
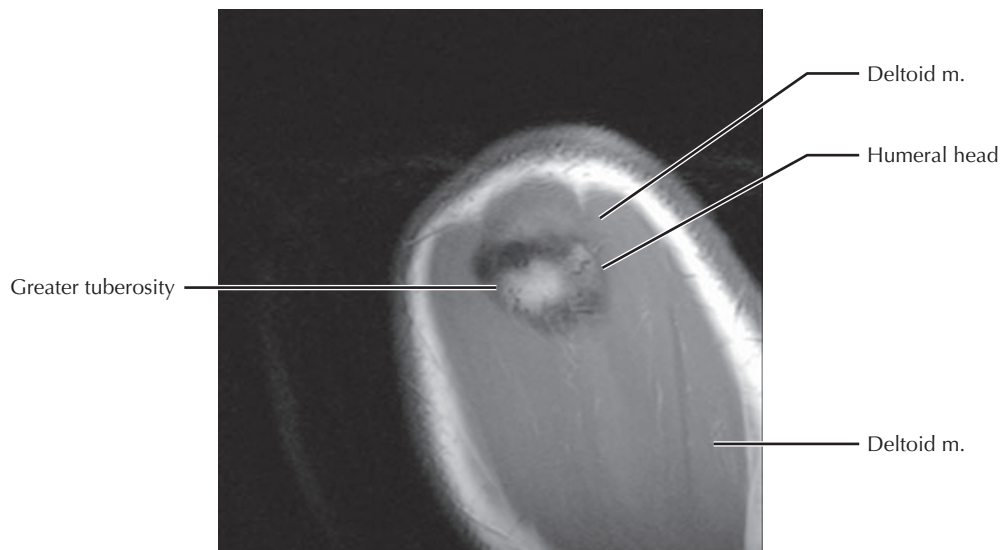
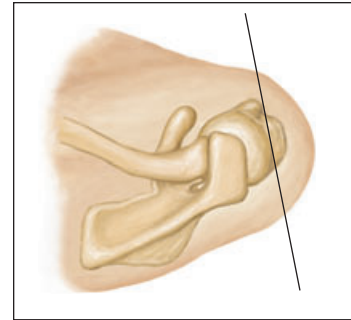


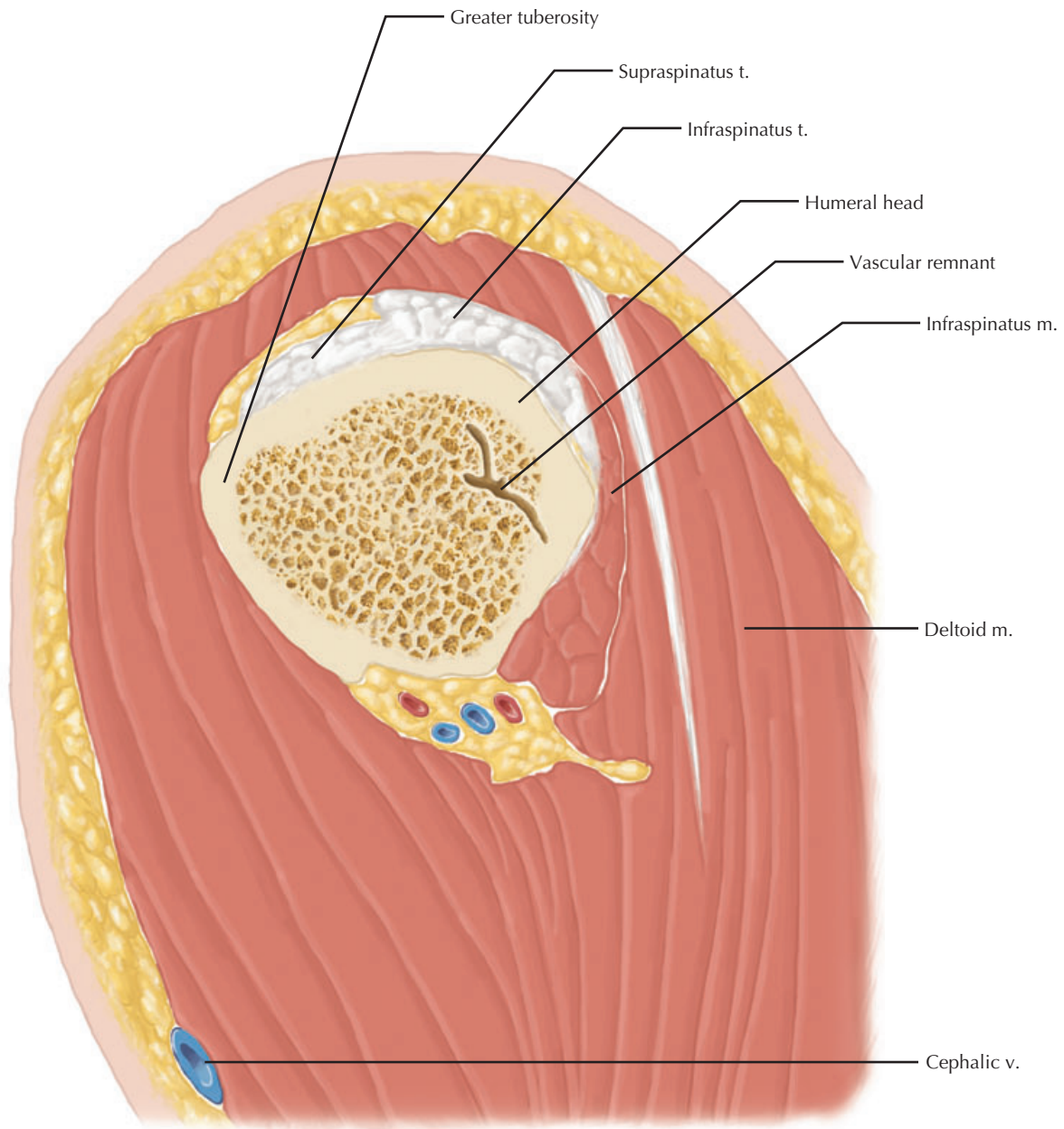
Deltoid m.

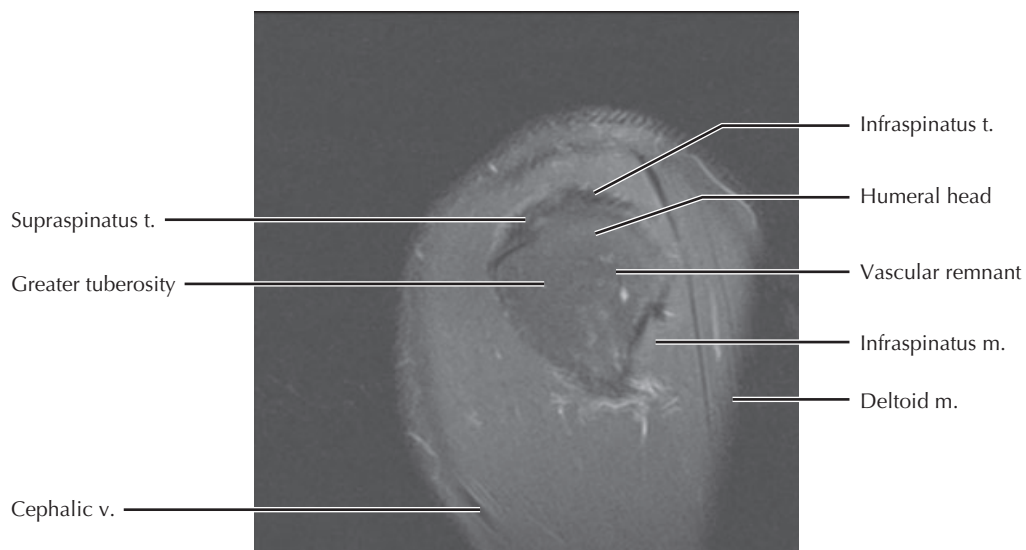
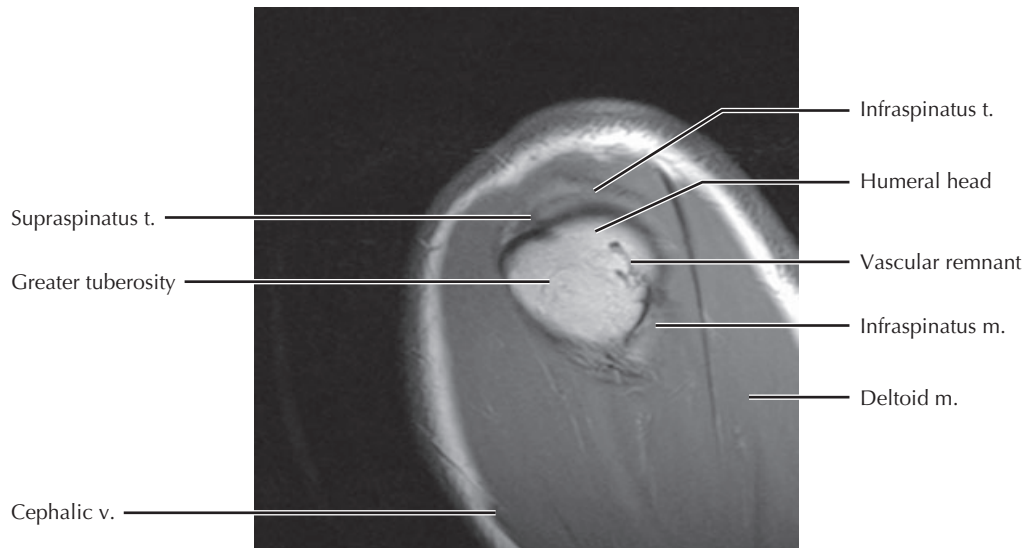
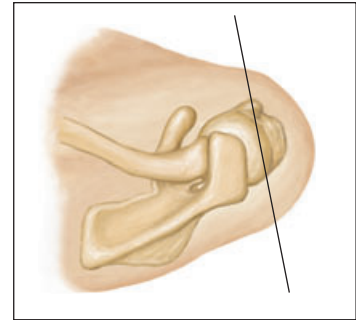


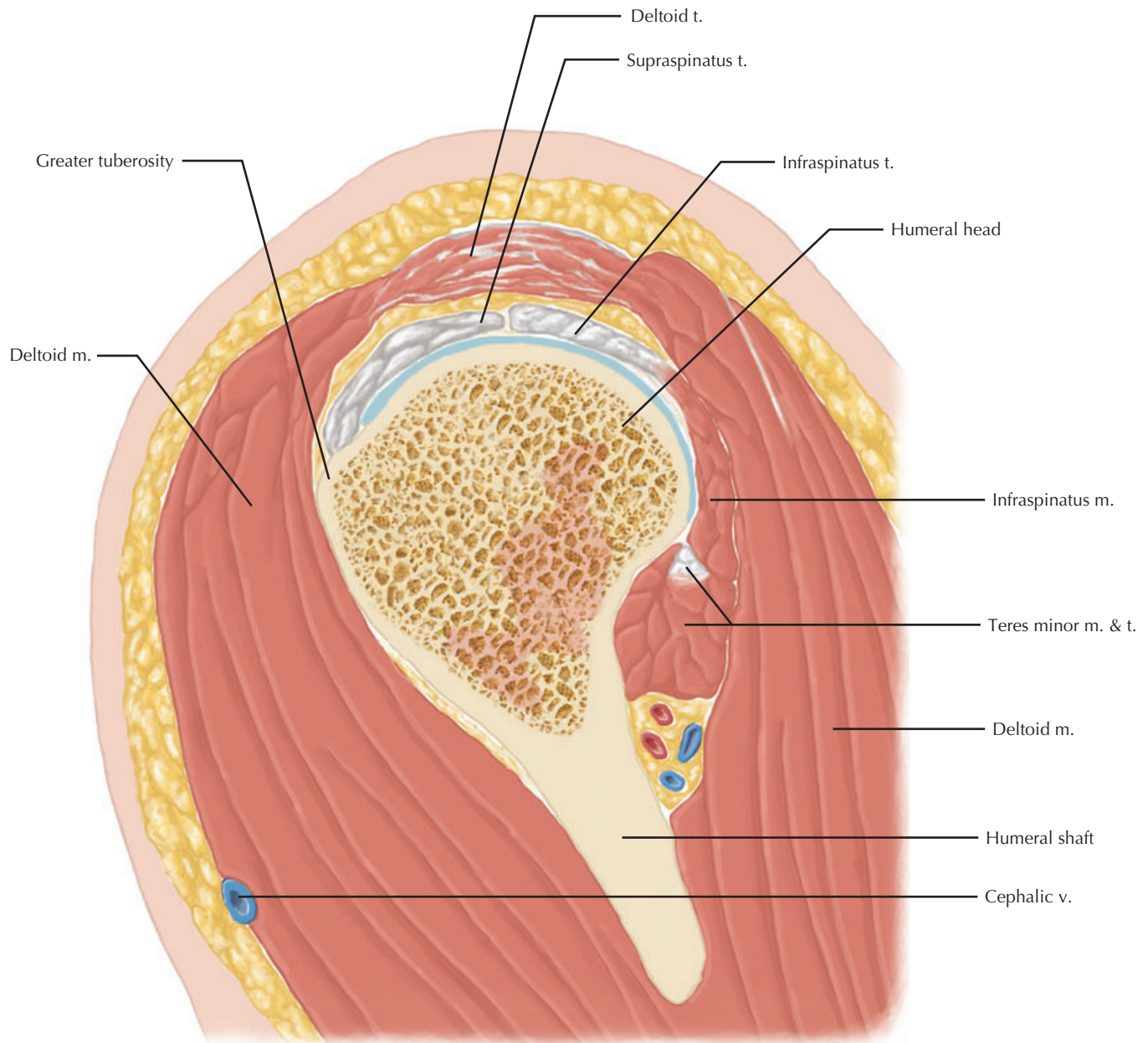
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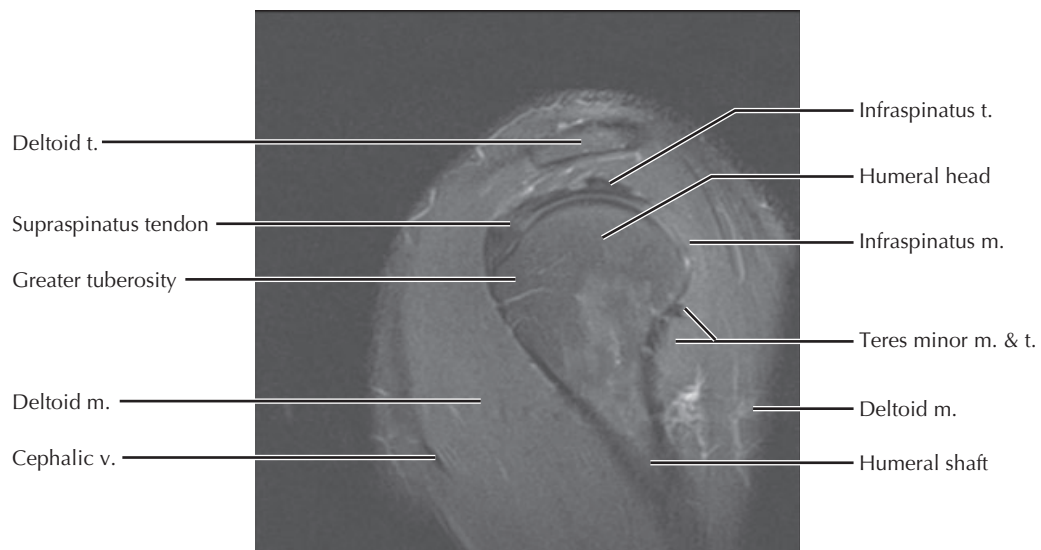
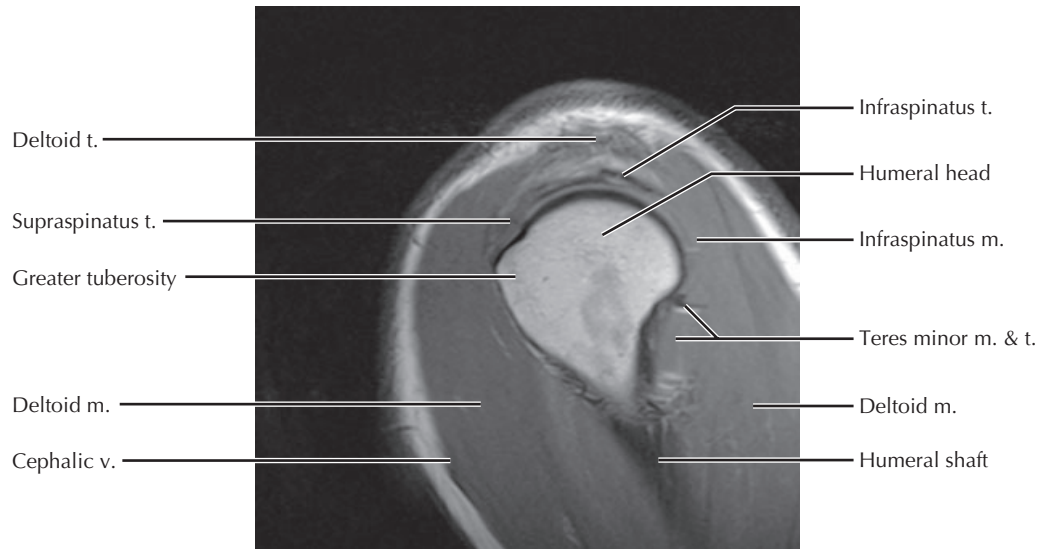
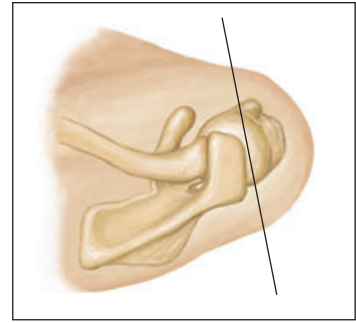


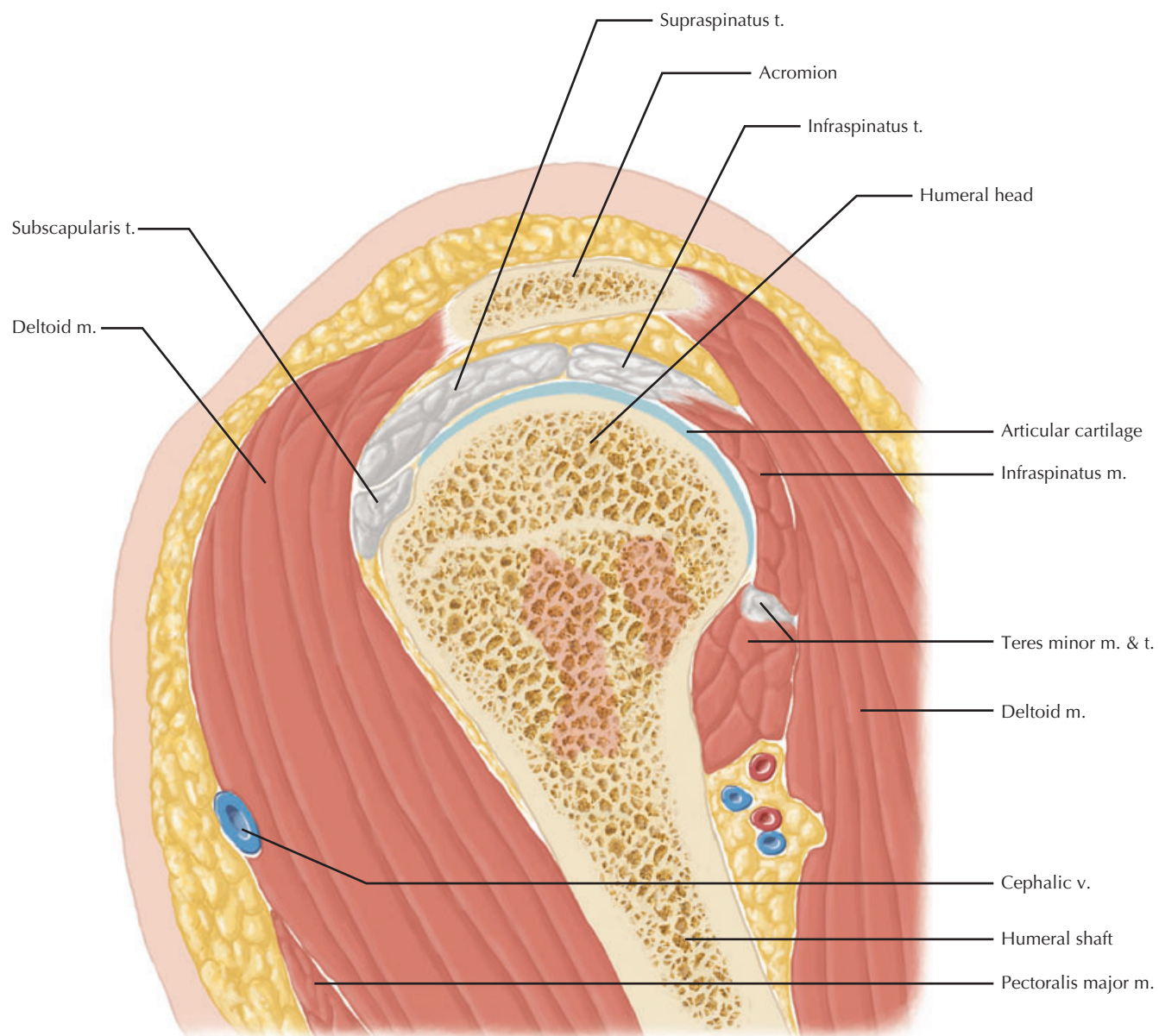


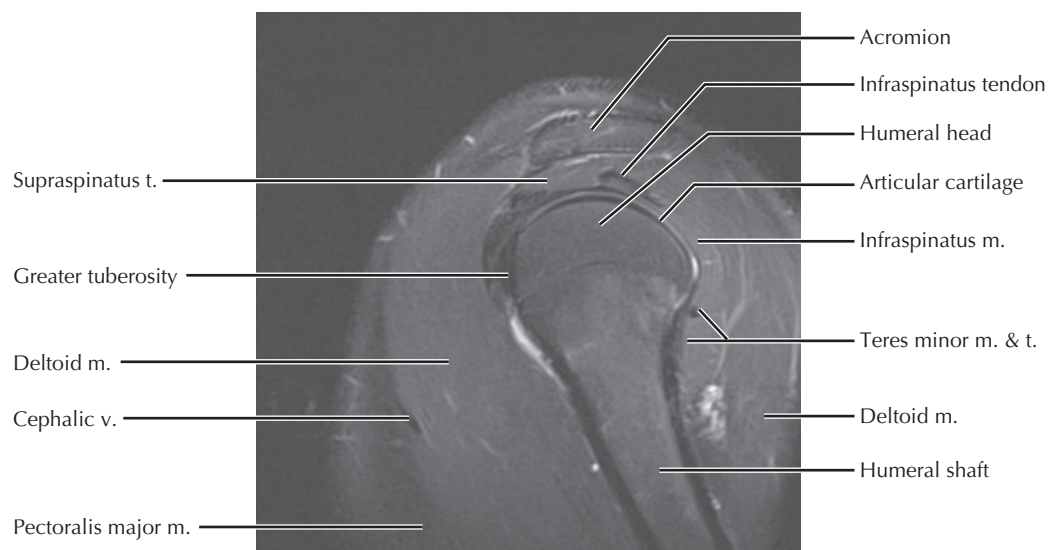
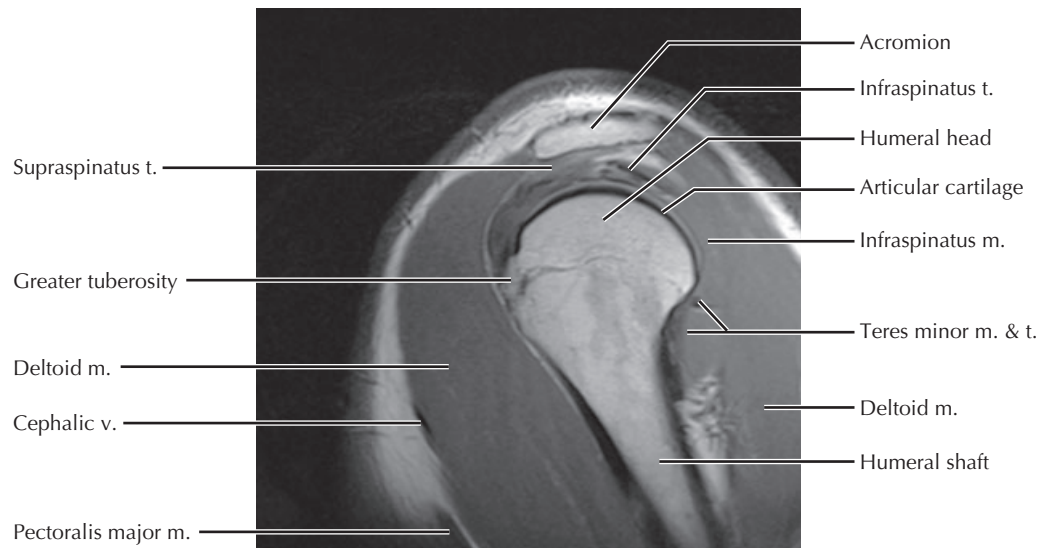
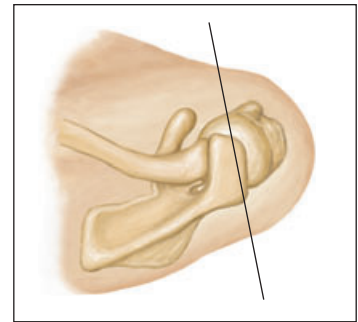


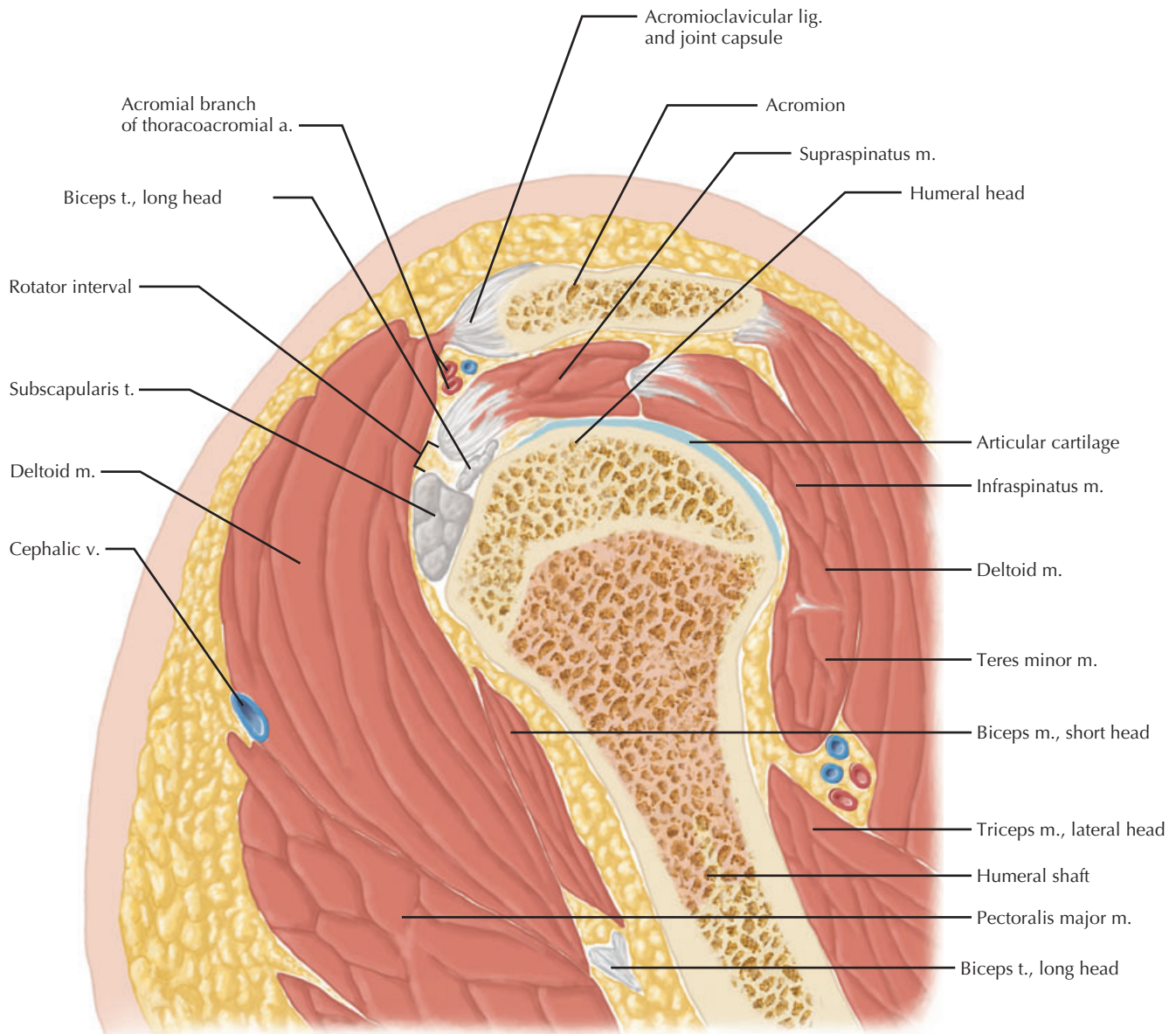






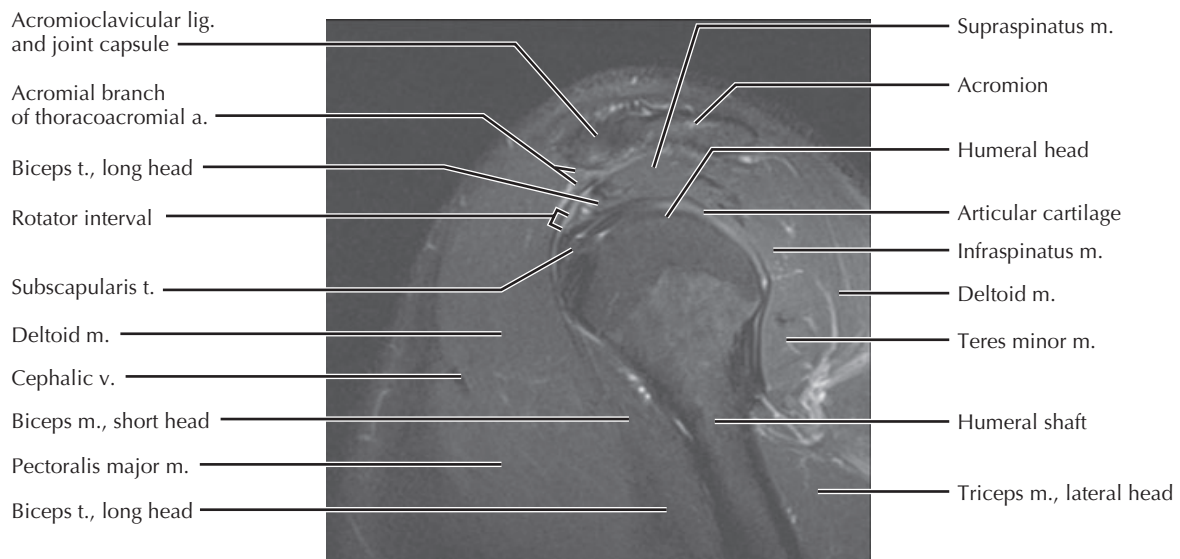
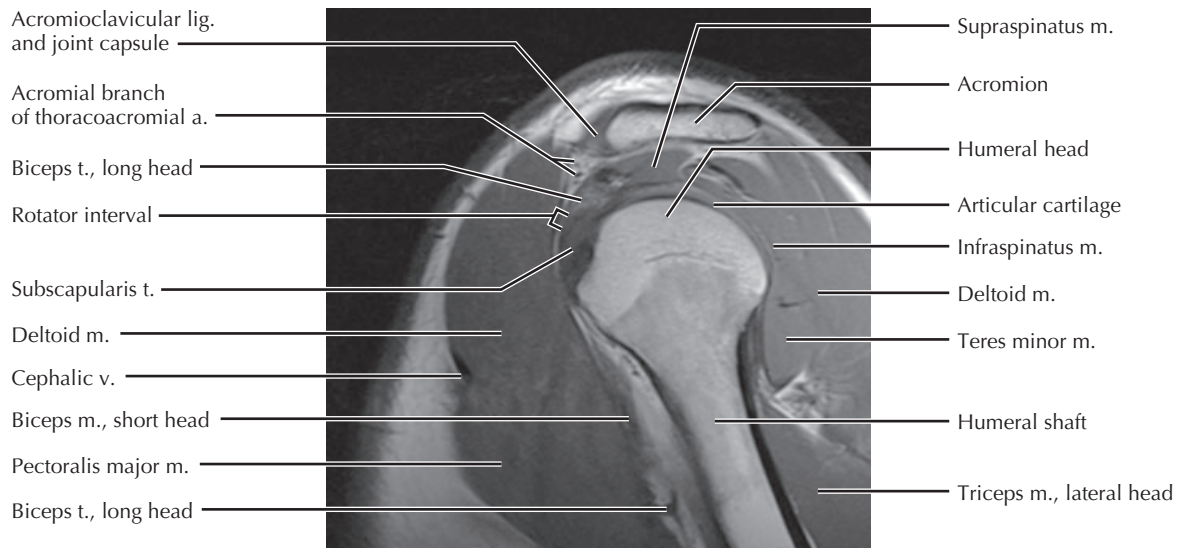
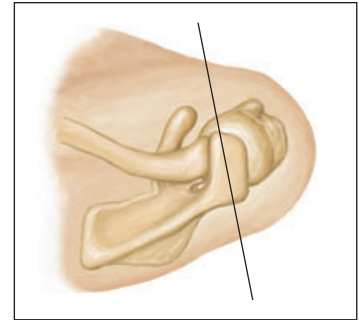


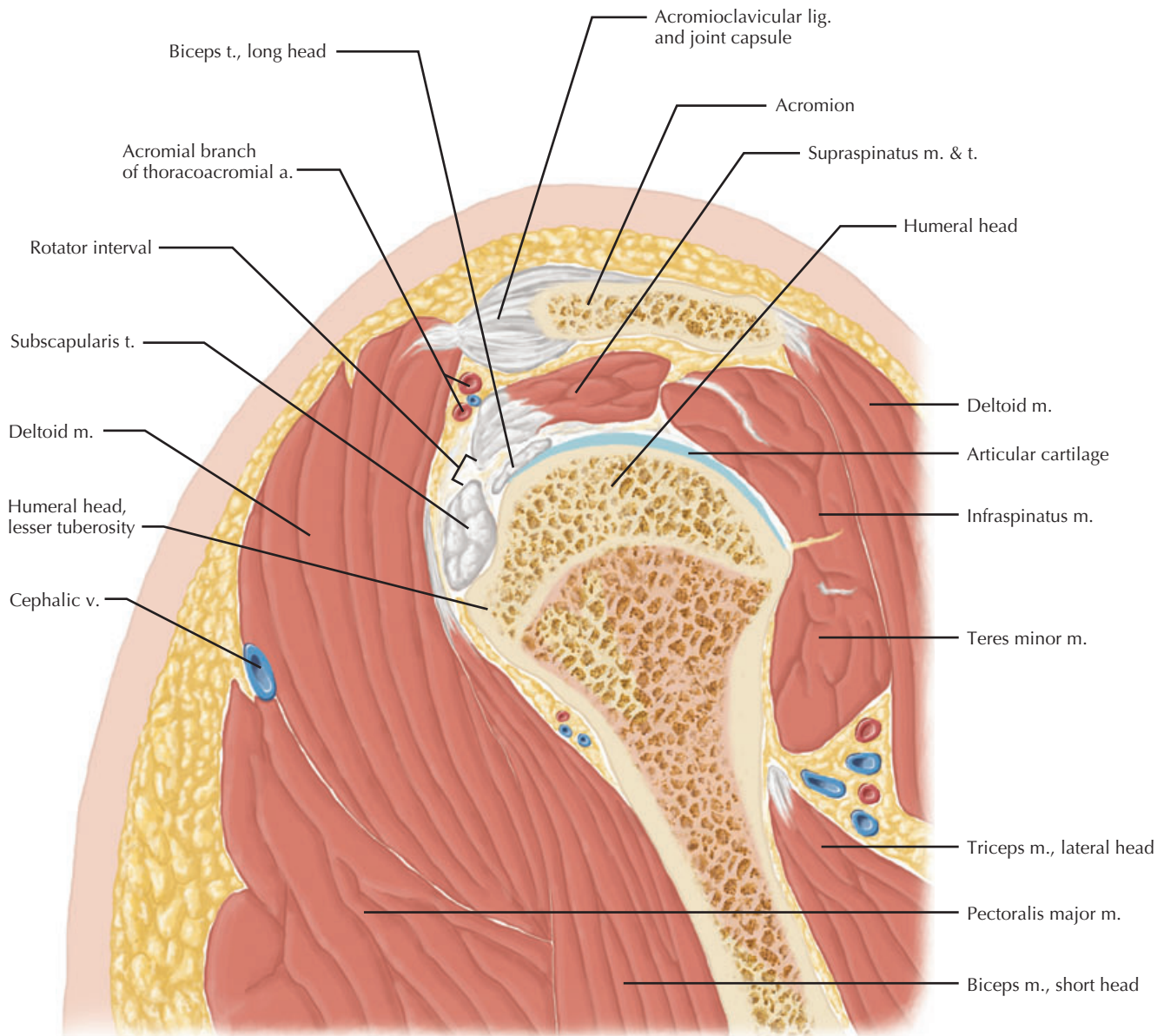




PATHOLOGIC PROCESS

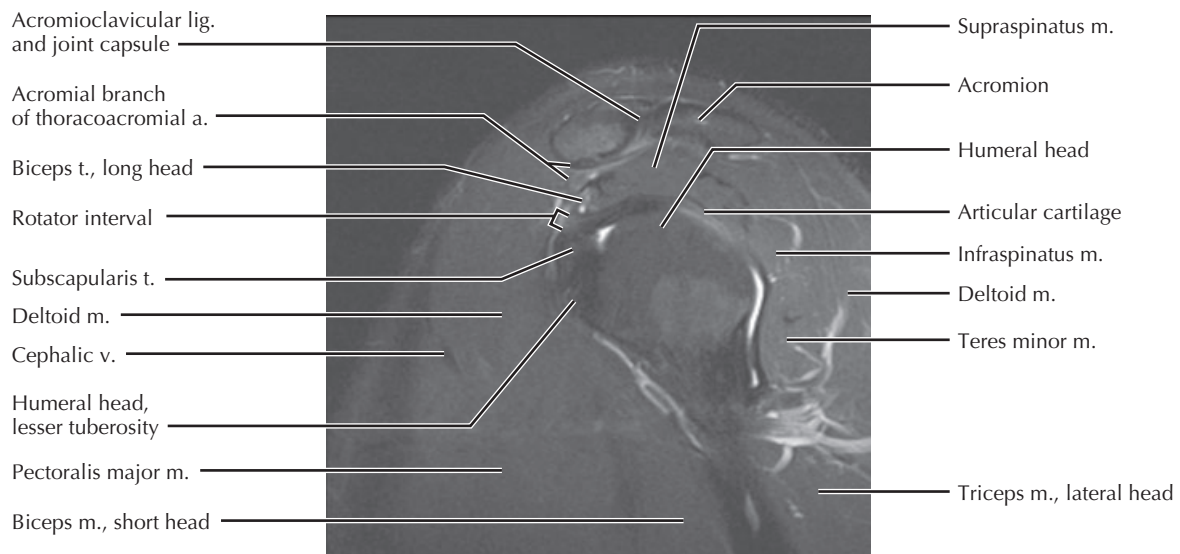
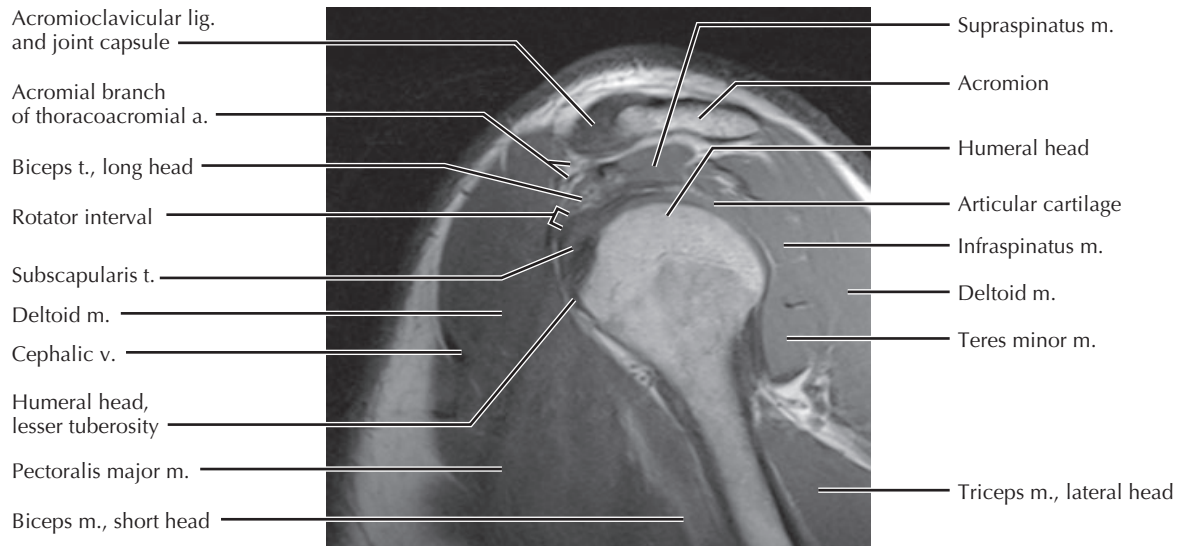
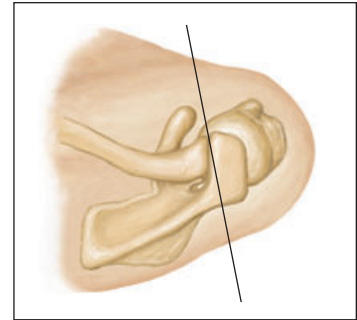
The normal "quadrilateral space" is bounded by the humerus medially, teres major inferiorly, teres minor superiorly, and long head of triceps laterally. The axillary nerve and posterior humeral circumflex artery travel through this space and can become compressed, resulting in quadrilateral space syndrome. With an incidence of 0.8%, this syndrome is diagnosed most often by finding atrophy on T1-weighted MR images in the teres minor and less often in the deltoid. Rarely, quadrilateral space syndrome presents with high signal without atrophy on T2-weighted images in these muscles.

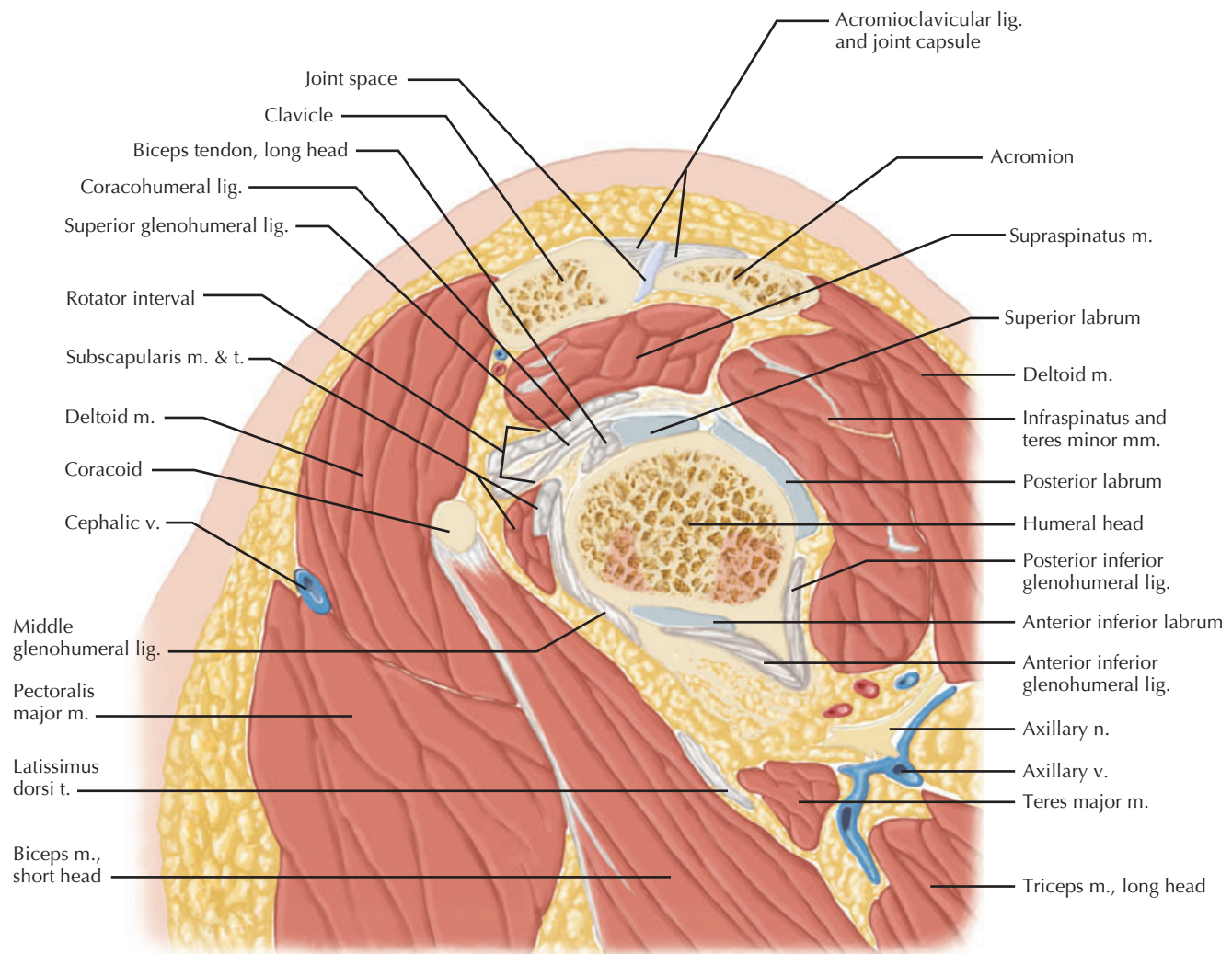




PATHOLOGIC PROCESS

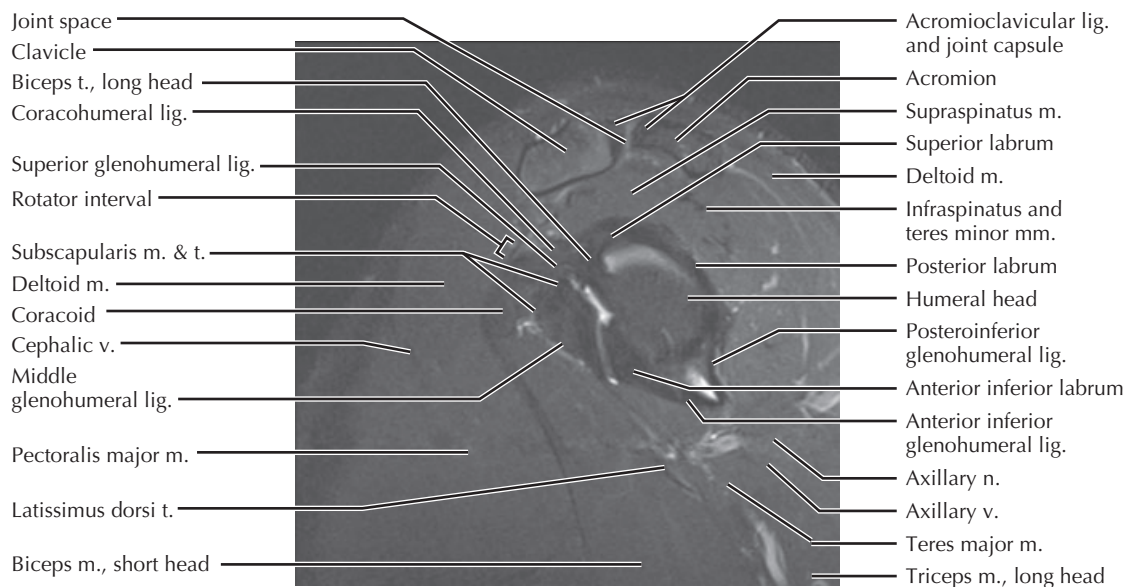
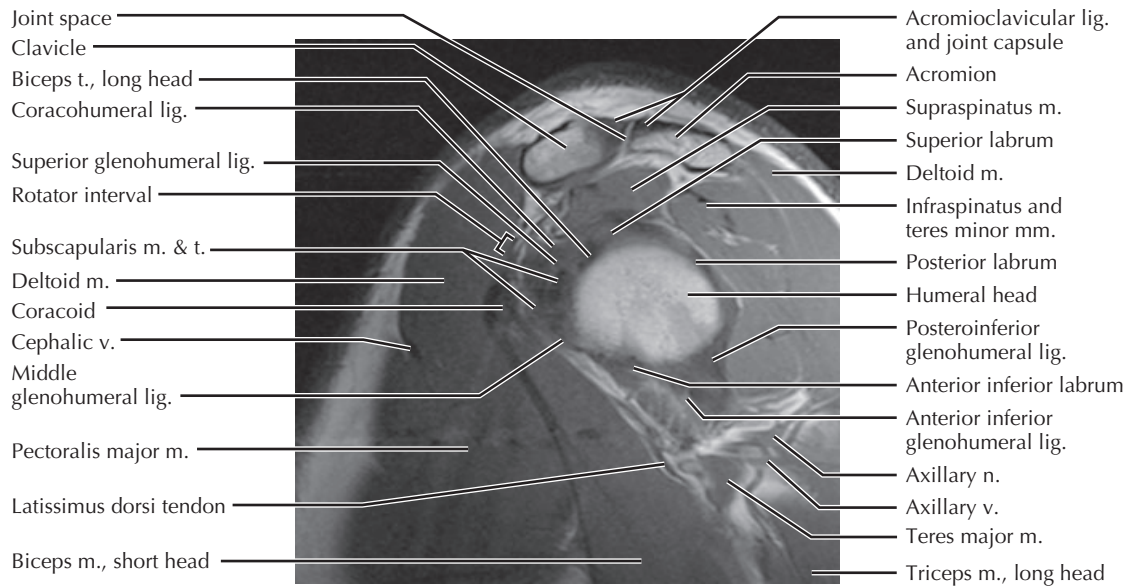
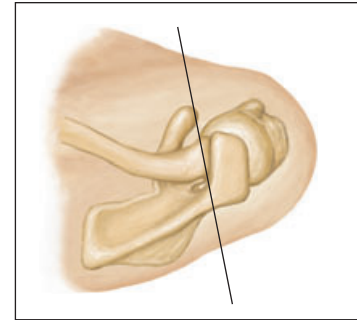
Parsonage-Turner syndrome (also called brachial neuritis or neuralgic amyotrophy) is characterized clinically by acute pain across the top of the shoulder, followed by weakness in the shoulder girdle muscles. Neurogenic edema is identified on MRI as increased signal in one or more muscle bellies on T2-weighted images. The supraspinatus and infraspinatus muscles are most frequently involved, and these diagnostic findings are most dramatically depicted on sagittal images.

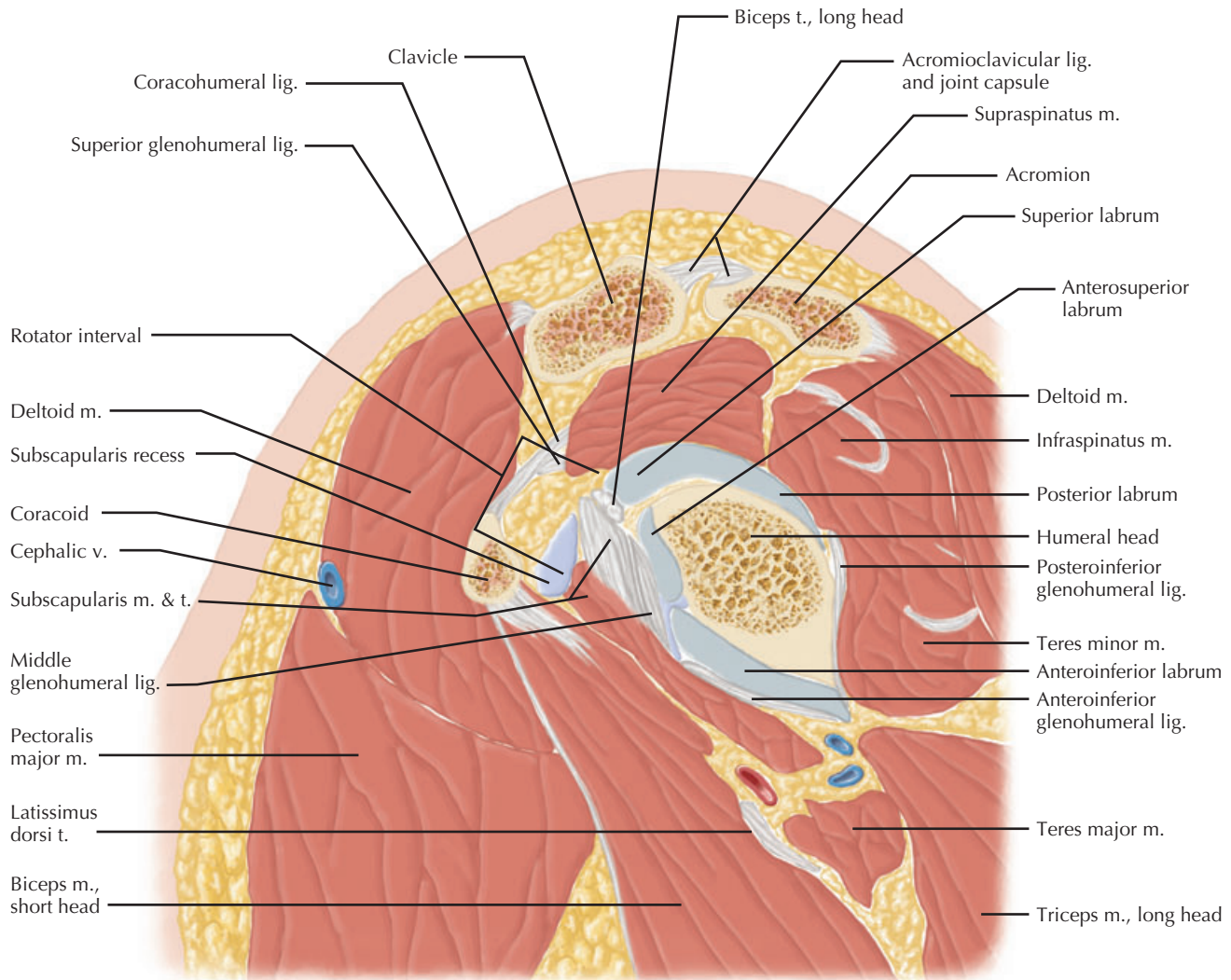




PATHOLOGIC PROCESS

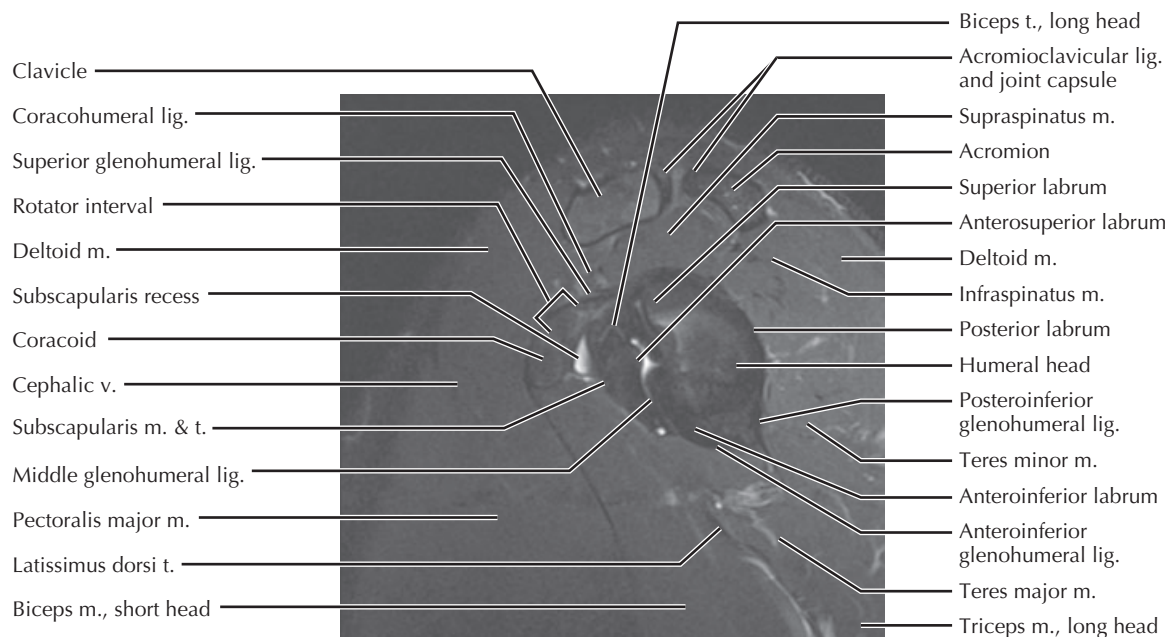
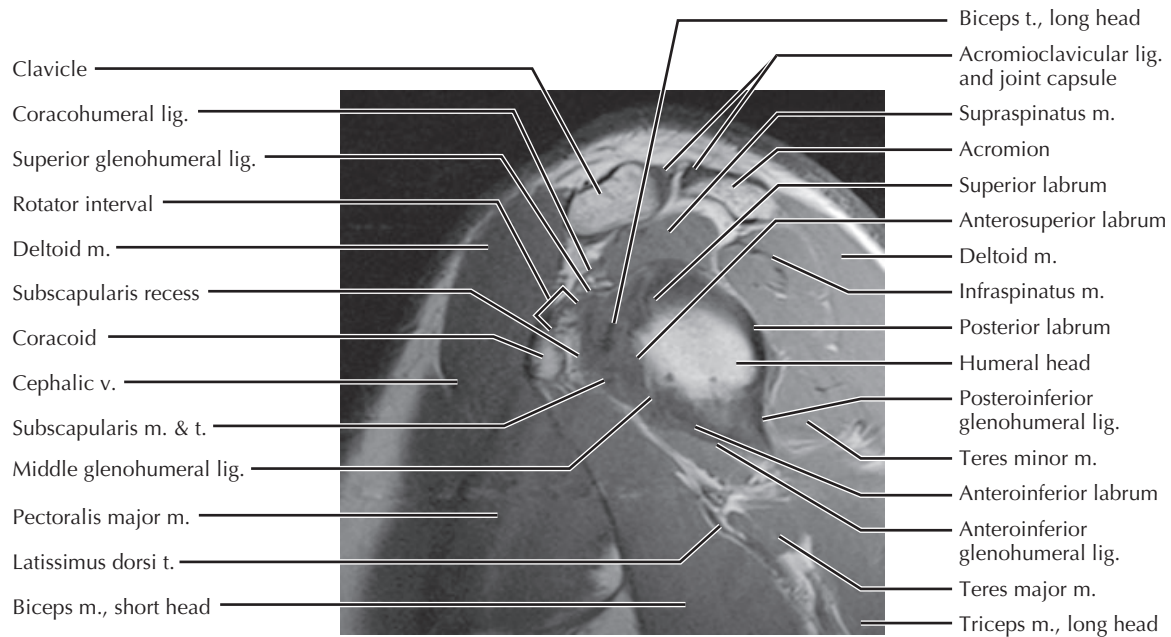
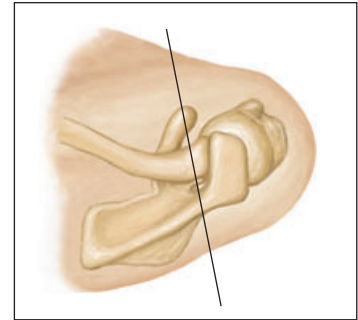
Several processes can lead to increased signal within the infraspinatus muscle on T2-weighted MR images. These include masses within the spinoglenoid notch, Parsonage-Turner syndrome, and trauma. Most often, neurogenic edema in the infraspinatus results from a perilabral cyst compressing the suprascapular nerve in the spinoglenoid notch. Varices in the spinoglenoid notch have also been implicated.

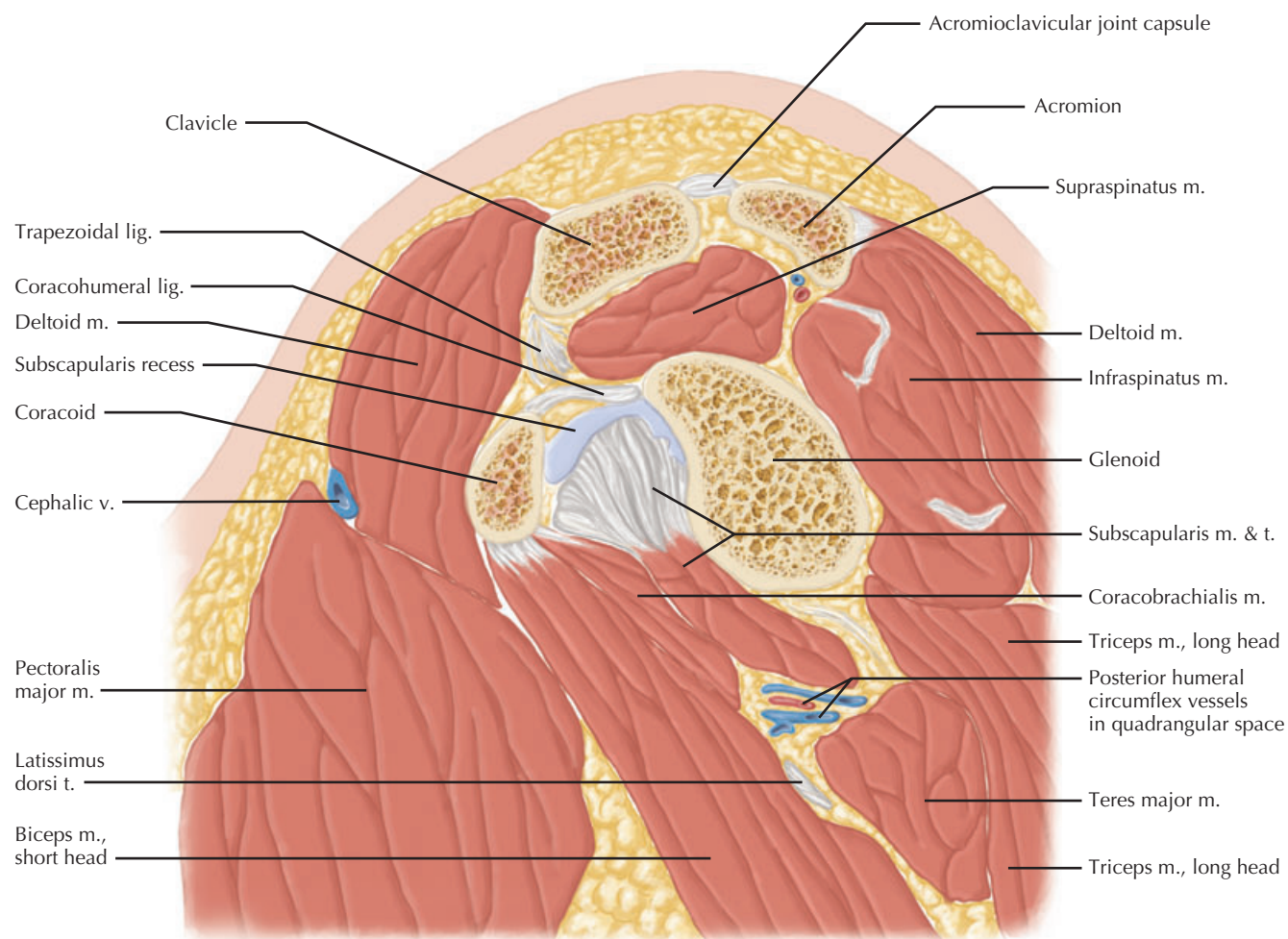


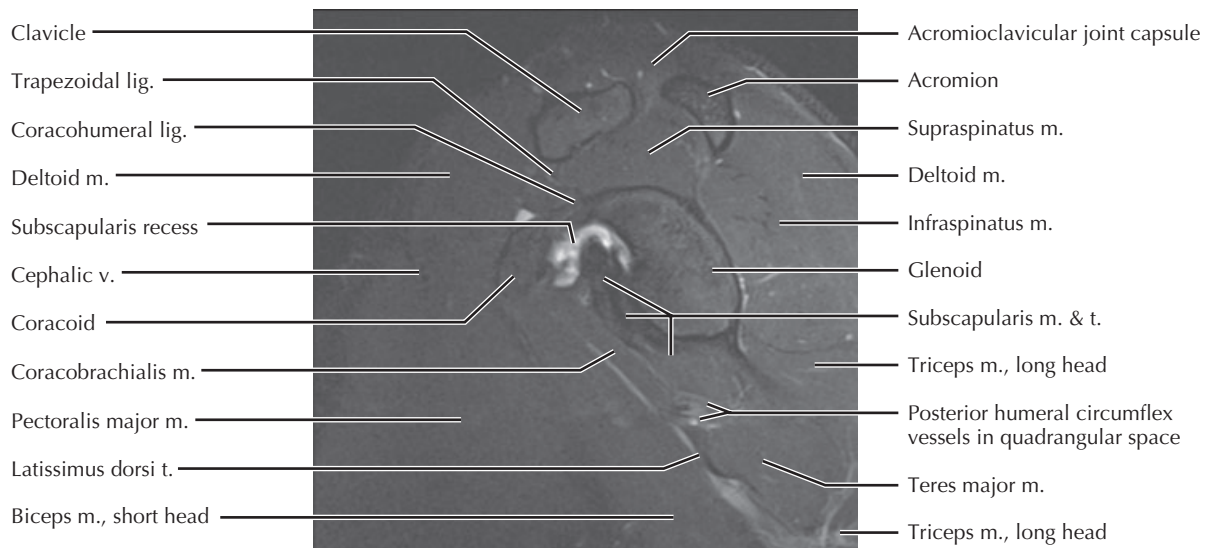
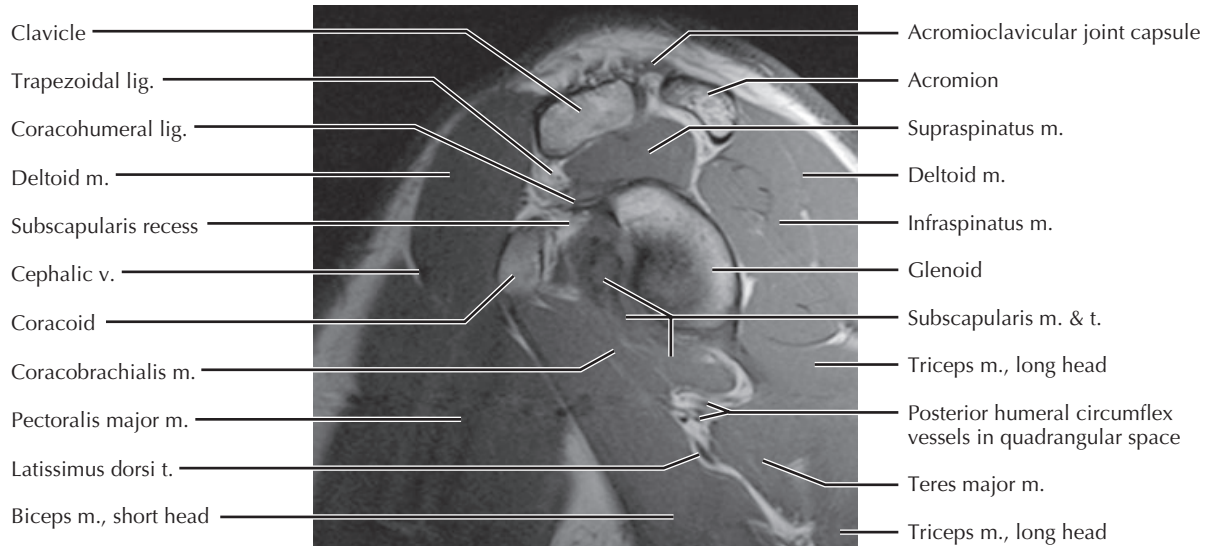
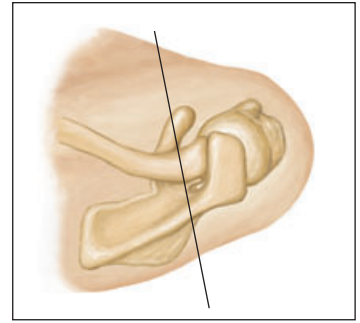


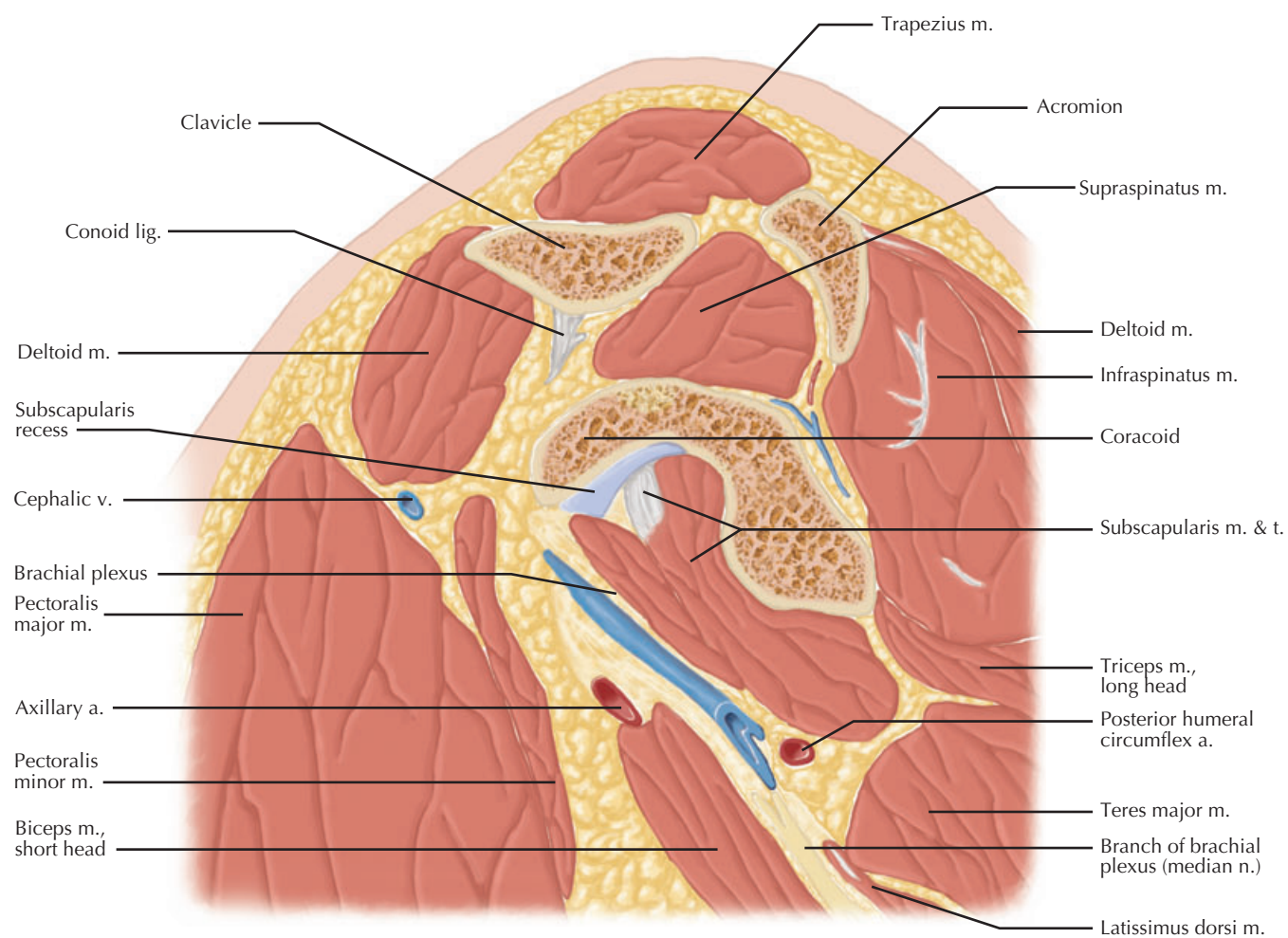
PATHOLOGIC PROCESS

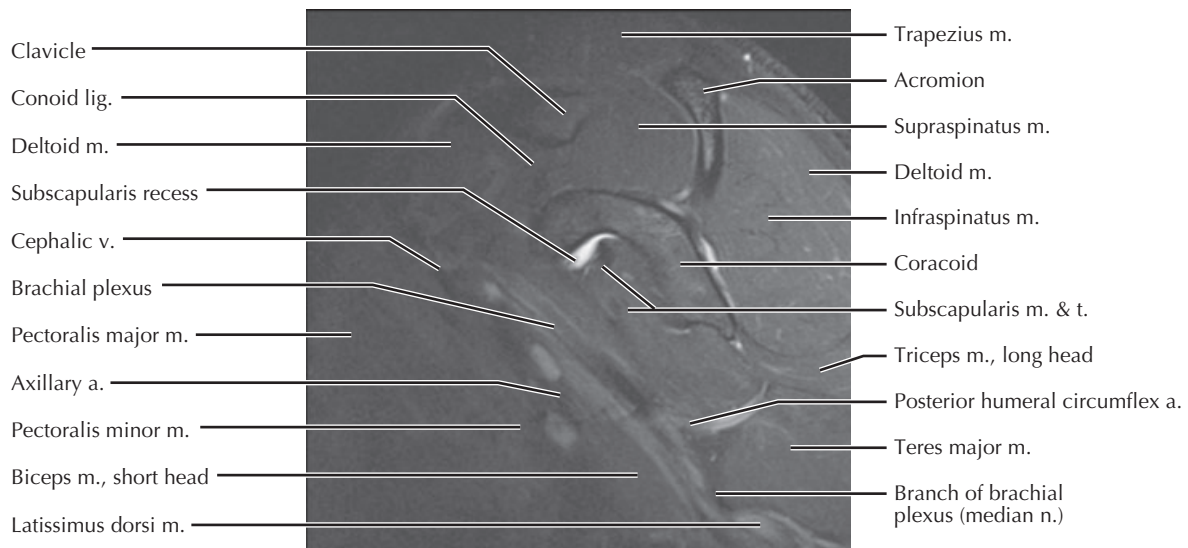
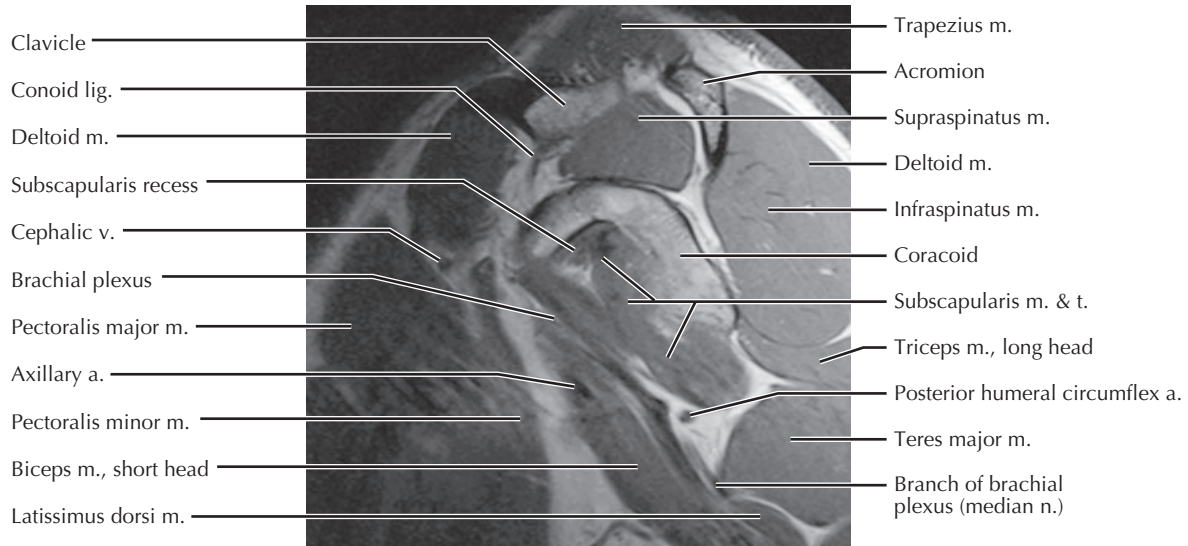
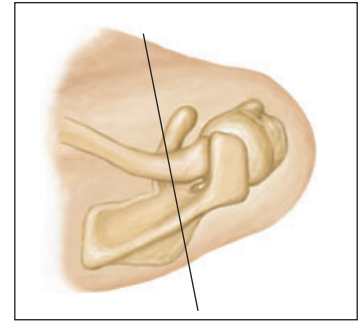
Two important pathologic processes can involve the "rotator interval." Well visualized on this image, the rotator interval is the fat-filled triangular space between the inferior border of the supraspinatus muscle and the superior border of the subscapularis tendon. This space contains the long head of the biceps tendon, the superior glenohumeral ligament, and the coracohumeral ligament. The rotator interval is implicated in adhesive capsulitis, as evidenced by replacement of the fat with intermediate signal on T1-weighted MR images. The presence of fluid in this space suggests rotator interval laxity.









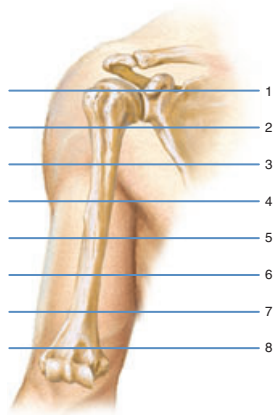


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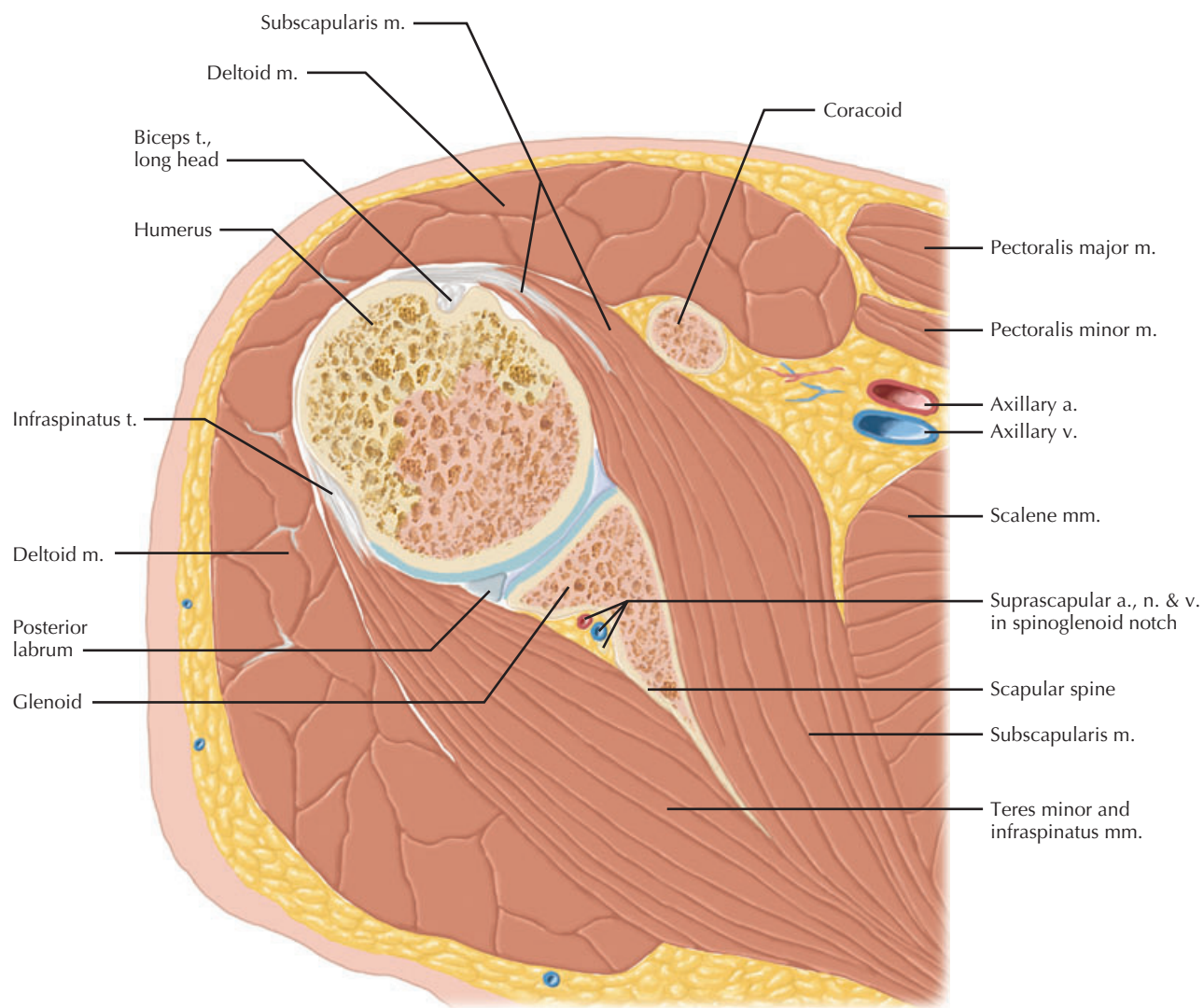
Chapter

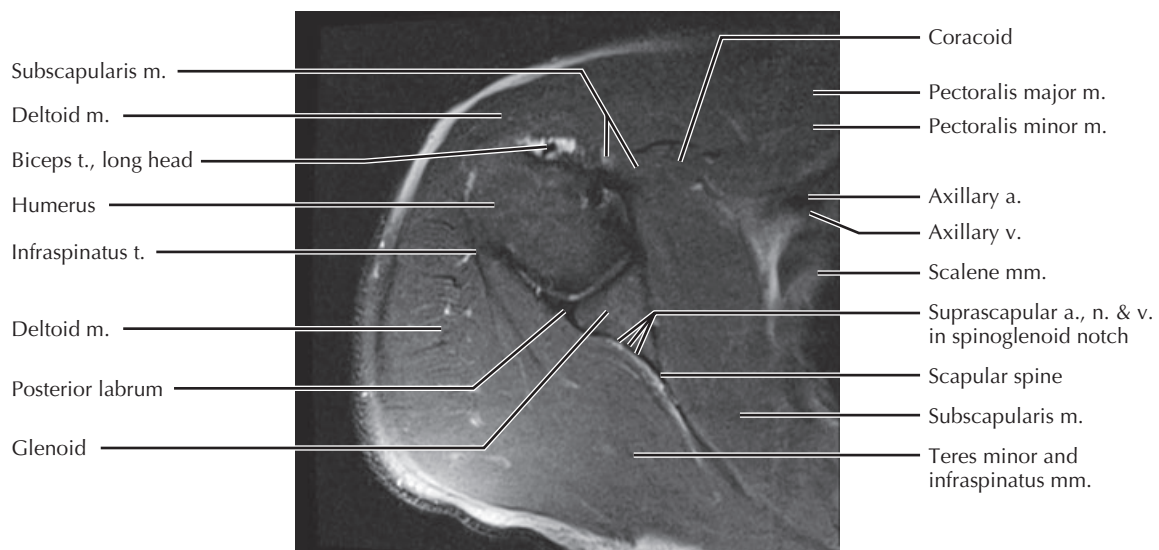
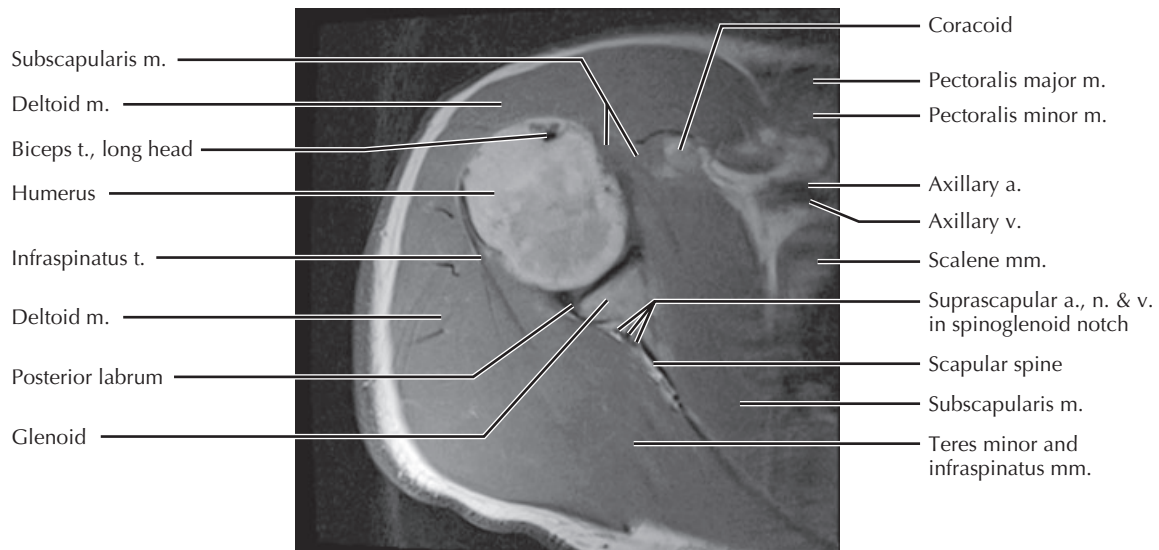
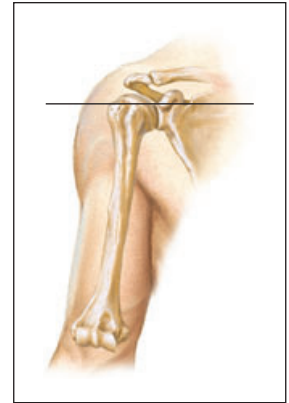
3

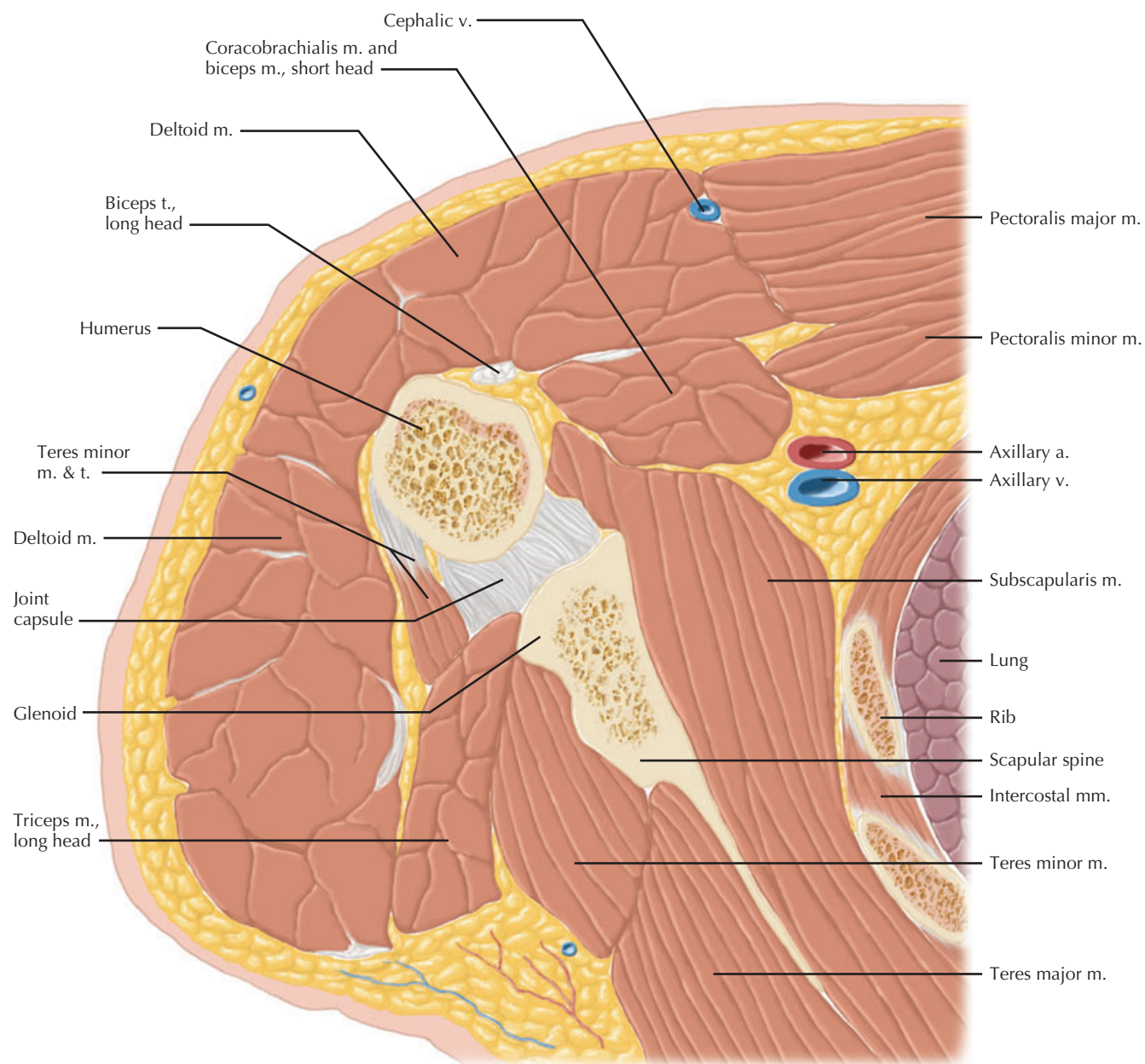
UPPER ARM

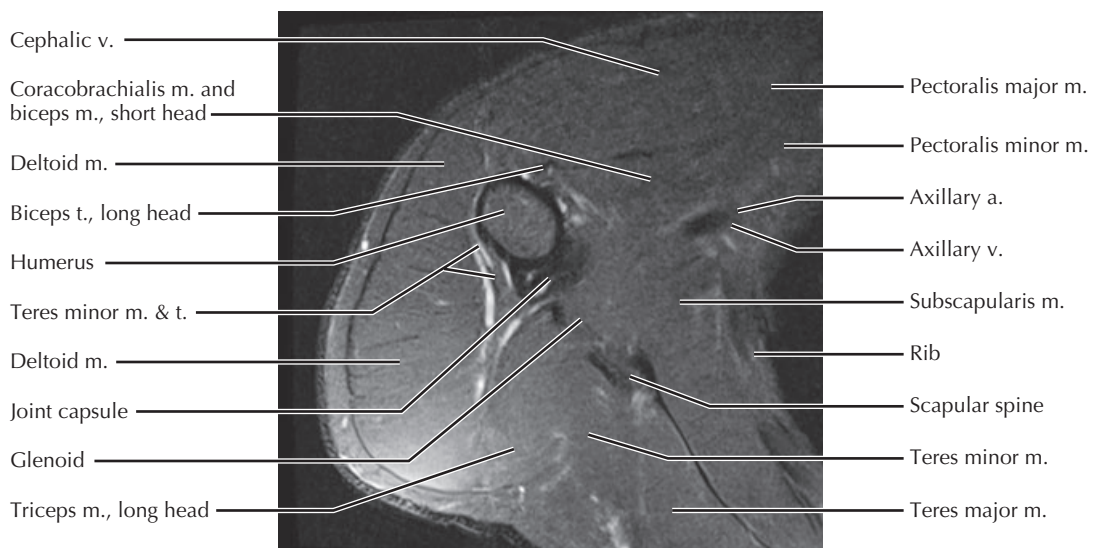
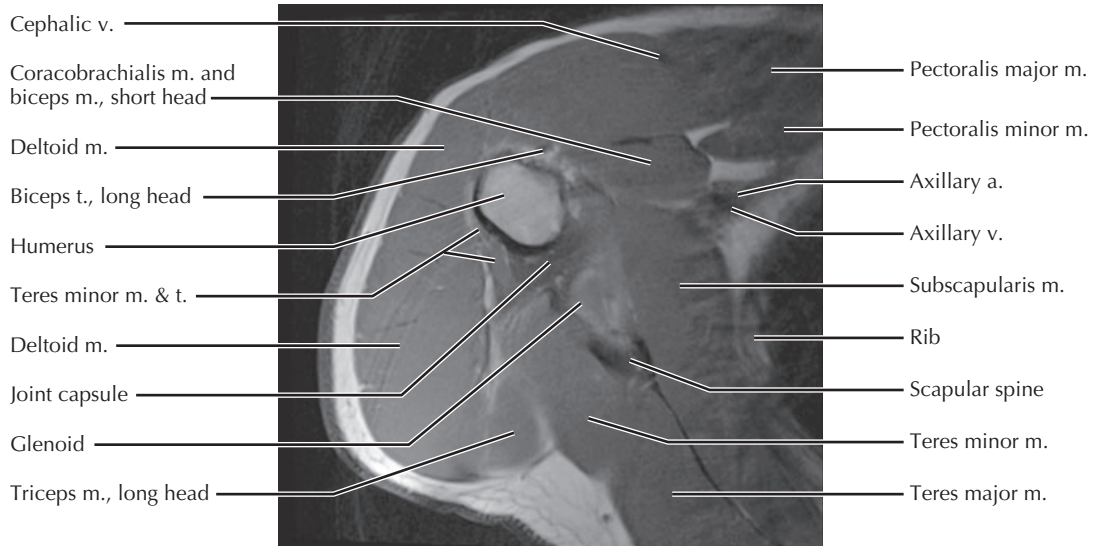
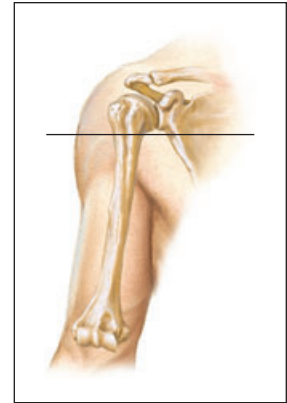


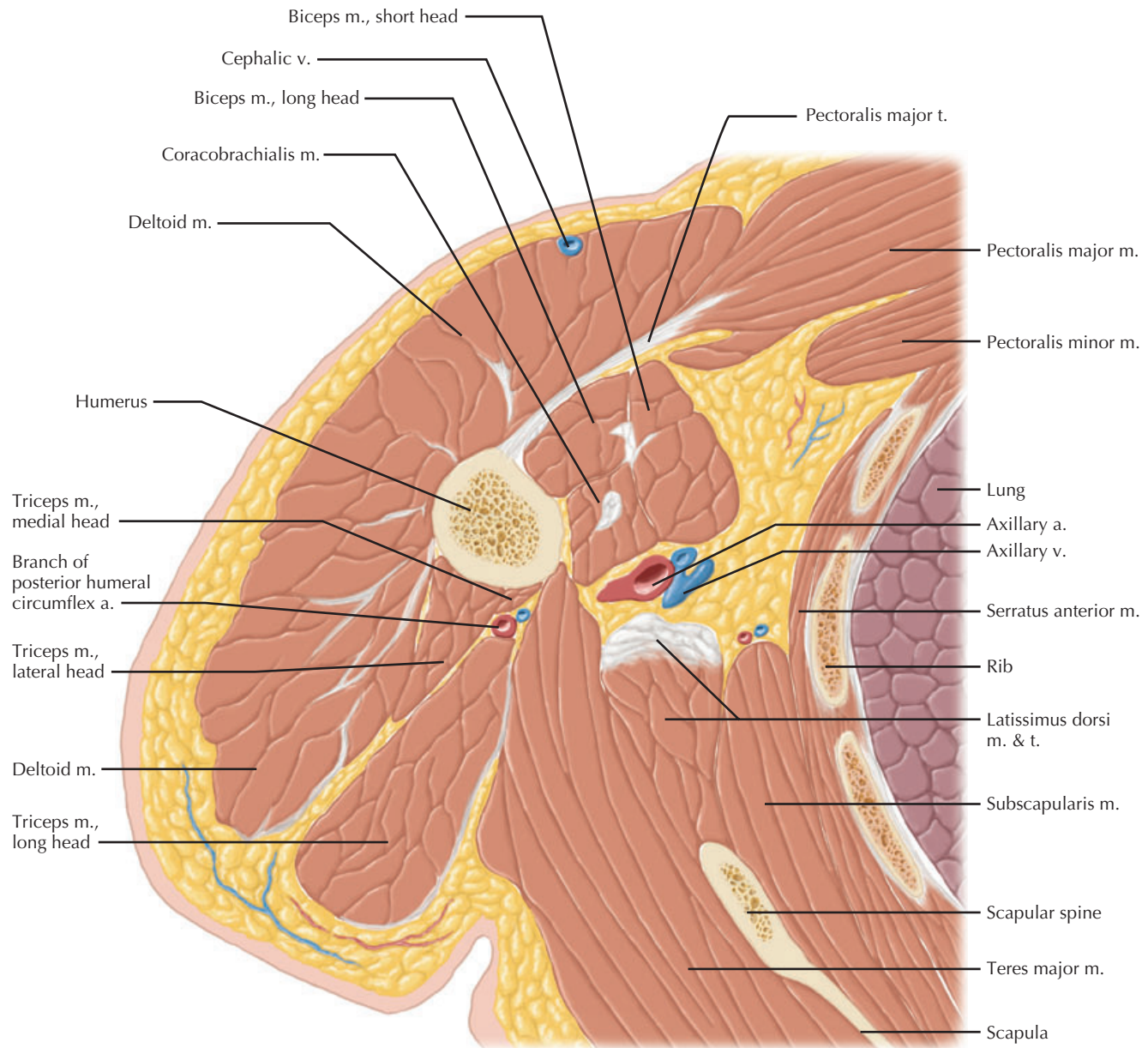
AXIAL 70





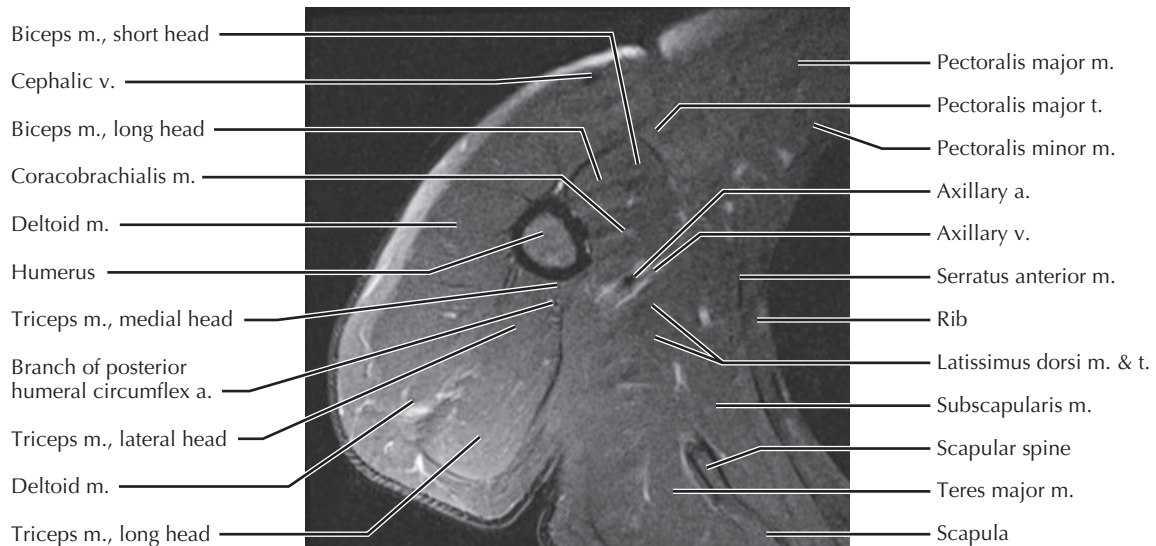
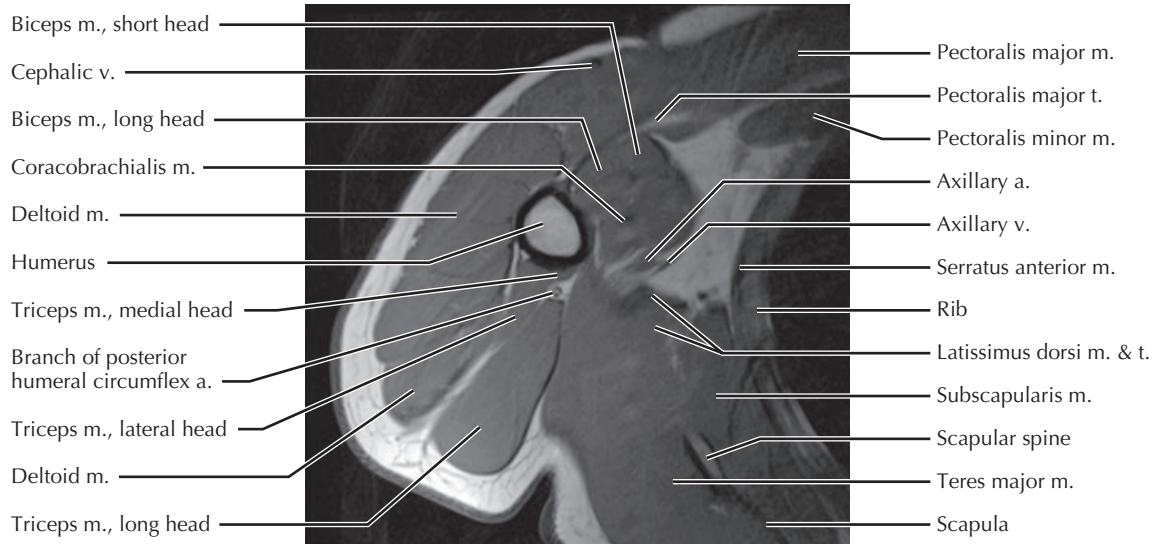
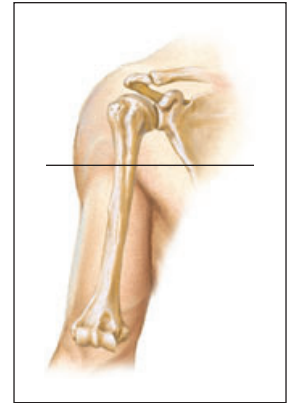


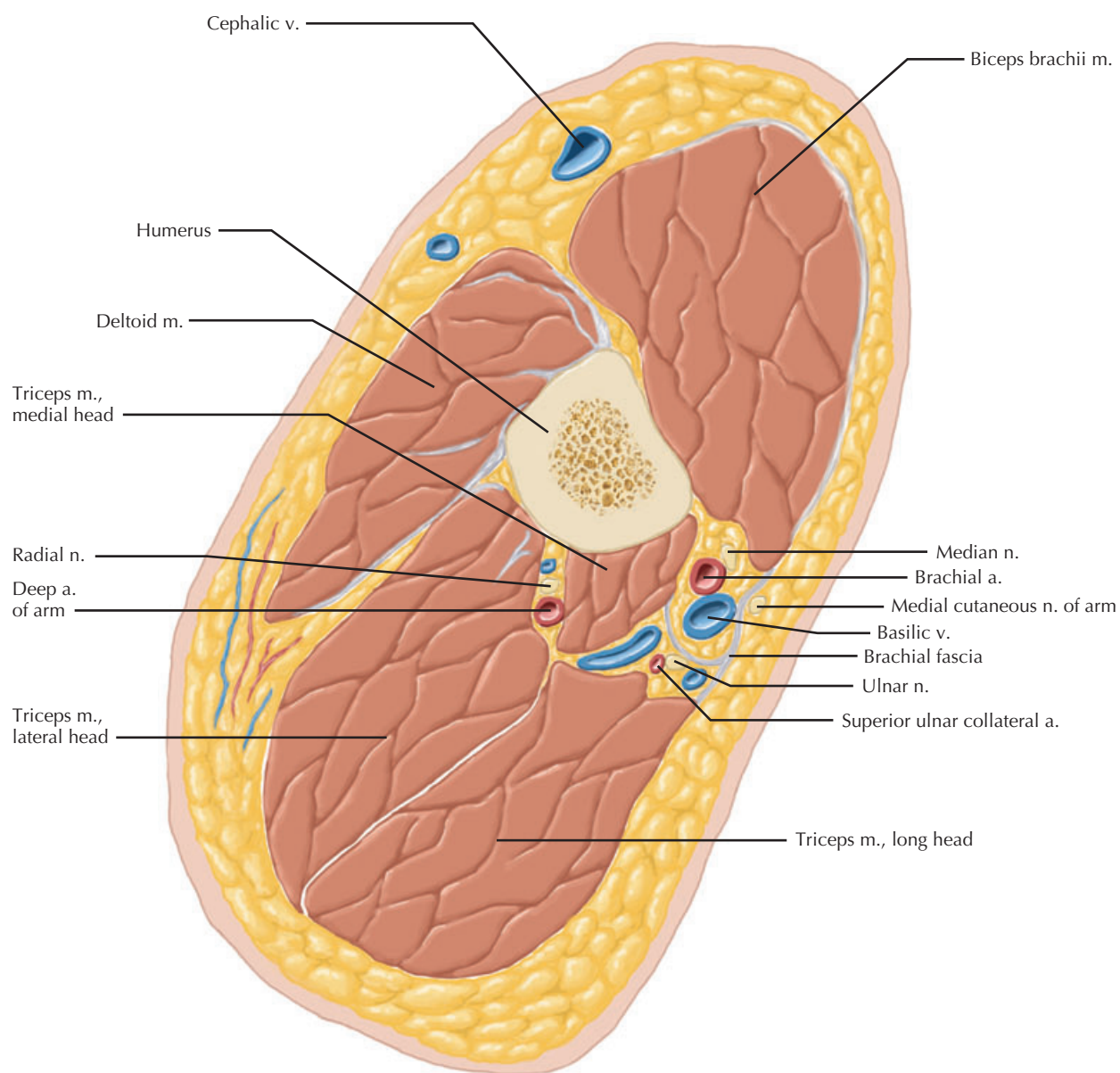




DIAGNOSTIC CONSIDERATION

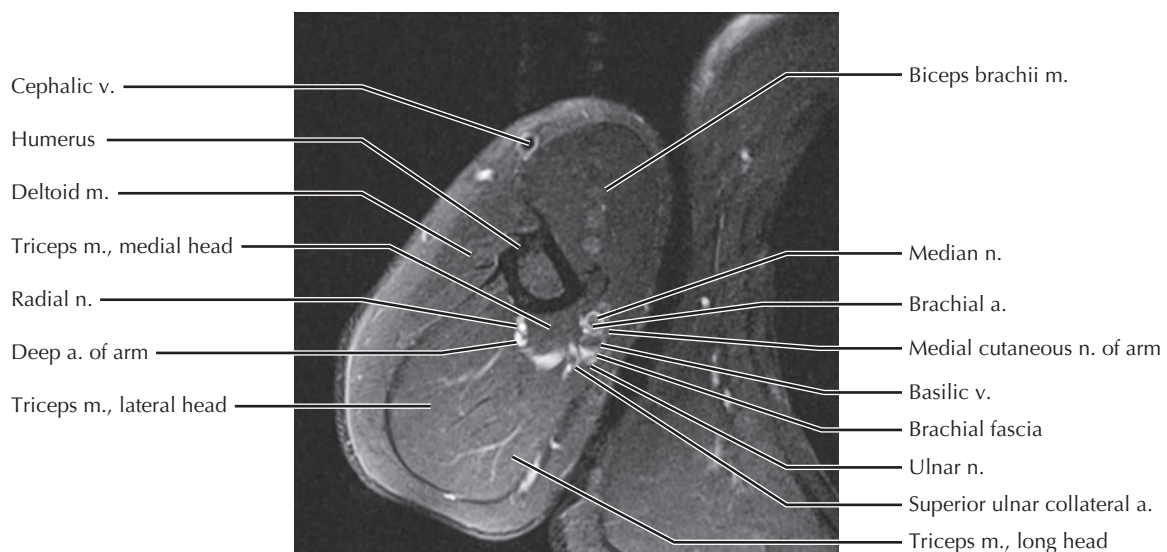
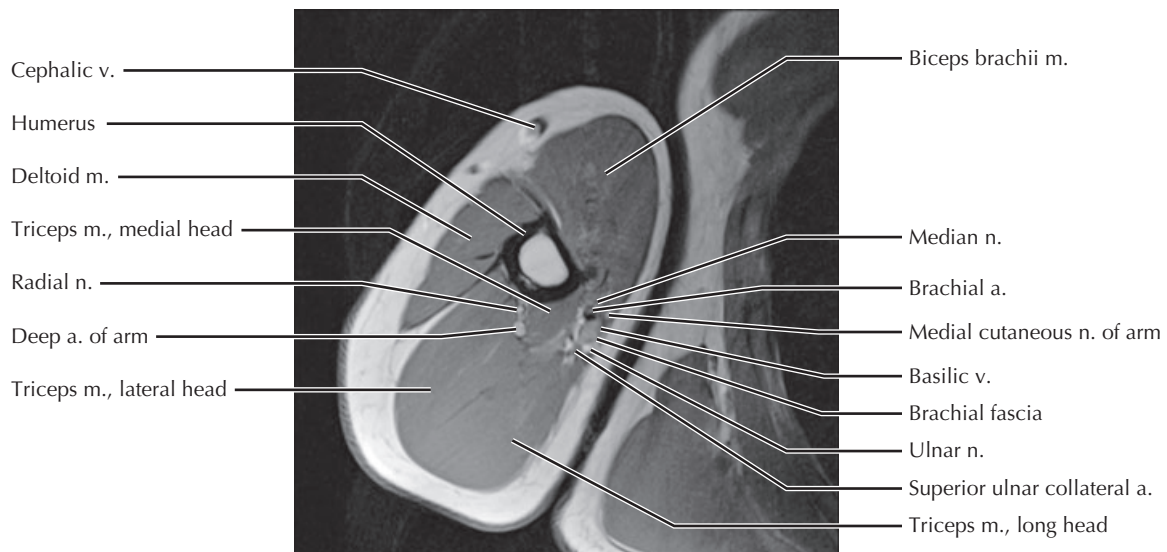
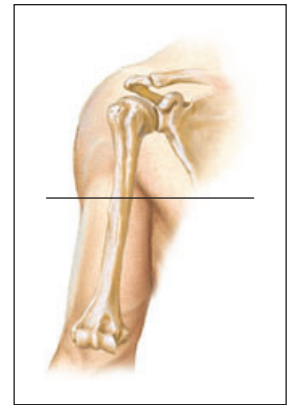
Pectoralis tears are not imaged well on routine shoulder MRI. Extending the axial images to this level ensures visualization of the pectoralis tendon and musculotendinous junction to identify tears and partial tears.

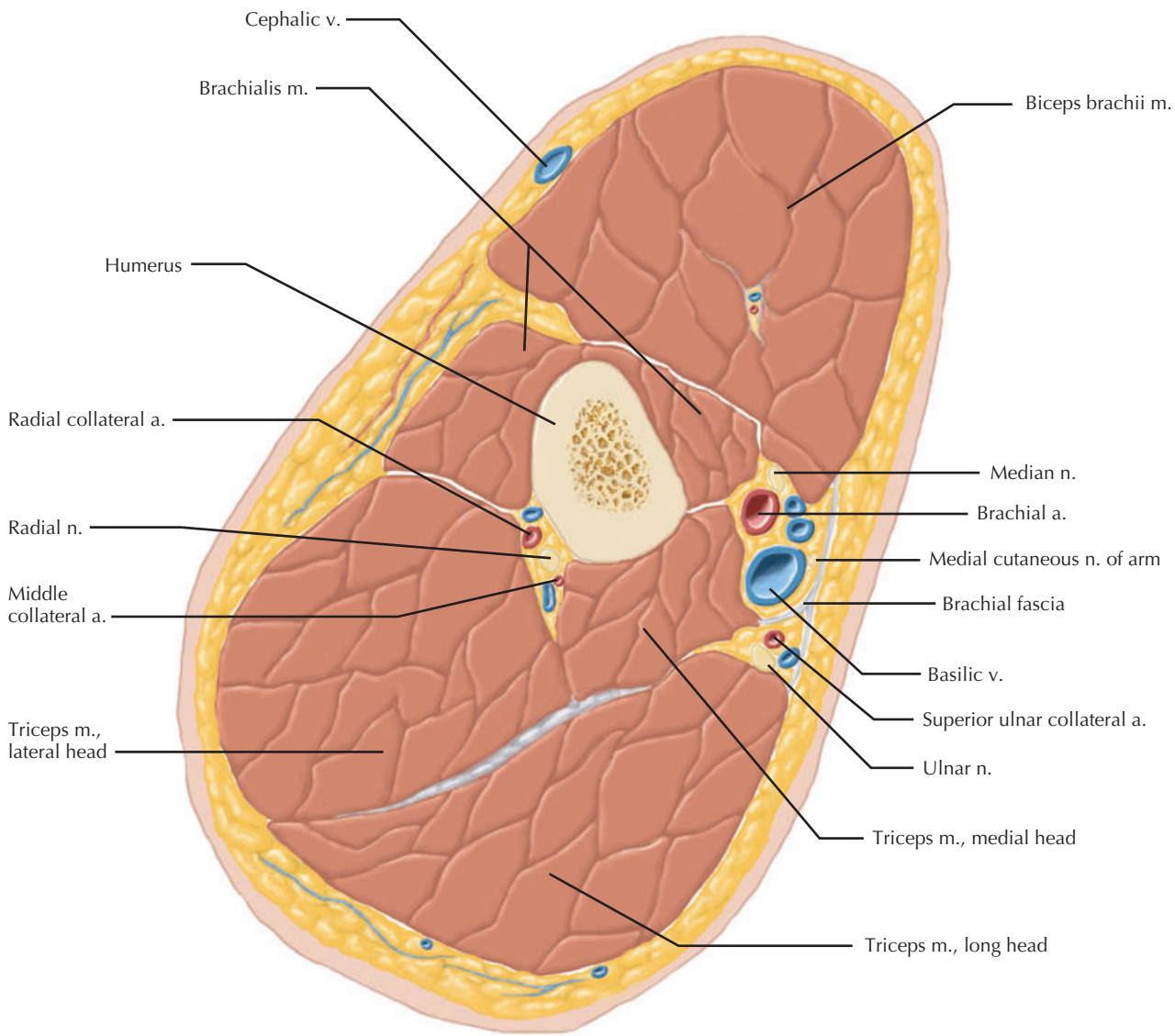




NORMAL VARIANT

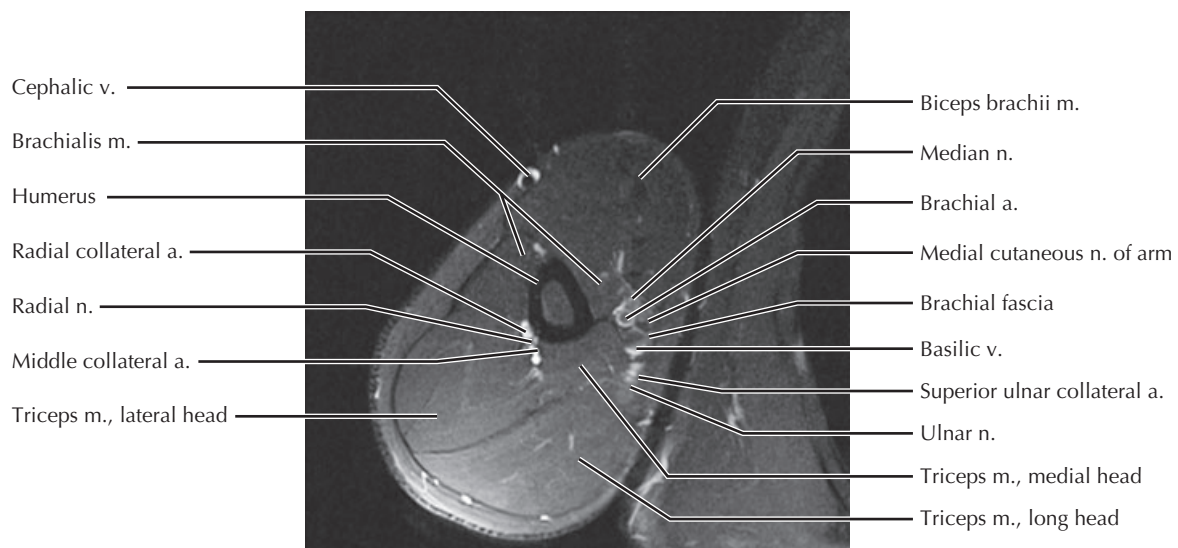
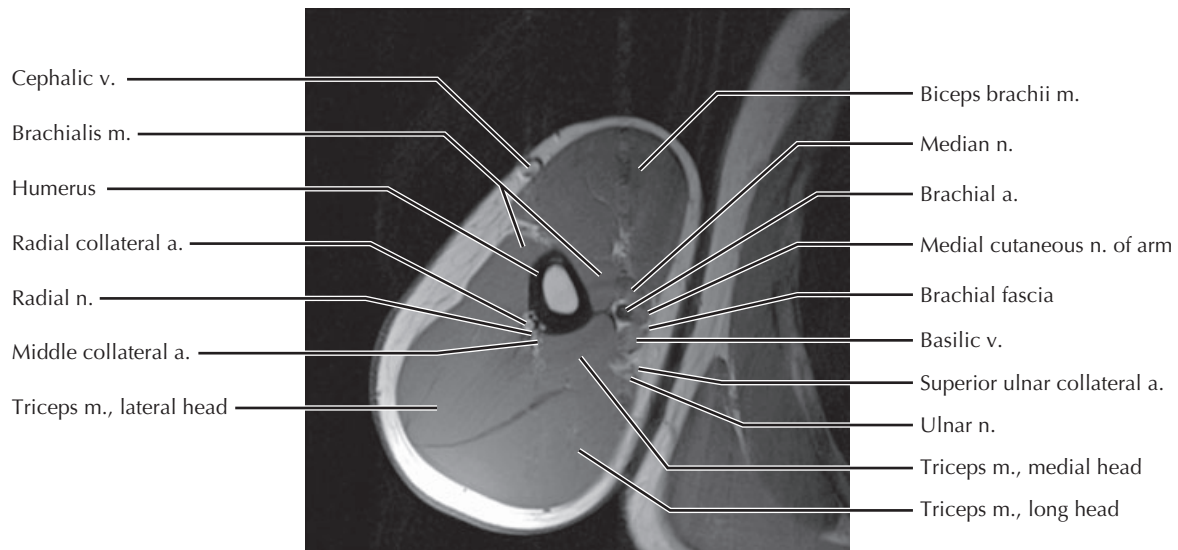
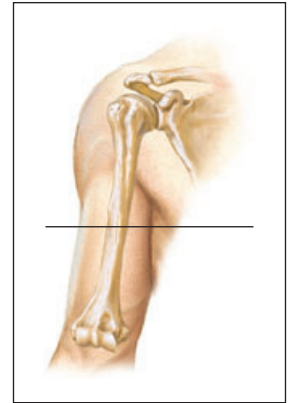
Occasionally, cortical thickening can occur at the deltoid tendon insertion site.

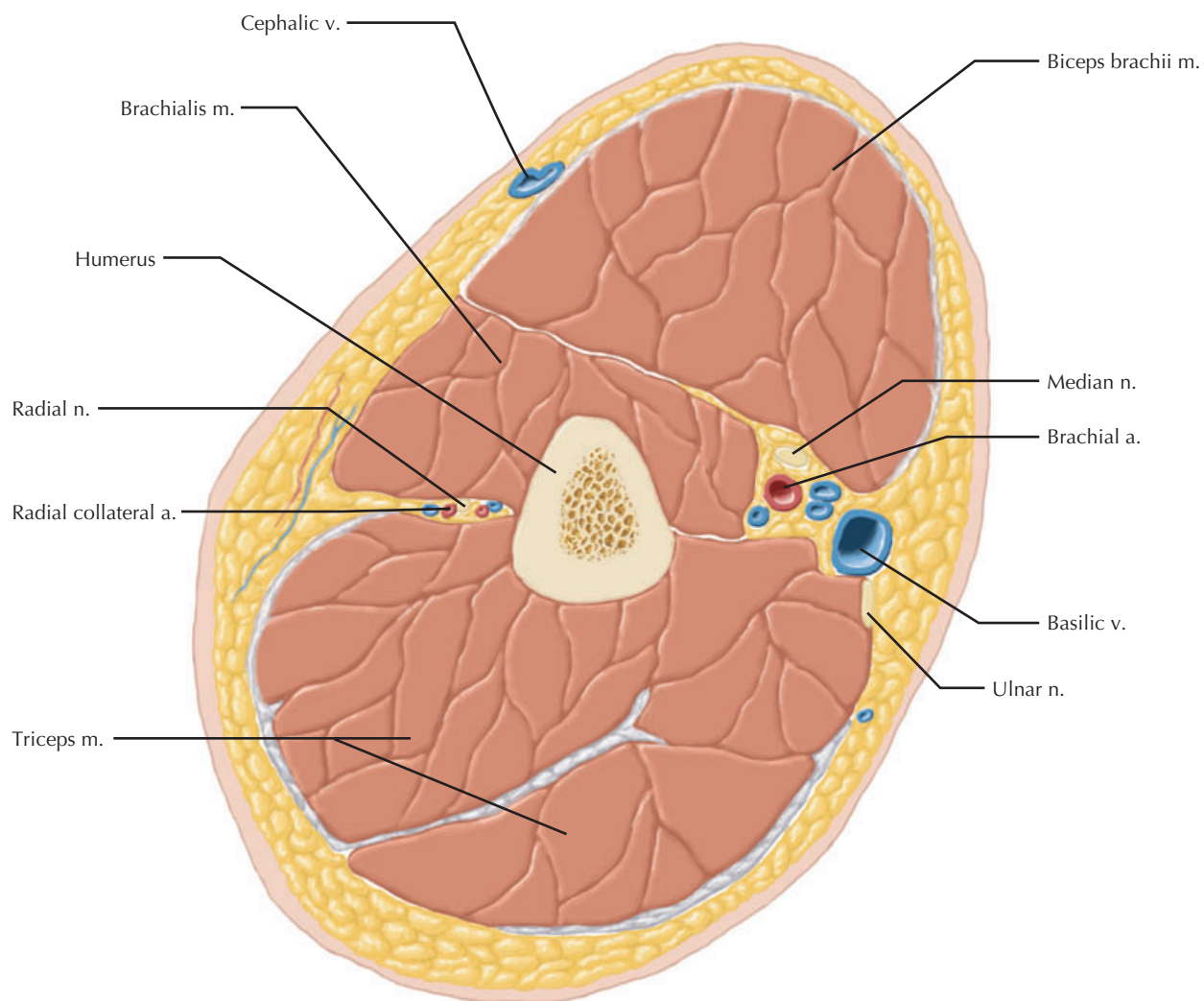




DIAGNOSTIC CONSIDERATION

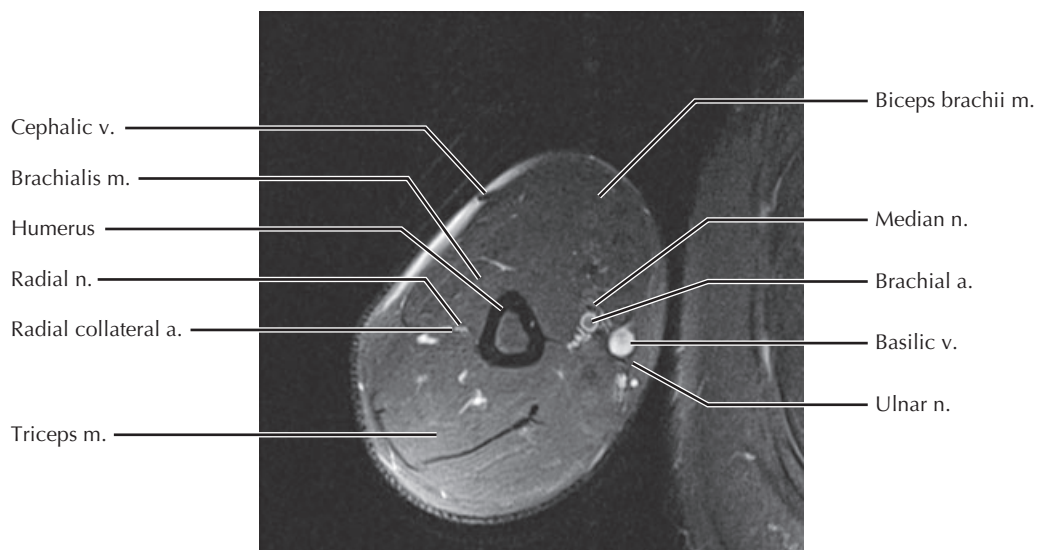
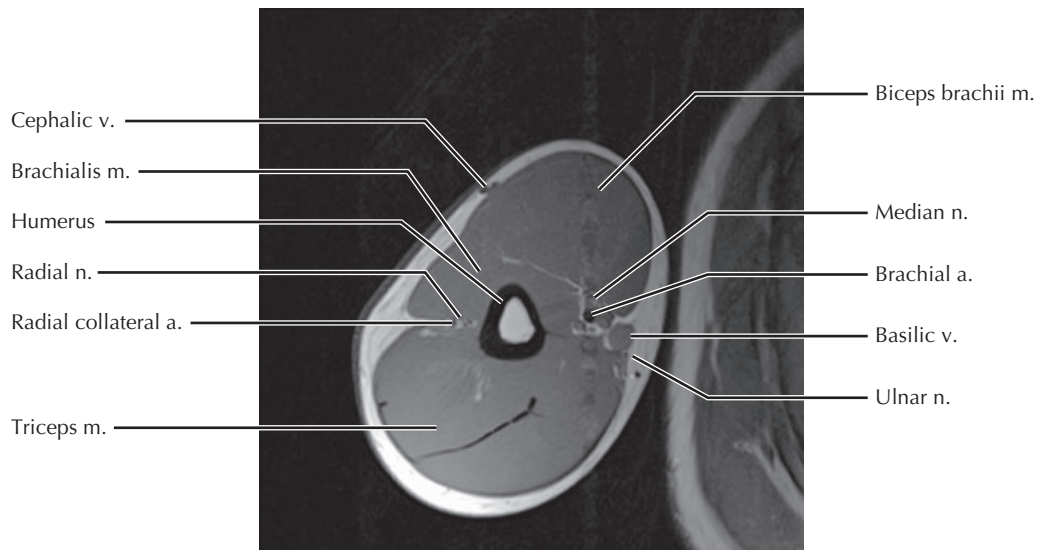
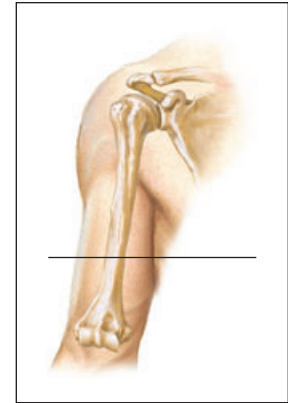
The pulsation artifact visible in the muscle bellies is produced by the brachial artery. In some MR images, this can be mistaken for a pathologic process. The linear distribution of the artifact and the extension of the artifact beyond the soft tissues confirm that it is not a true entity.

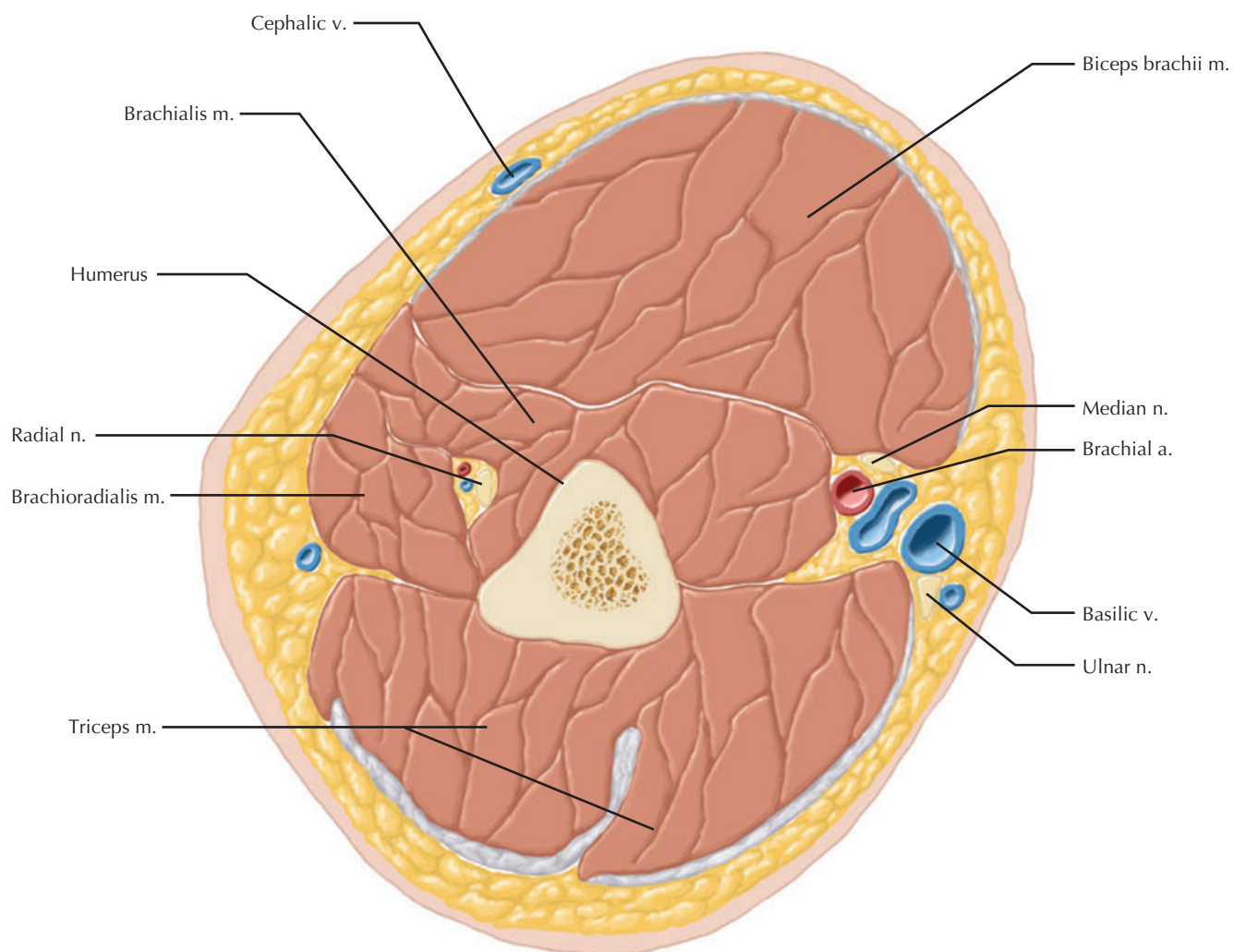


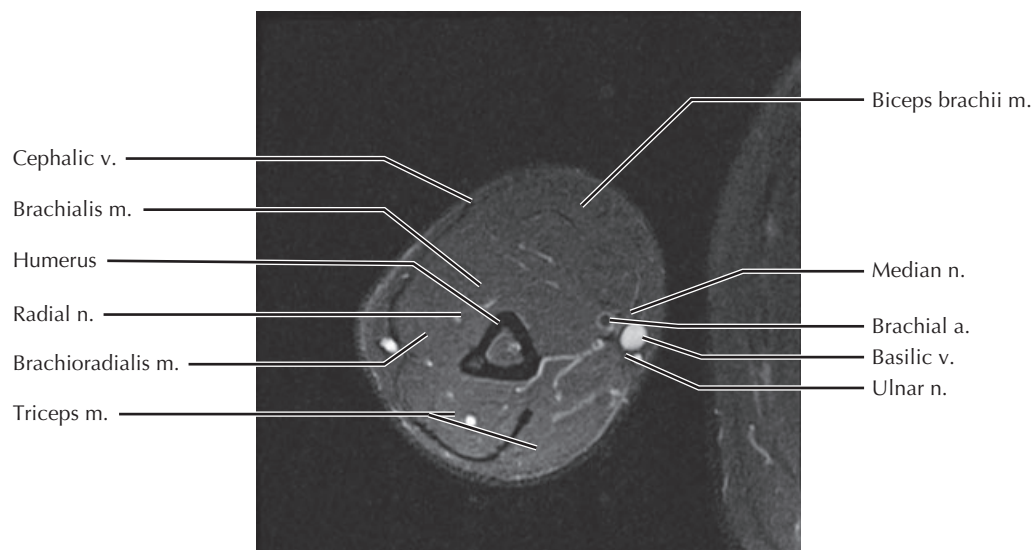
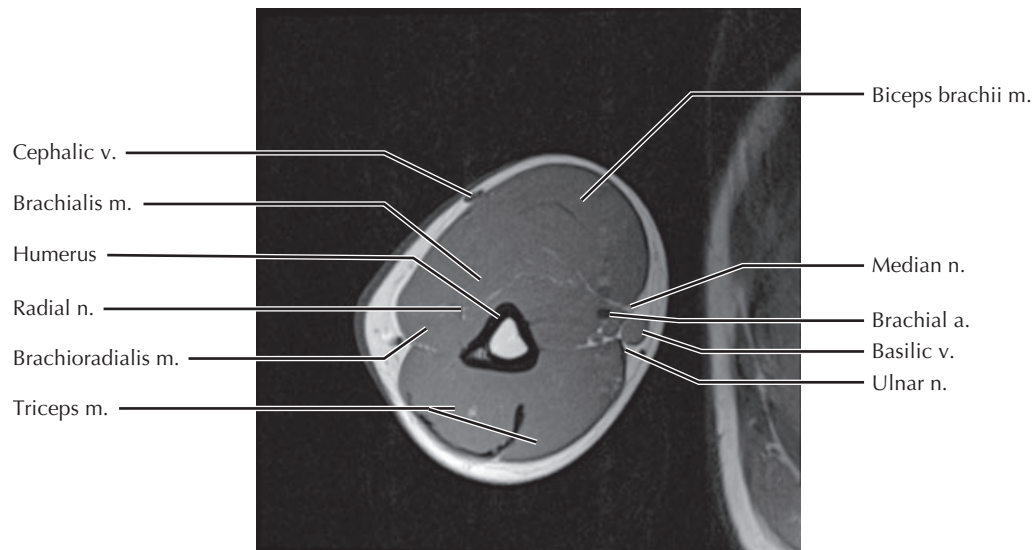
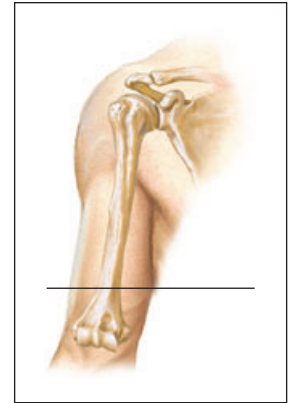


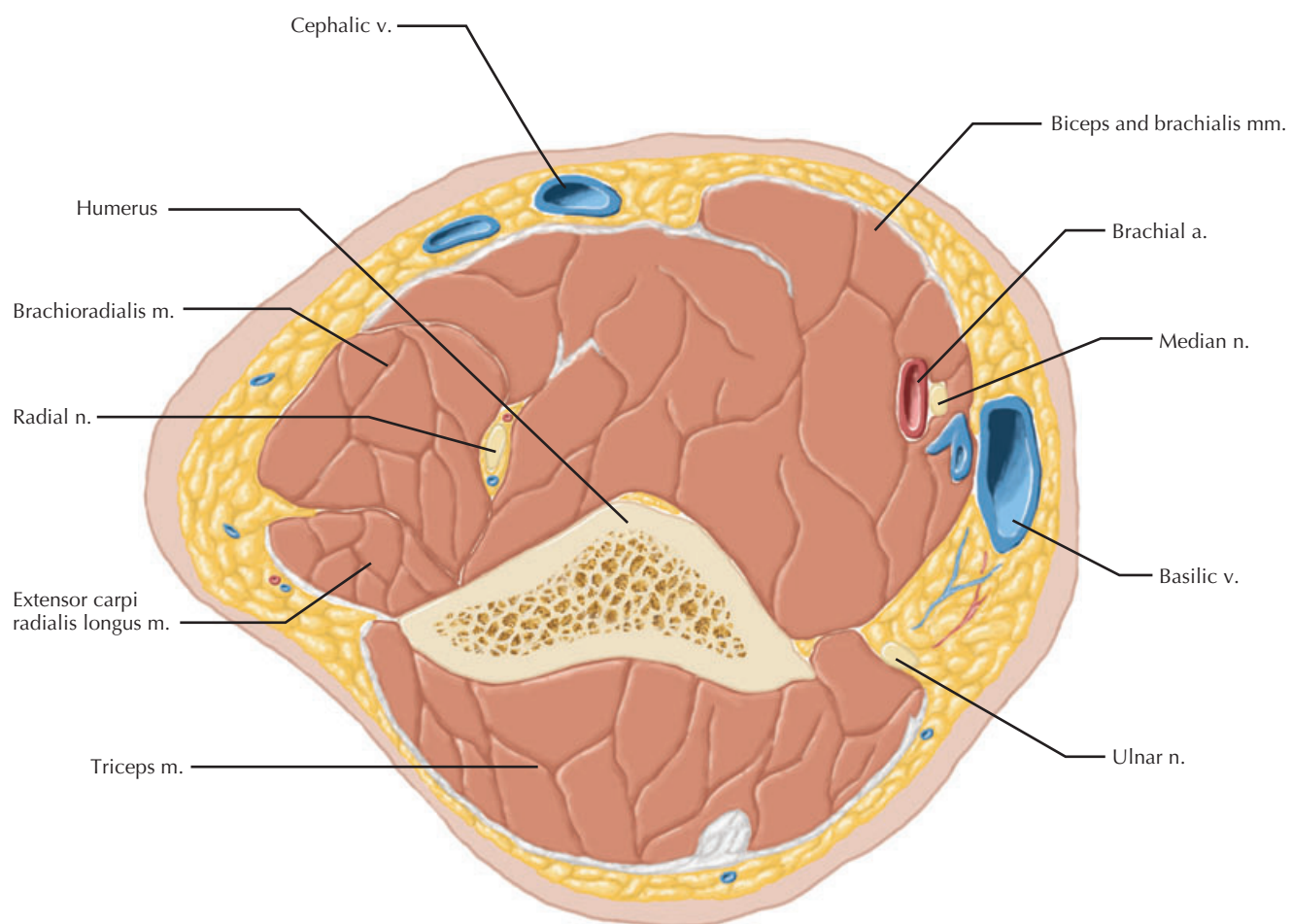
PATHOLOGIC PROCESS

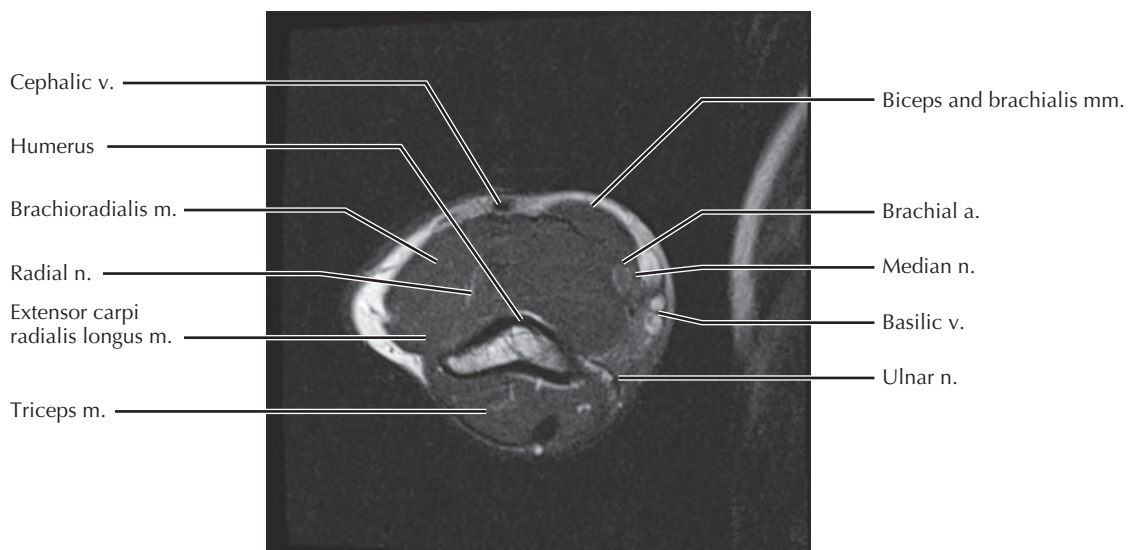
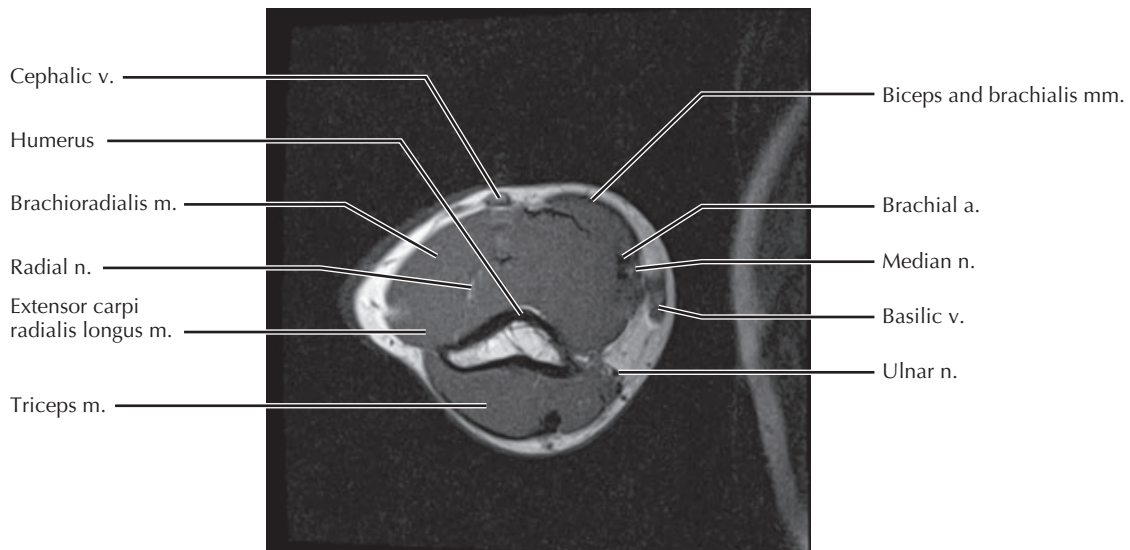
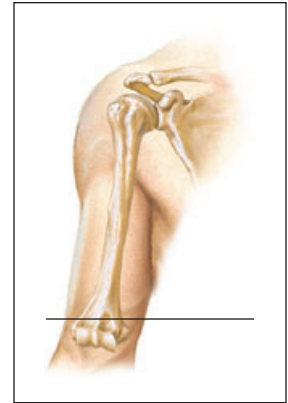
Although not present in the MR image here, high signal throughout a muscle belly can implicate a more proximal nerve injury (neurogenic edema).









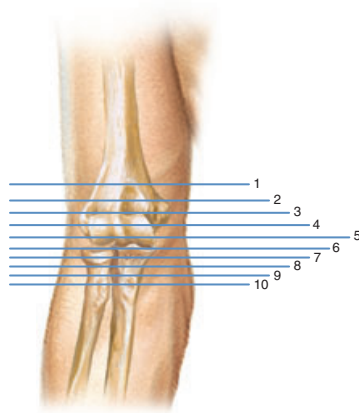


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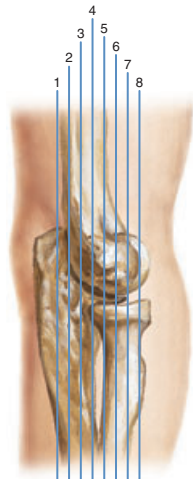
Chapter

4

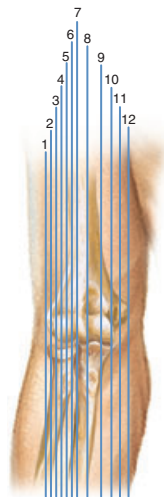
ELBOW



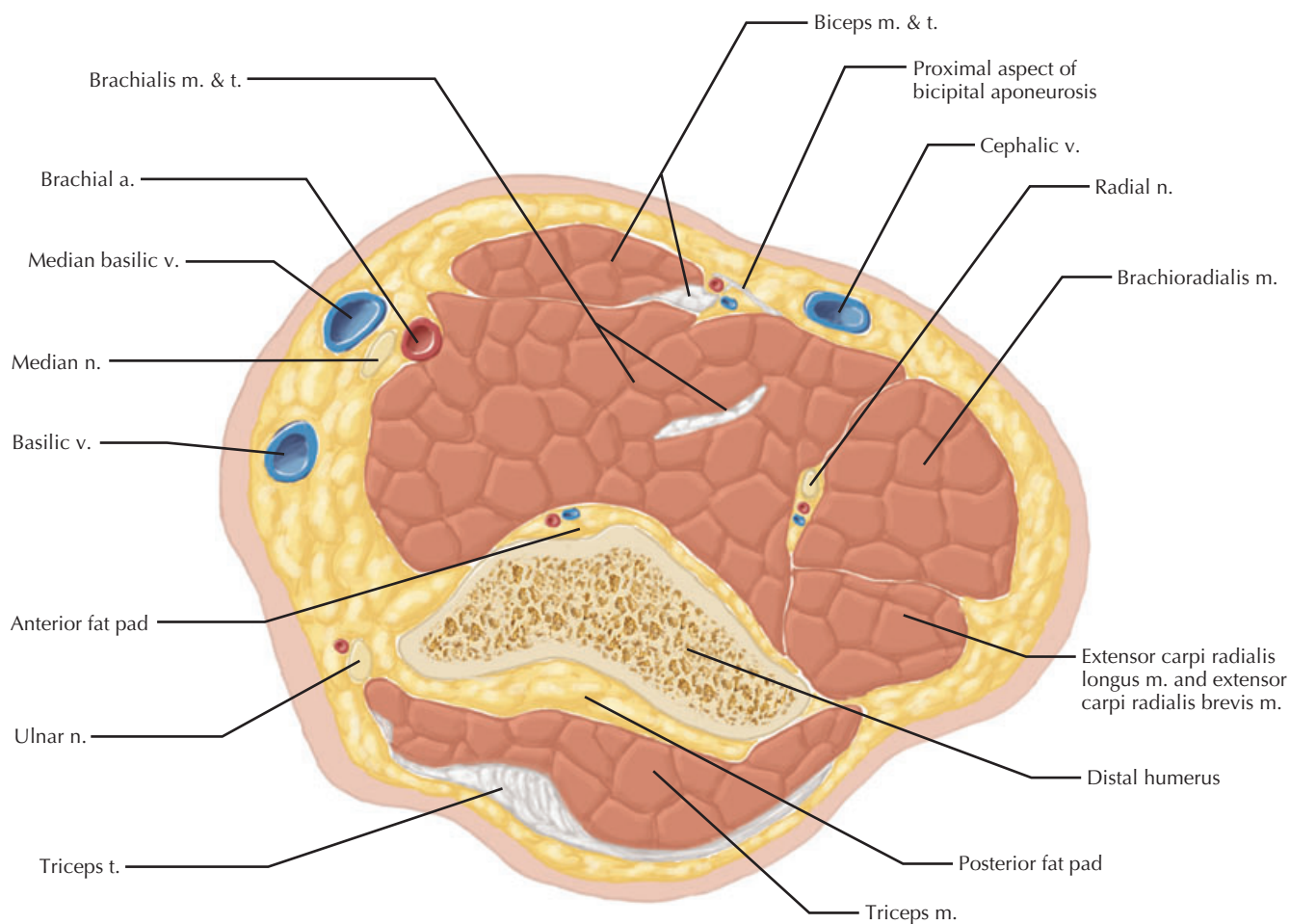
AXIAL 88



CORONAL 108

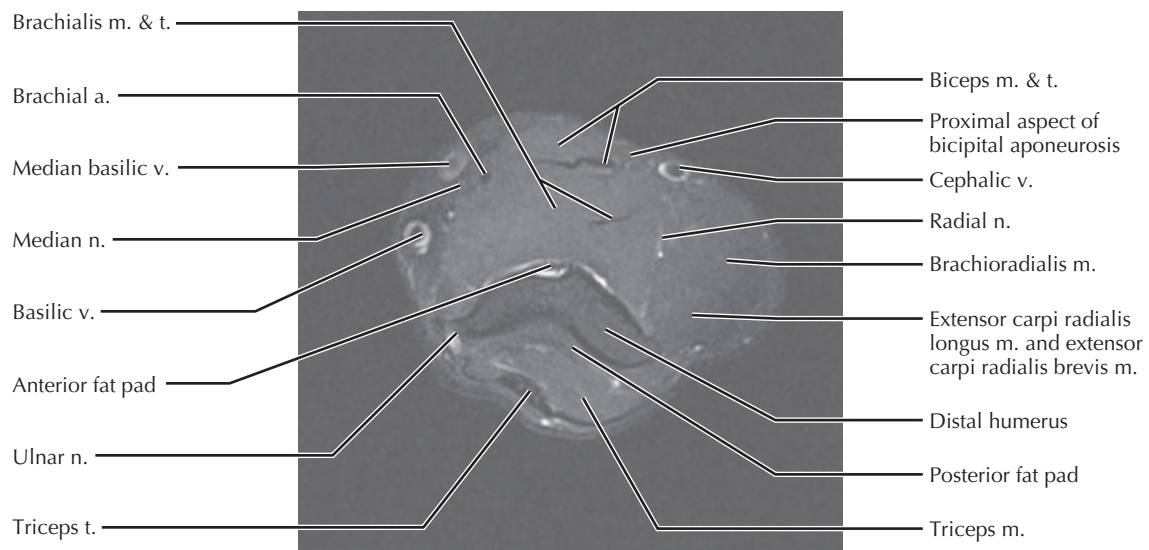
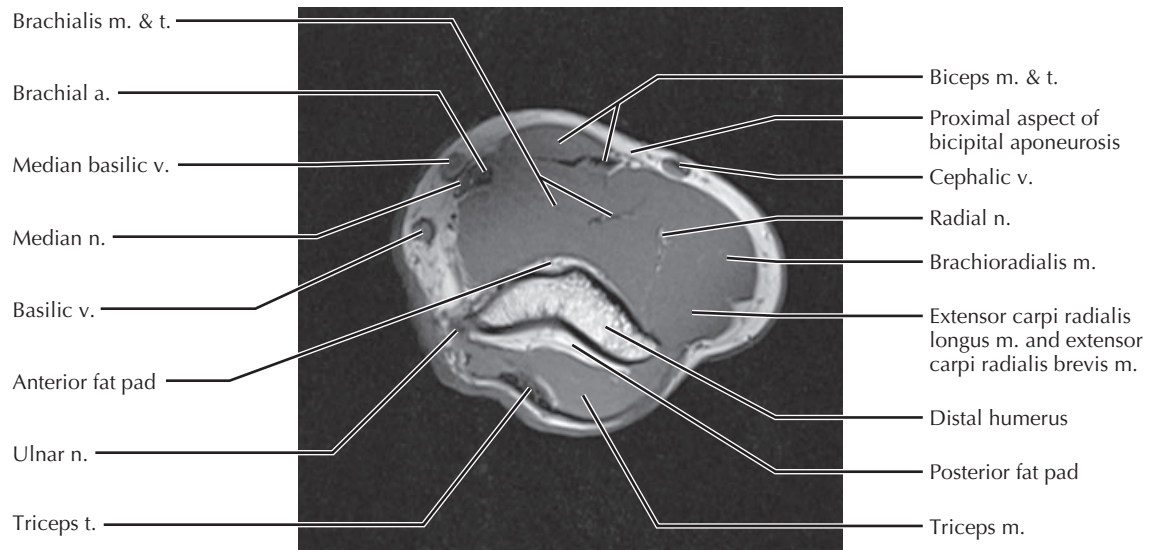
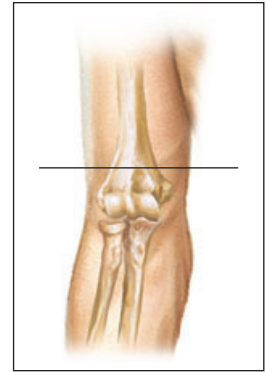


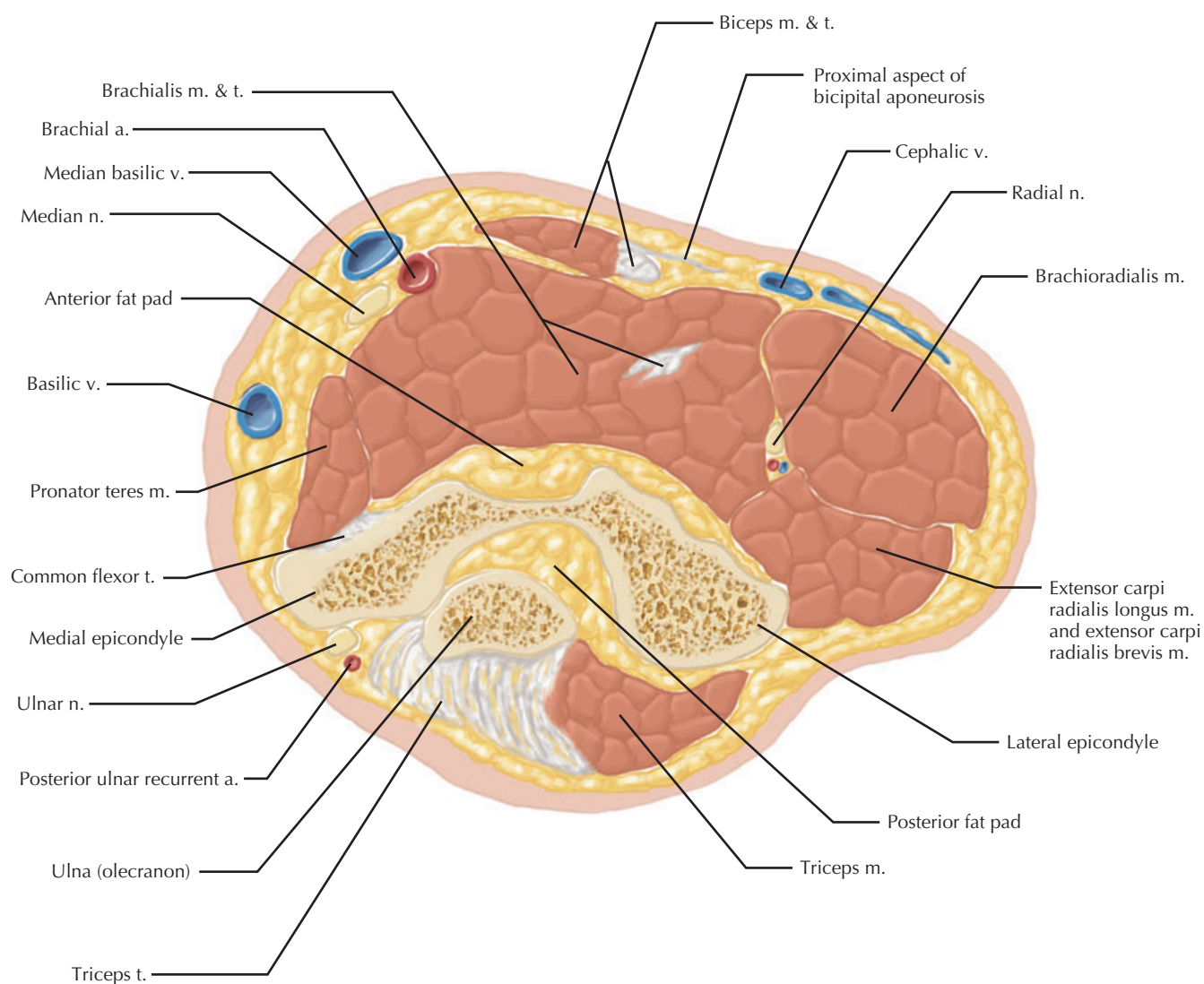
SAGITTAL 124



NORMAL VARIANT

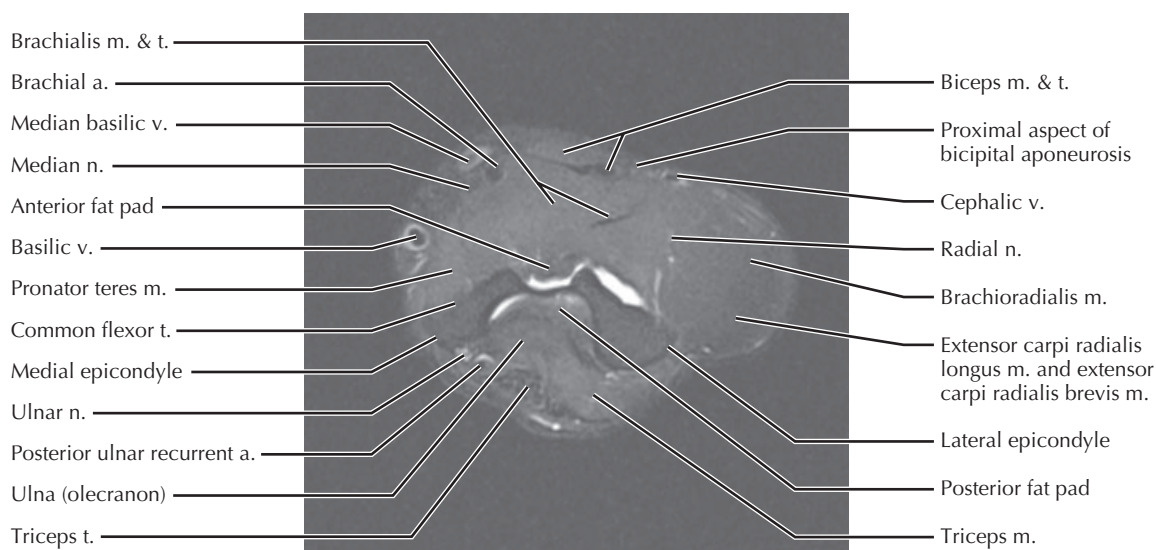
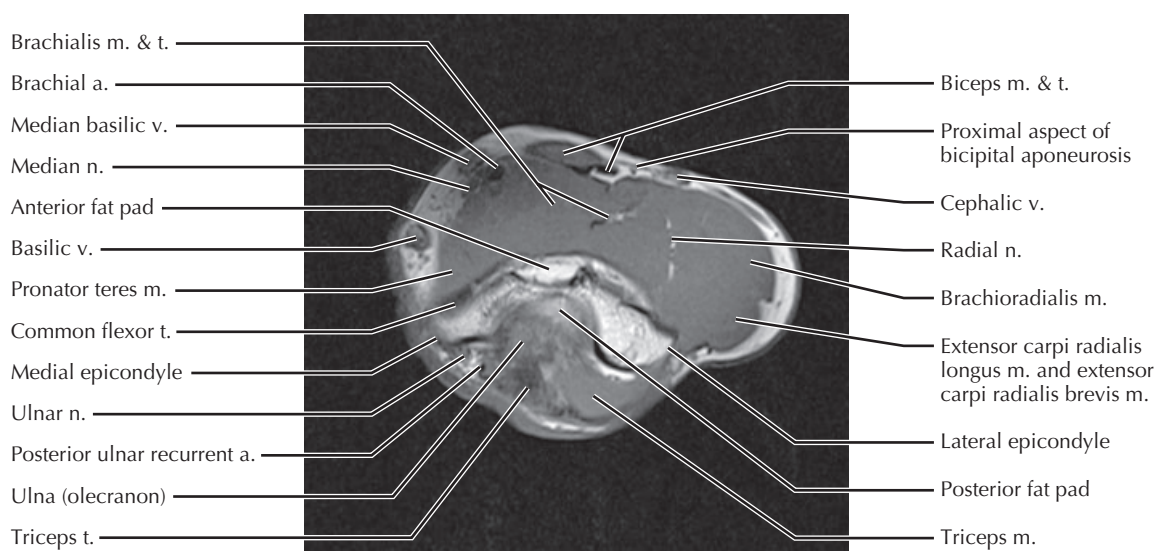
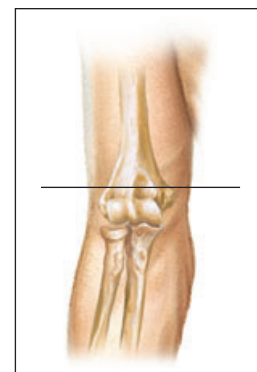
The medial head of the triceps can wrap onto the anterior side of medial epicondyle and cause ulnar nerve entrapment. This finding is best seen with the elbow imaged in flexion. Note that this variant is not observed on the MR image here.

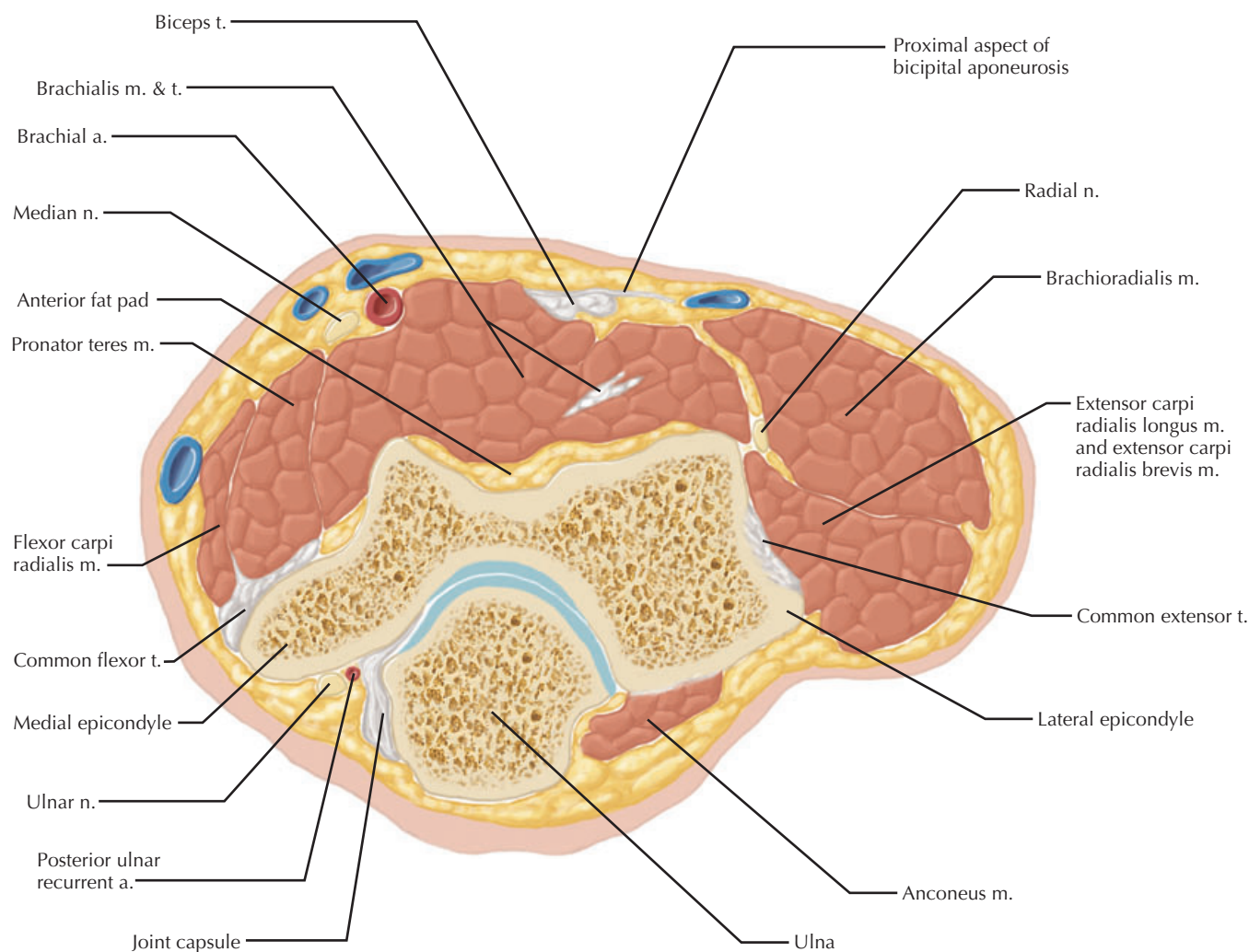




NORMAL ANATOMY

Note the intermediate signal throughout the triceps tendon. This is caused by the absence of tendon sheath, which results in connective tissue slips interdigitating among tendon fibers, creating a speckled appearance. This is especially evident on axial MR images.



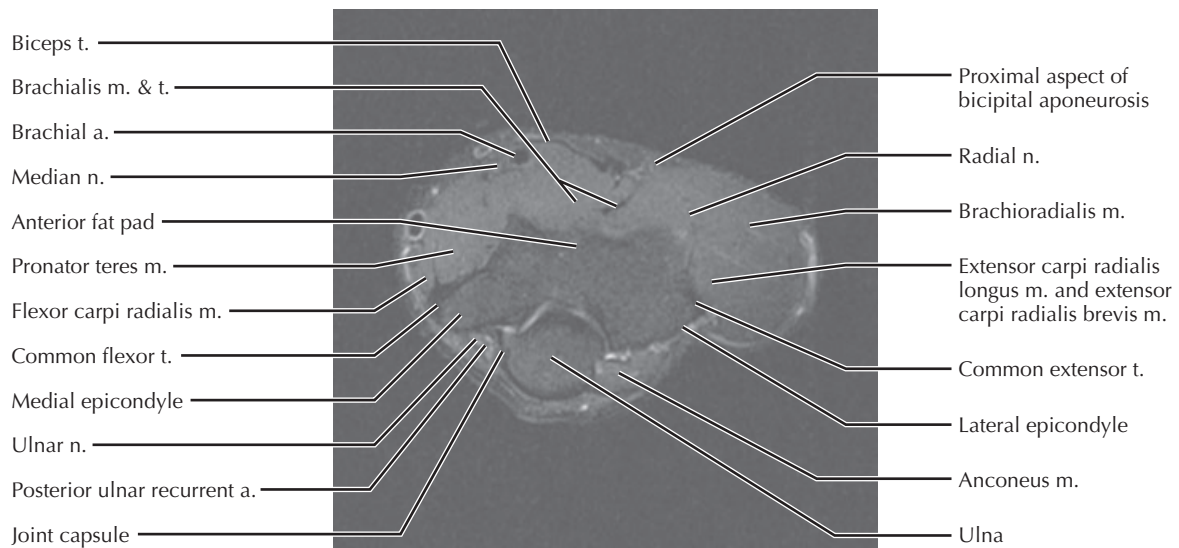
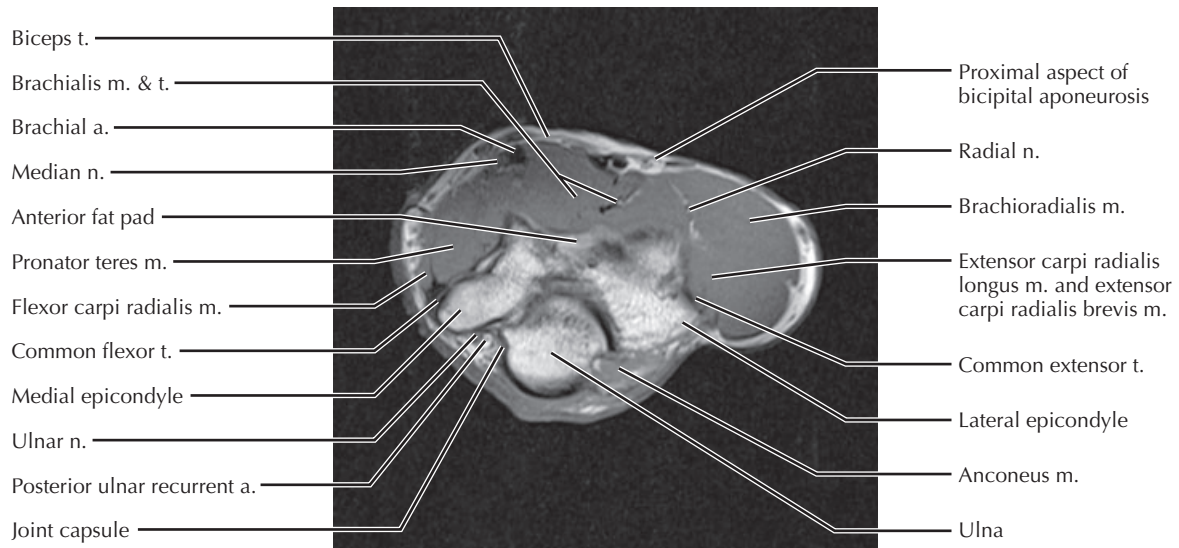
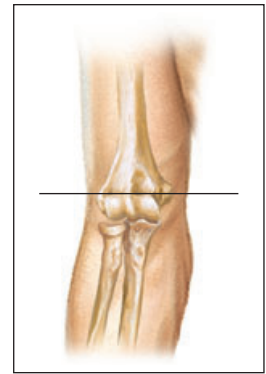


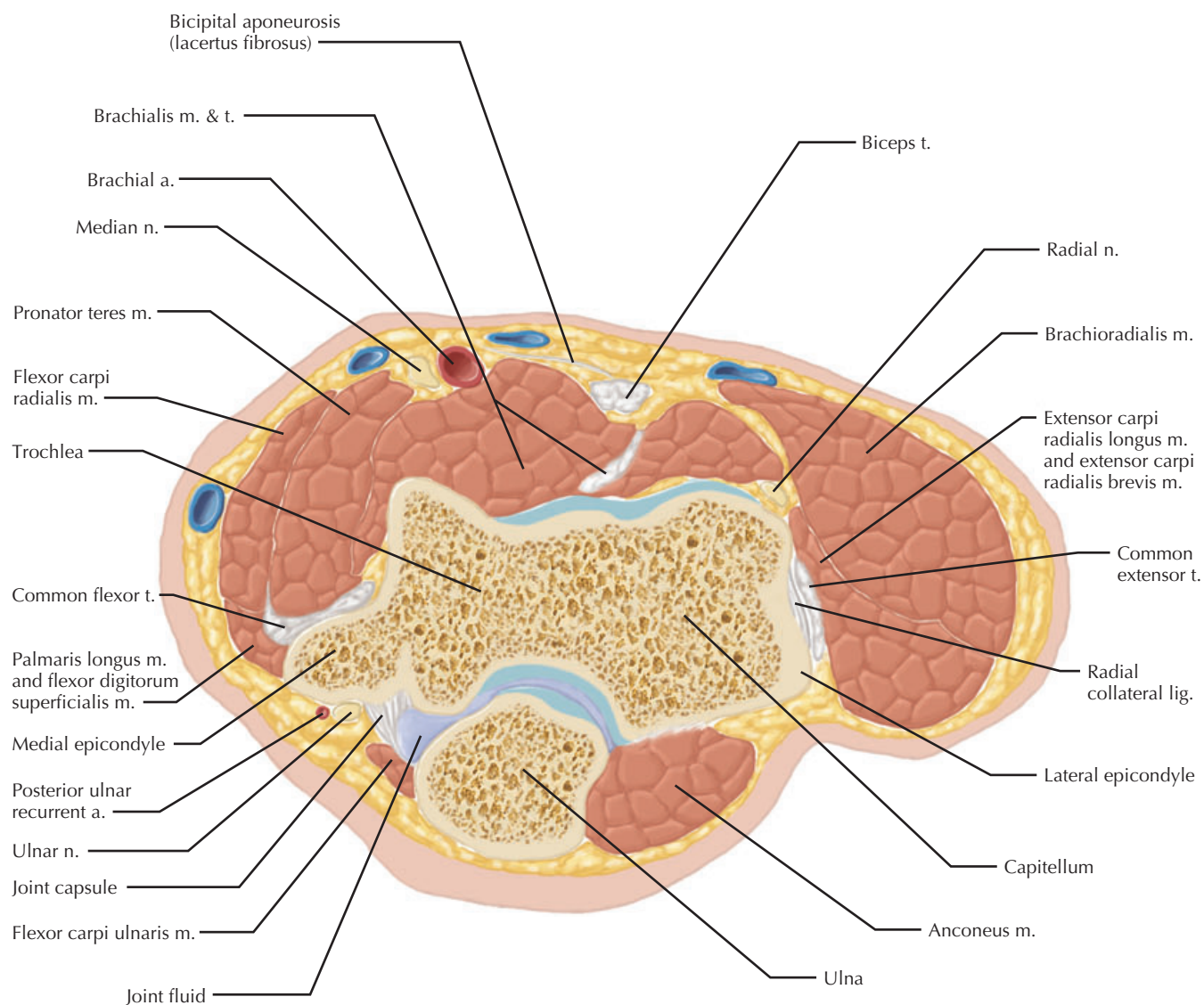
NORMAL ANATOMY

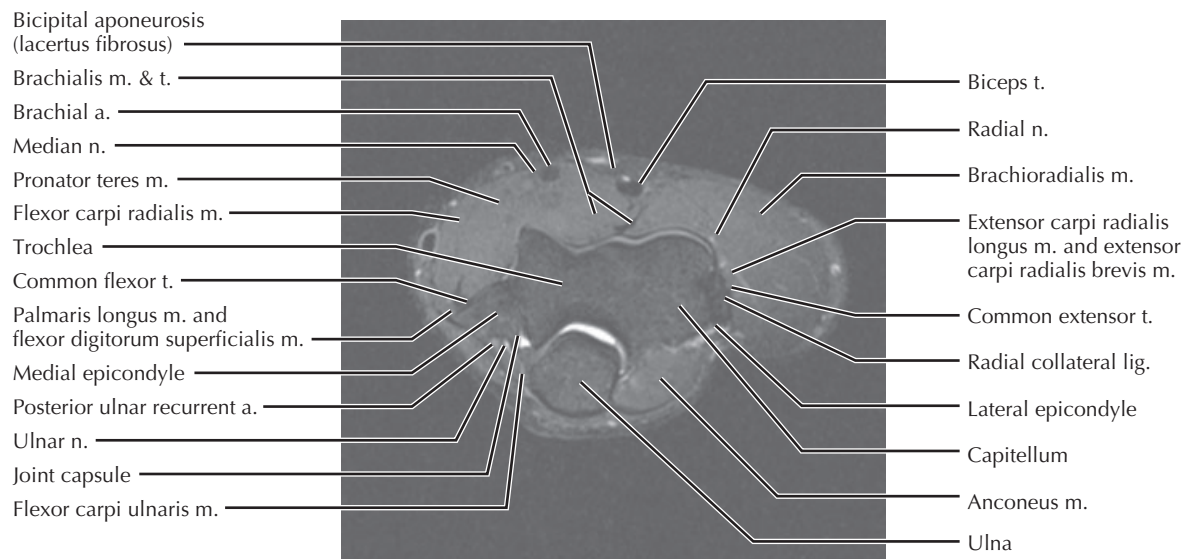
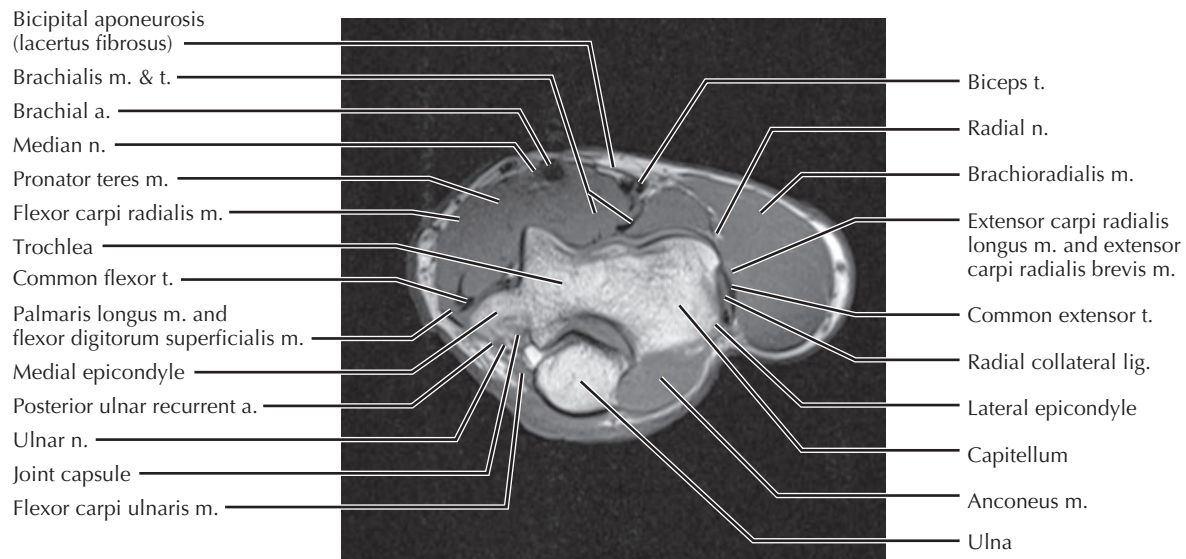
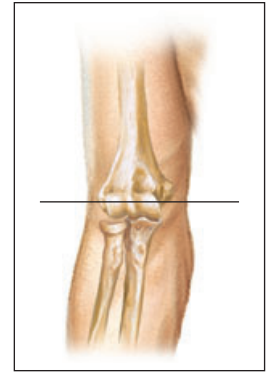
One of the features that can help distinguish medial from lateral on axial elbow views is the prominence of the medial epicondyle. Note the origin of the common flexor tendon on the medial epicondyle.

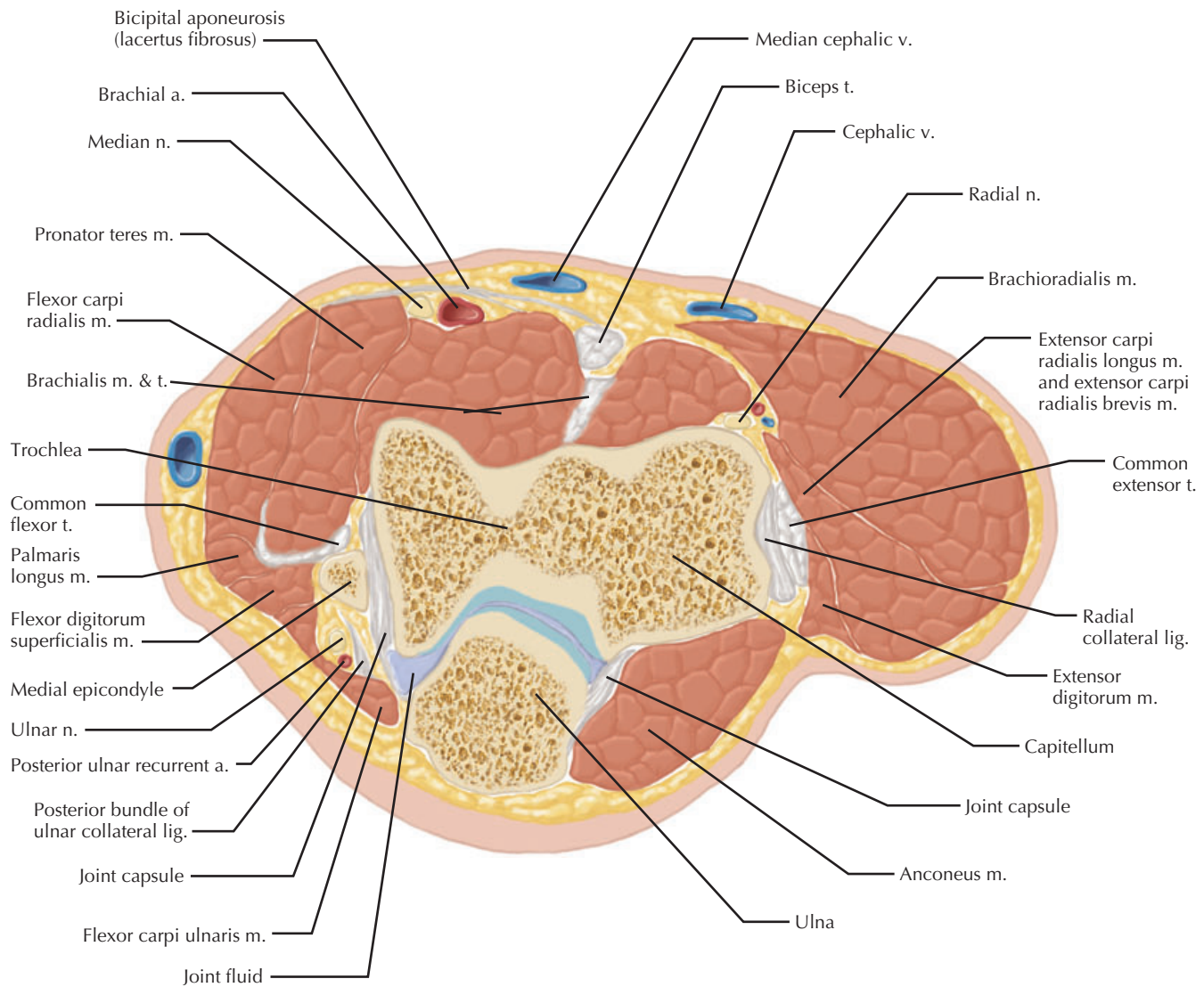
NORMAL VARIANT

An accessory muscle termed the *anconeus epitrochlearis* is sometimes visible at this level. Although not present in the MR image here, it would be located posterior to the medial epicondyle and adjacent to the ulnar nerve. When present, this accessory muscle can cause ulnar nerve entrapment.



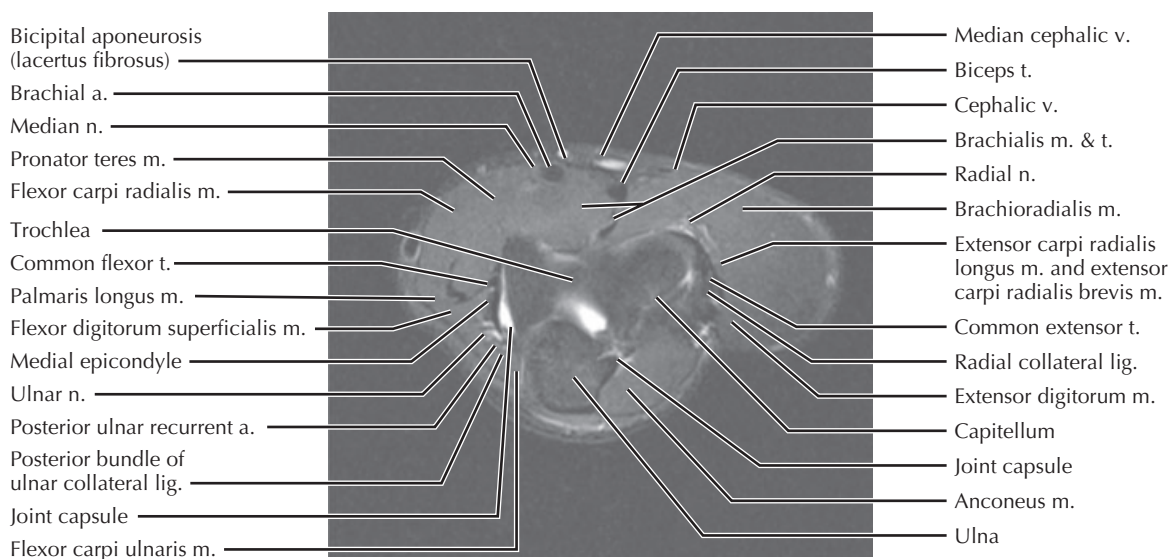
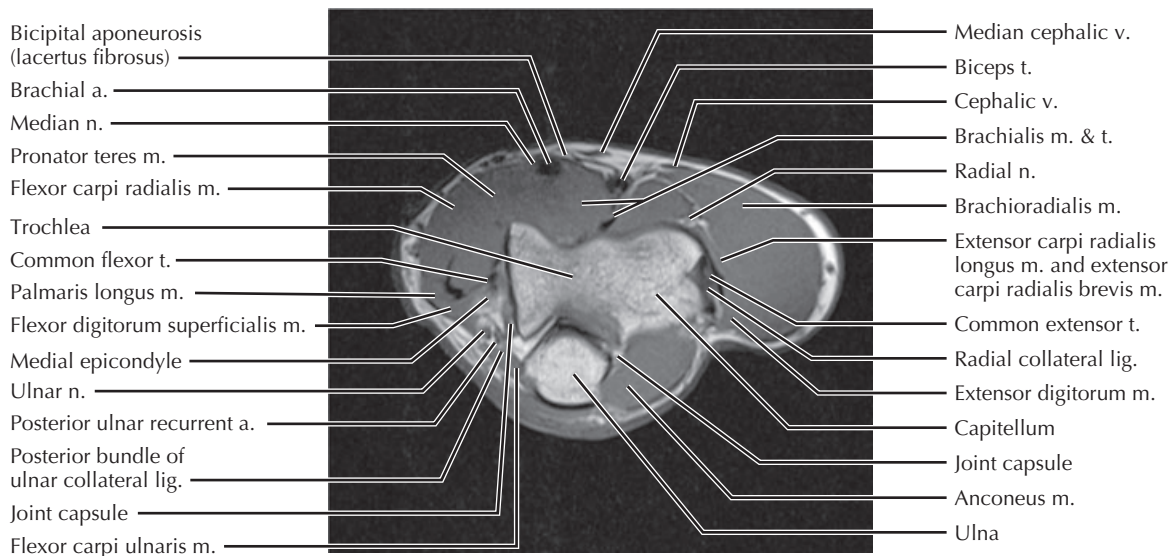


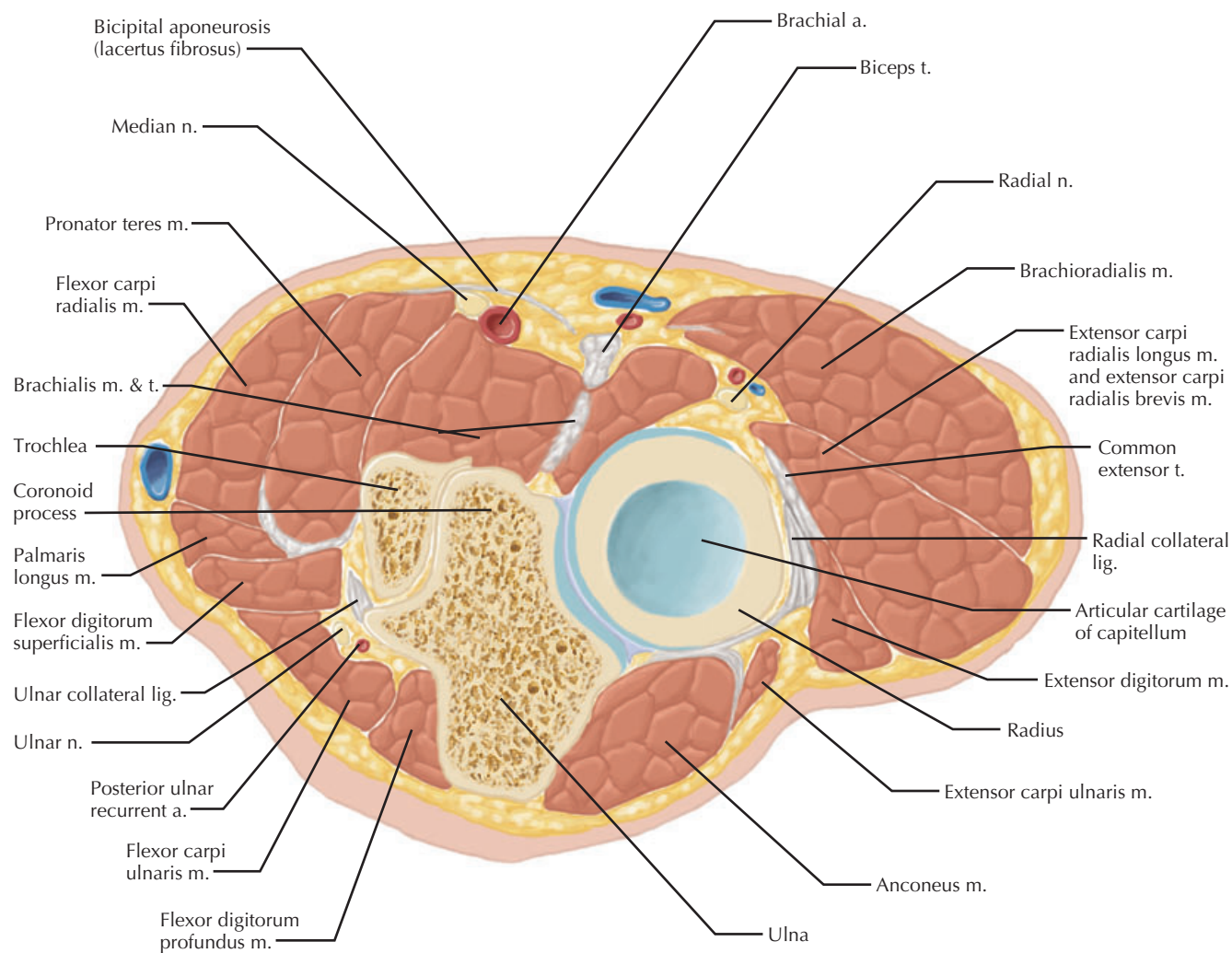


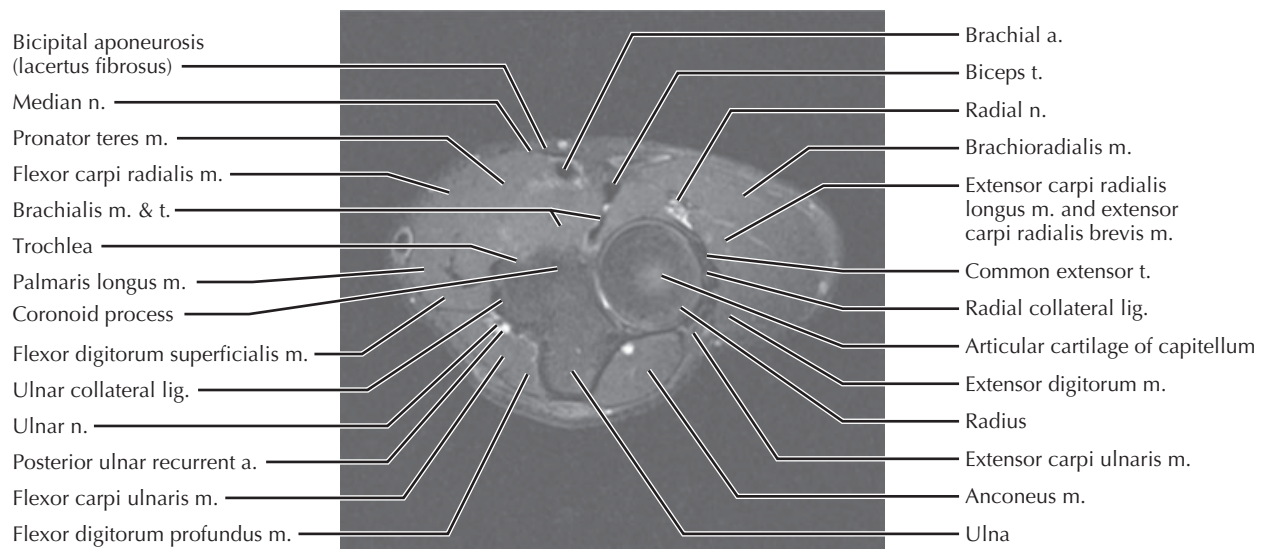
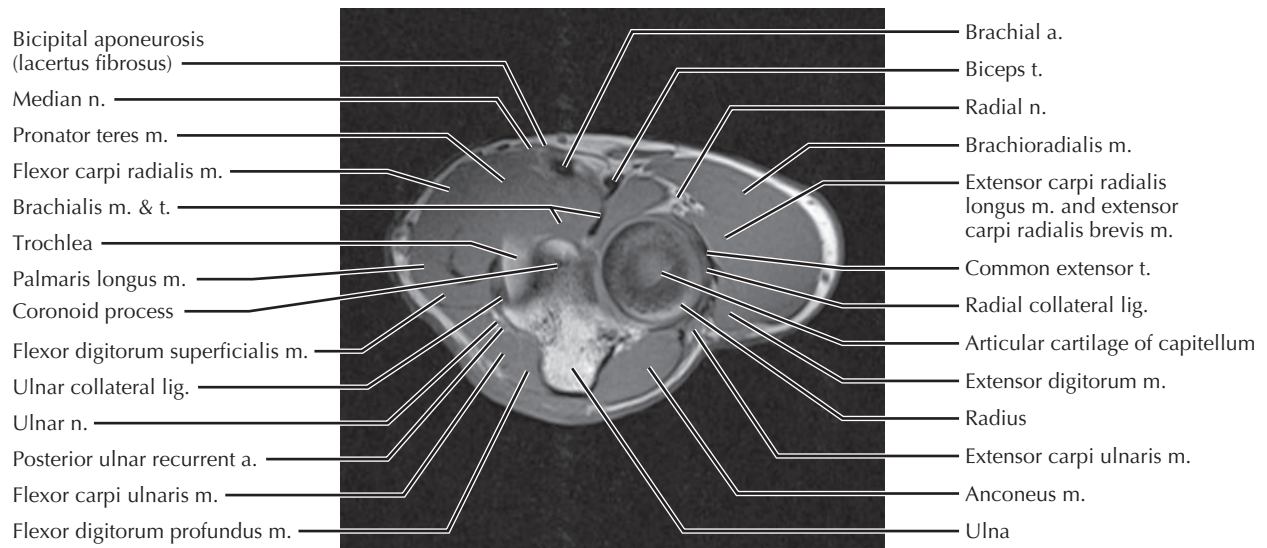
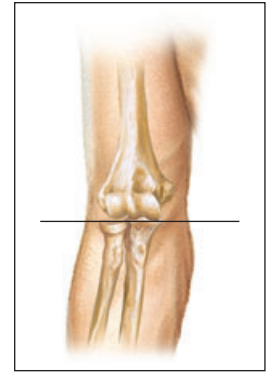


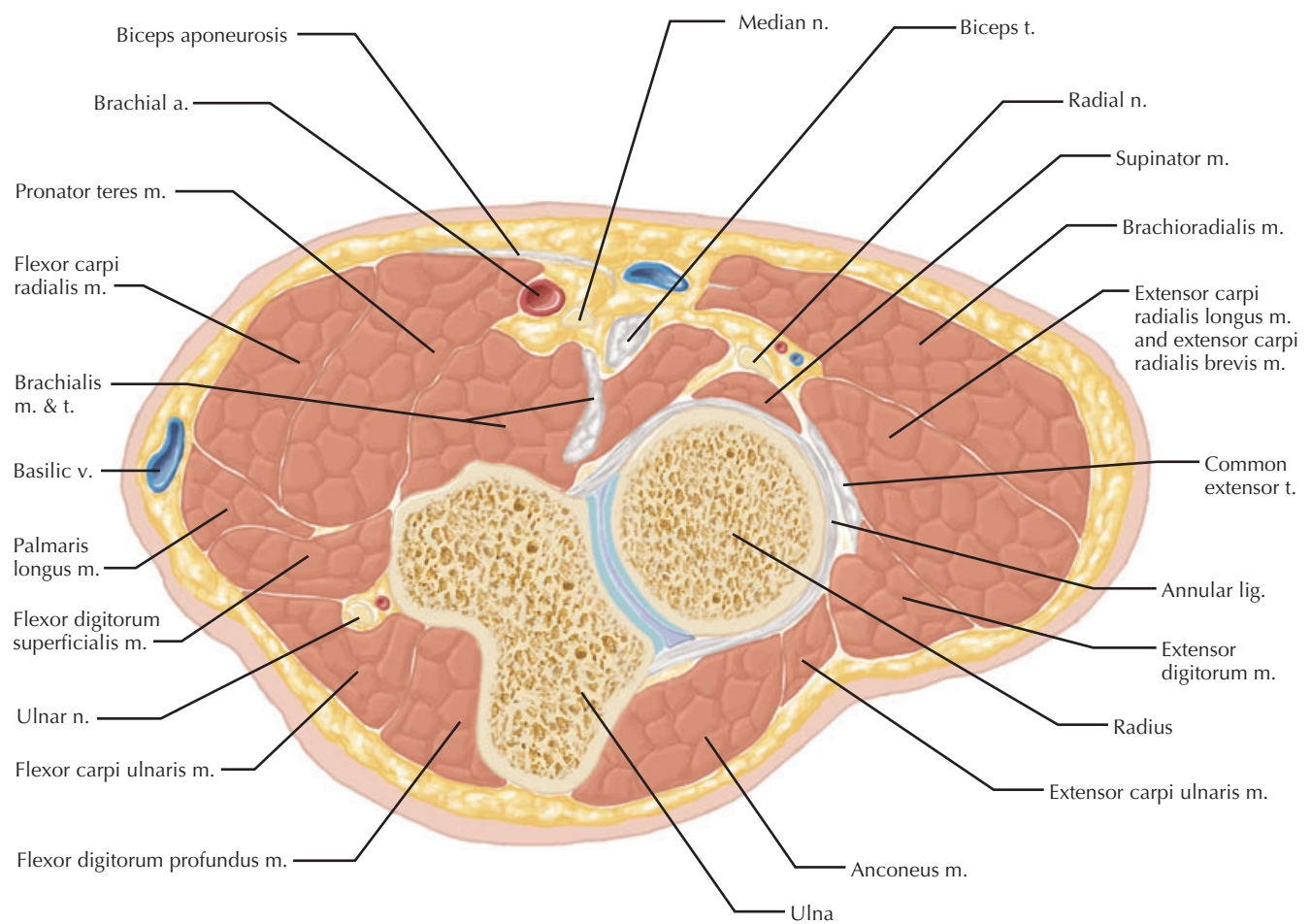
PATHOLOGIC PROCESS

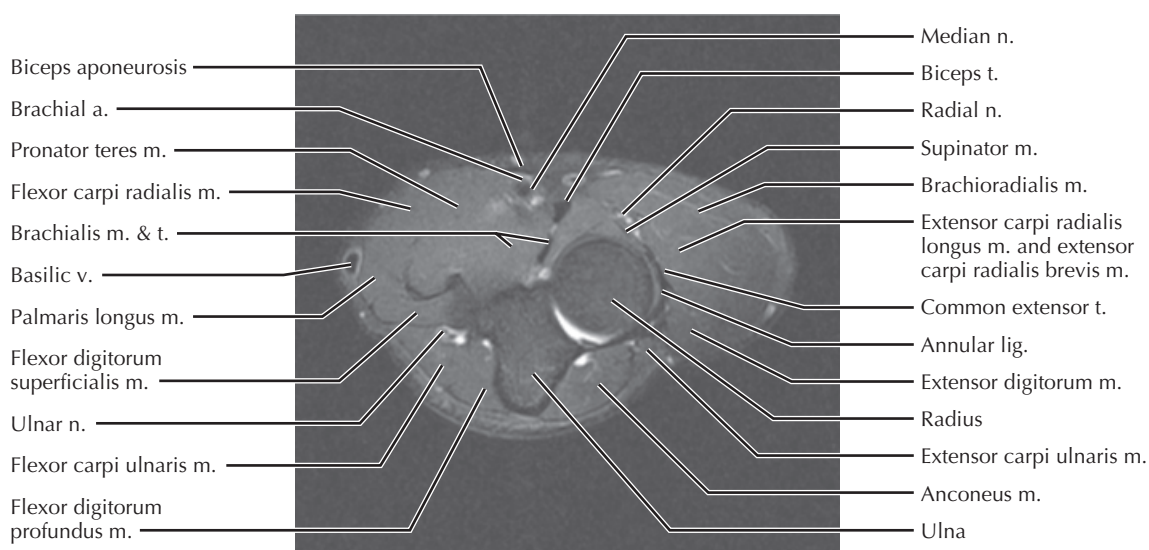
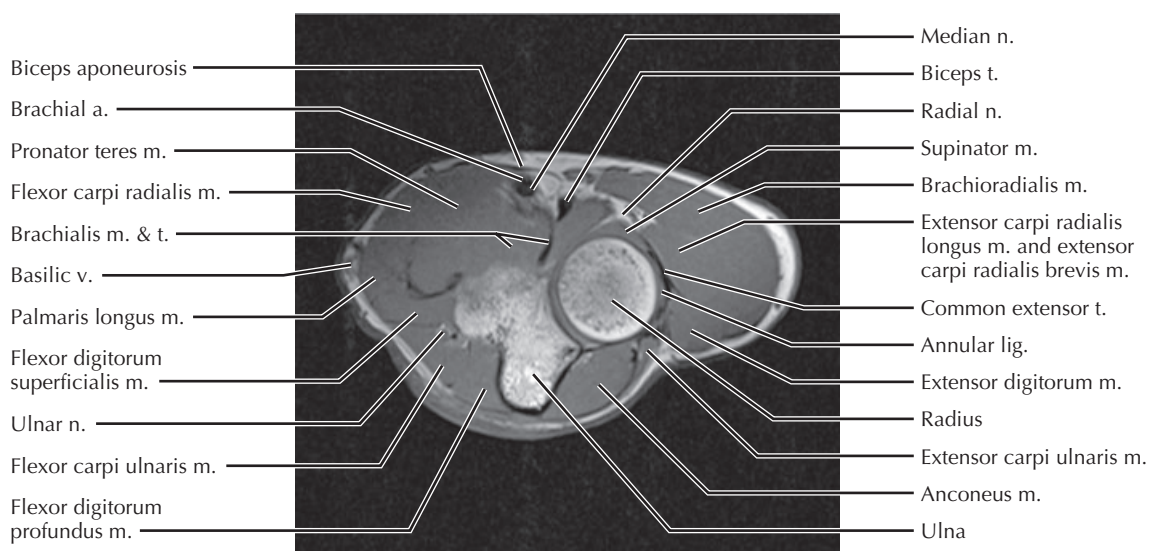
The ulnar nerve is particularly prone to injury because of its superficial location.

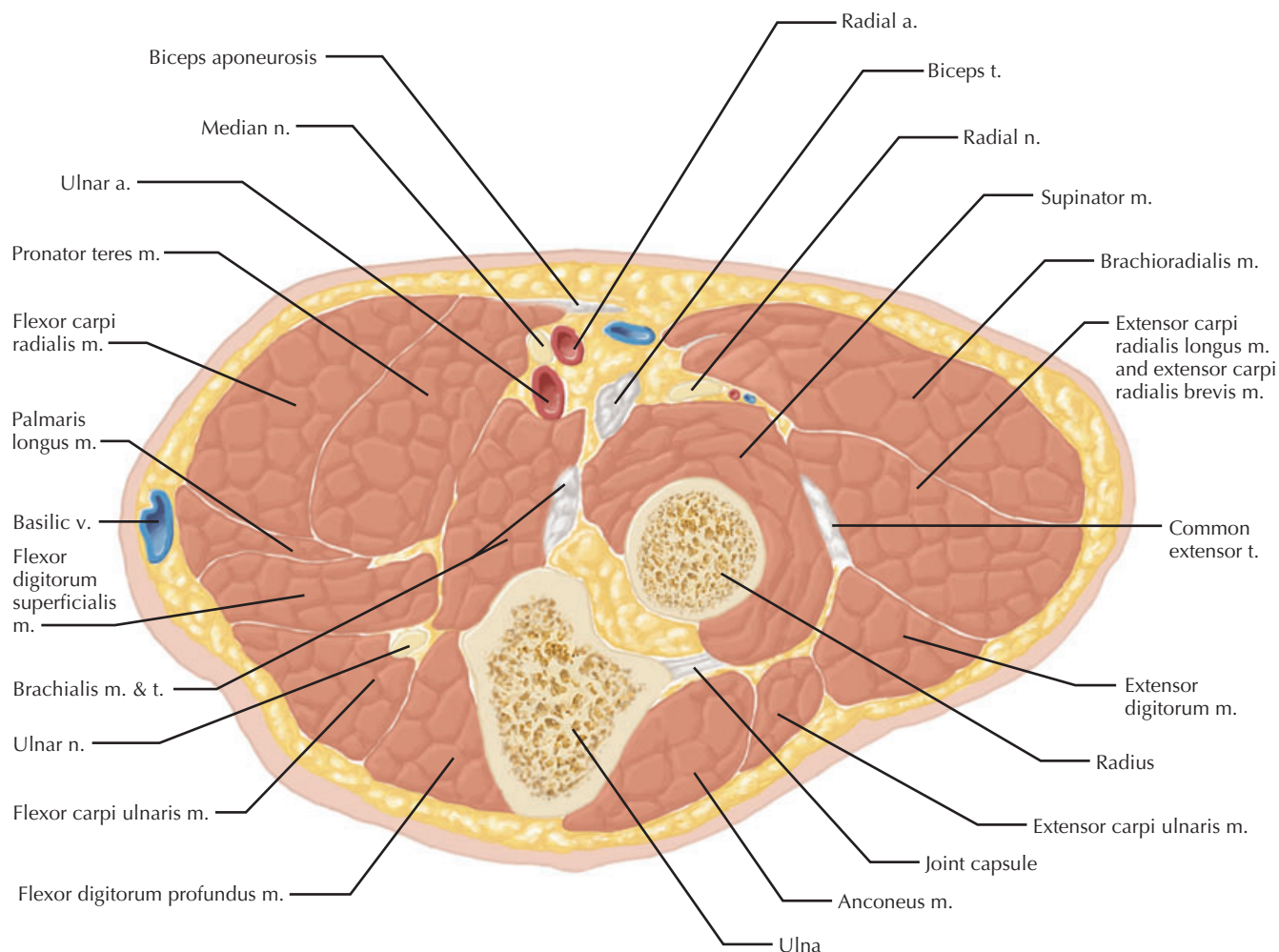






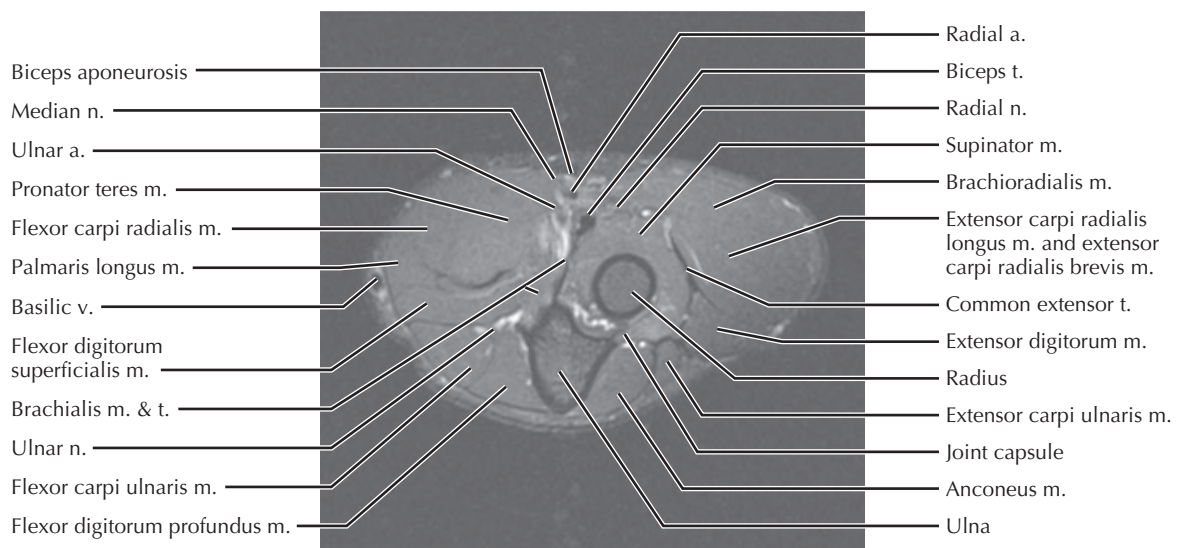
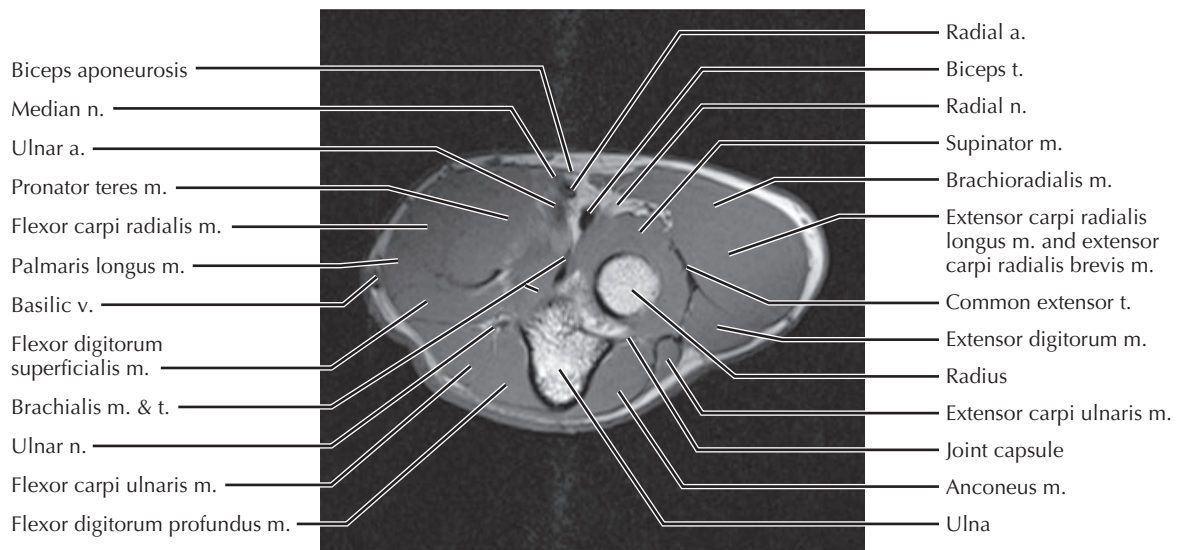
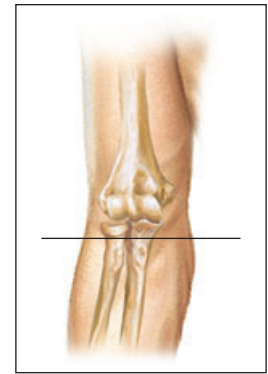


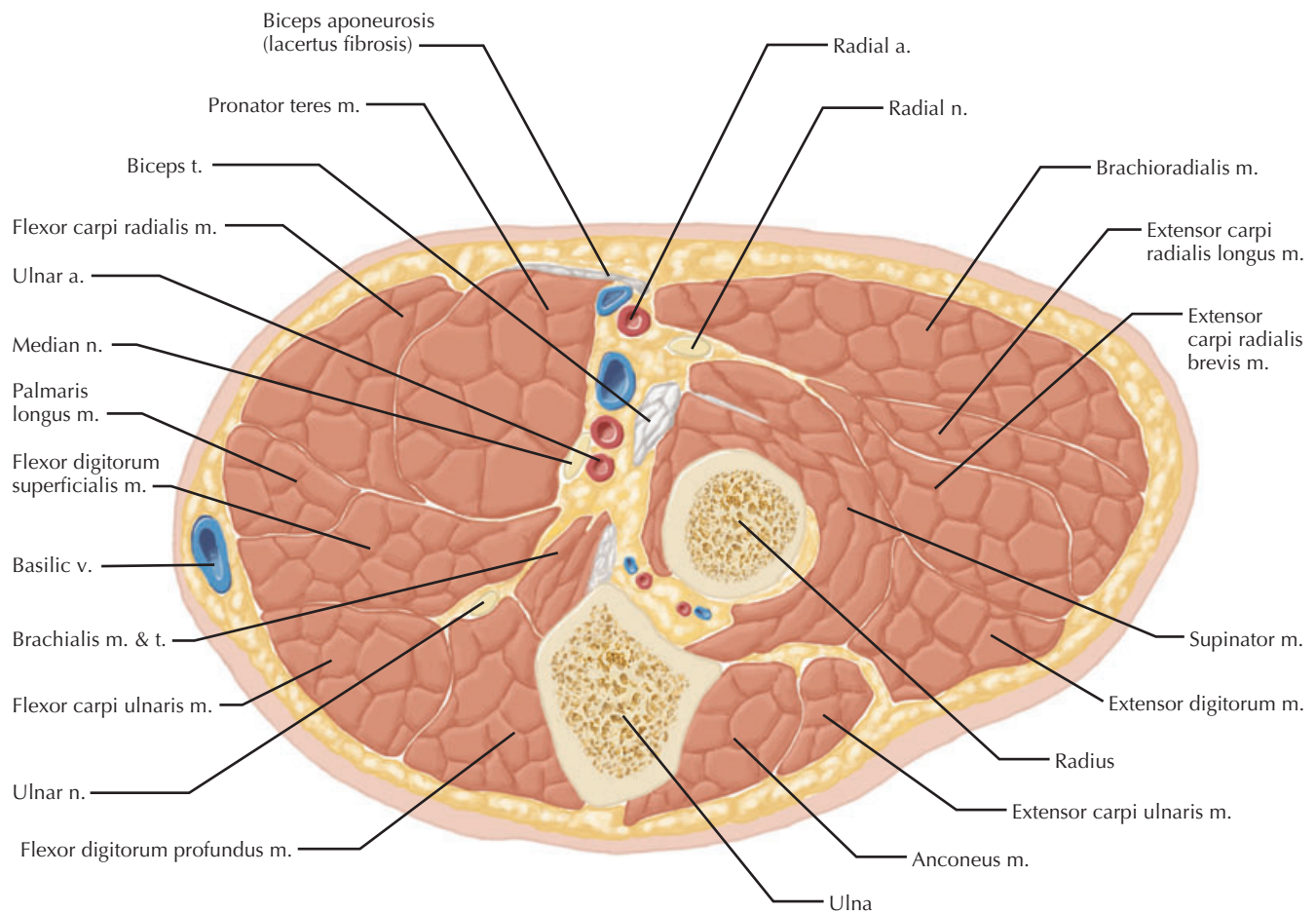


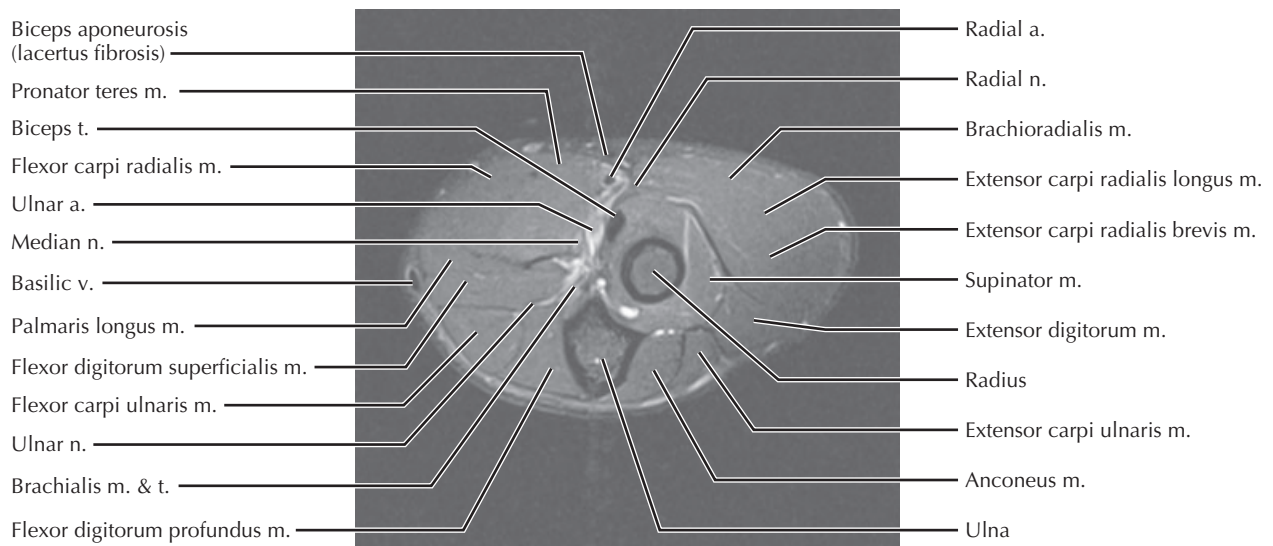
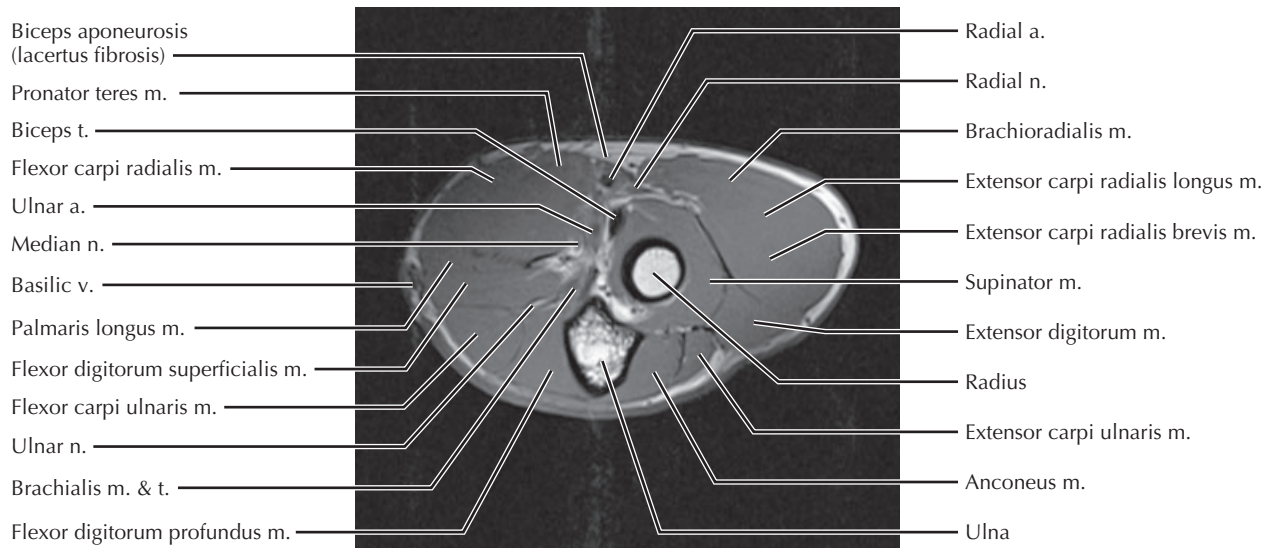
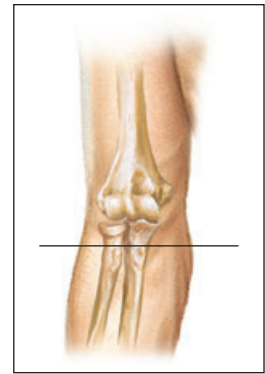


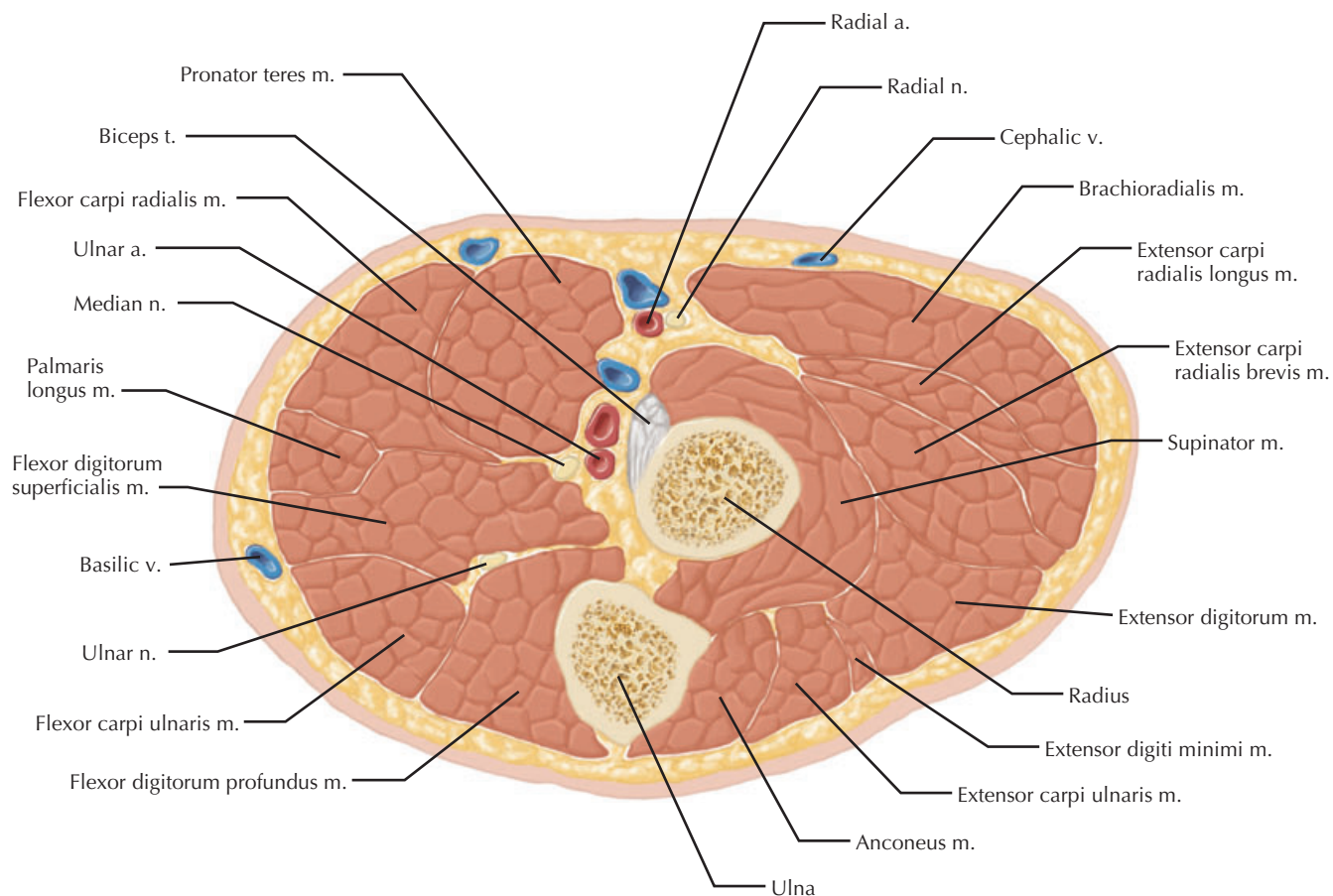
PATHOLOGIC PROCESS

The distal biceps tendon lacks a tendon sheath; therefore, inflammation in the distal biceps tendon should not be diagnosed as "biceps tenosynovitis." Instead, a fluid collection in the antecubital fossa is most often a bursitis and can occur in association with partial tears of the biceps tendon.



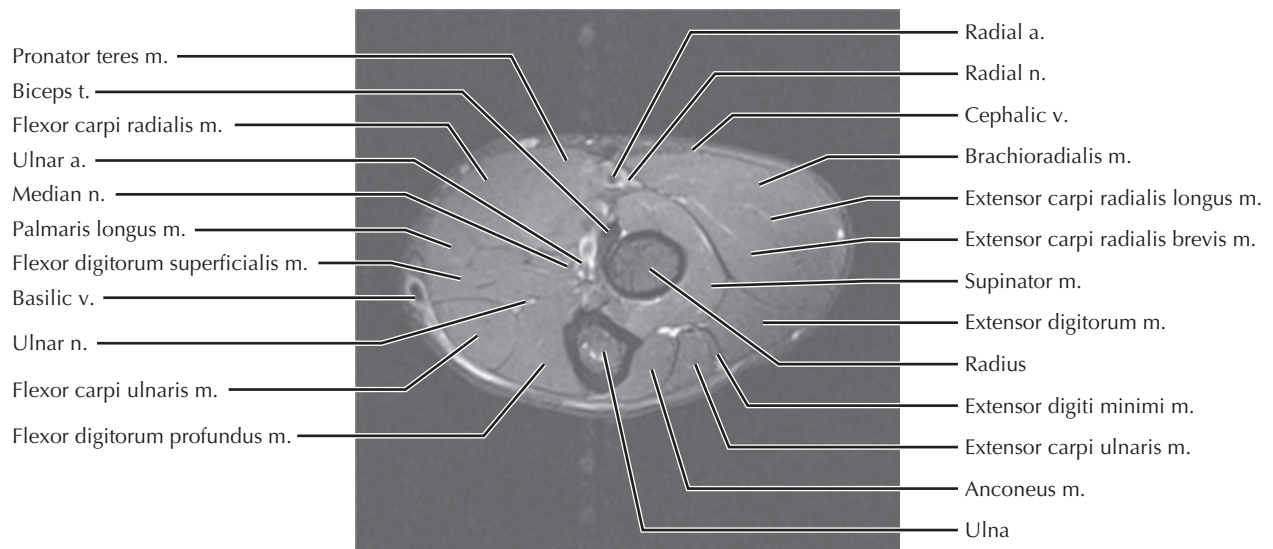
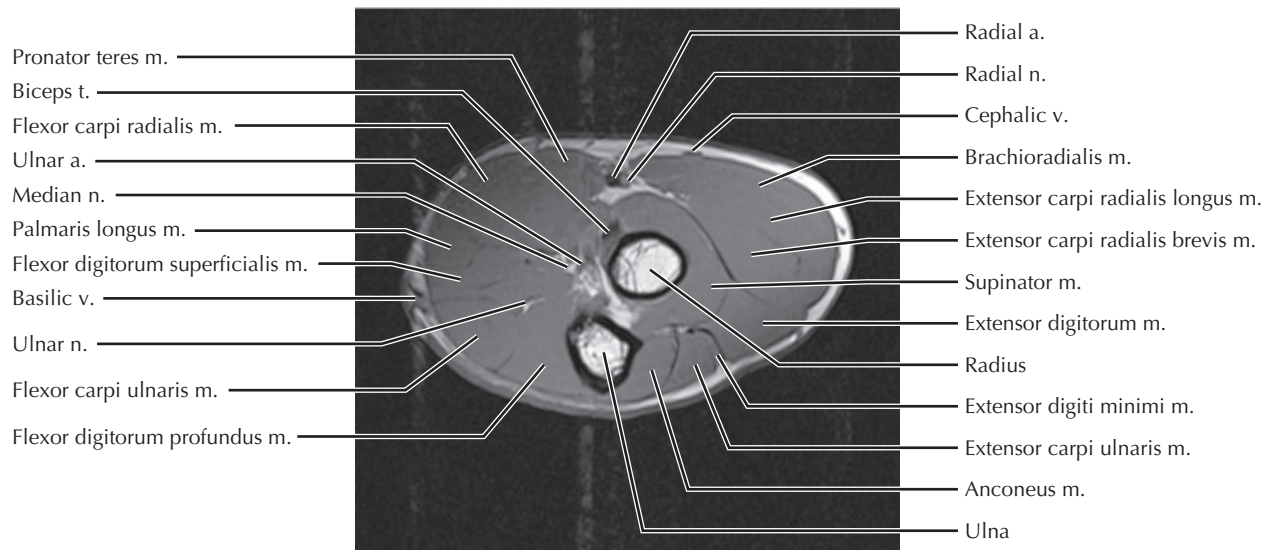
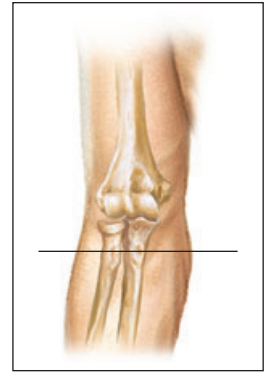


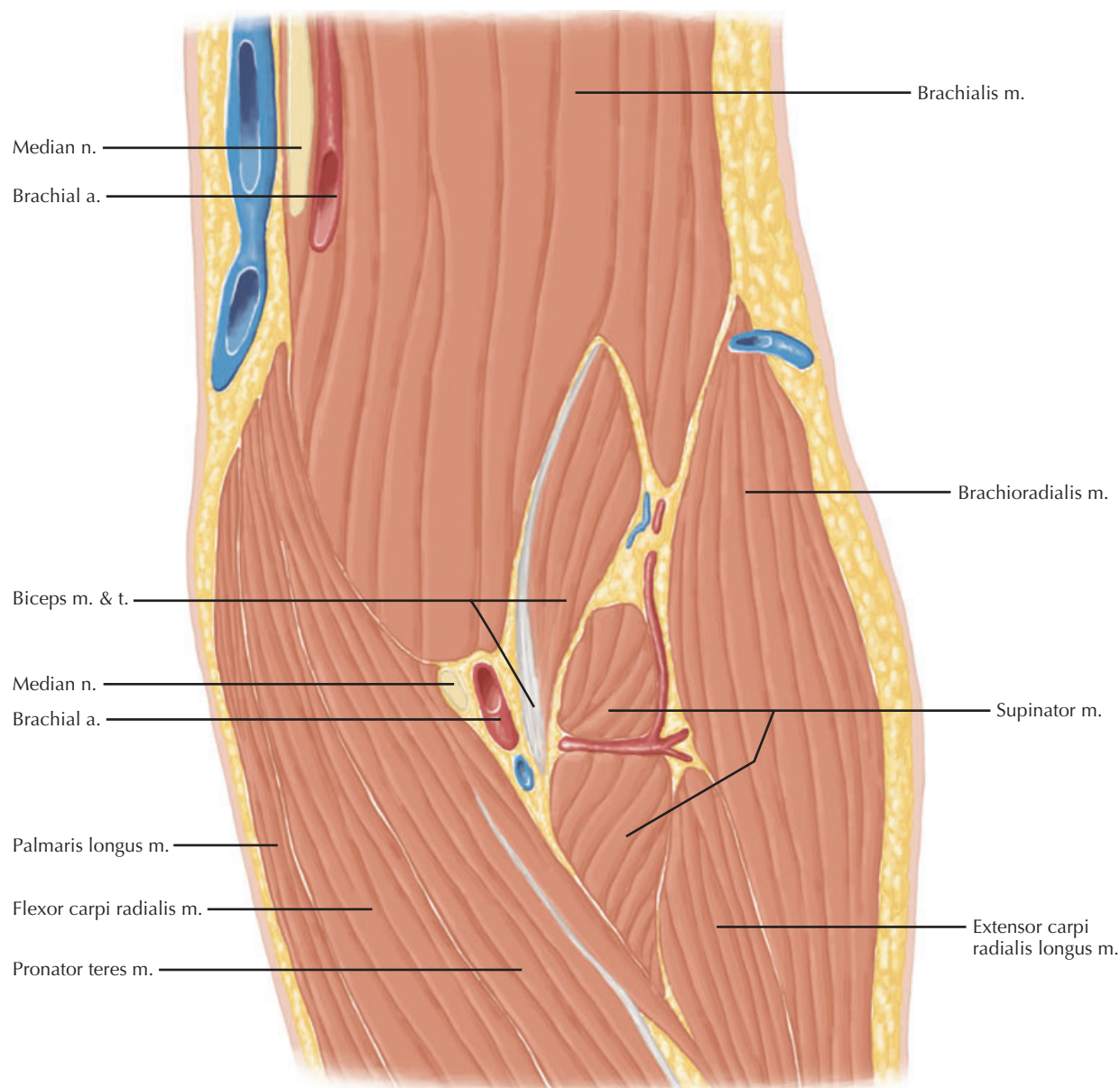




DIAGNOSTIC CONSIDERATION

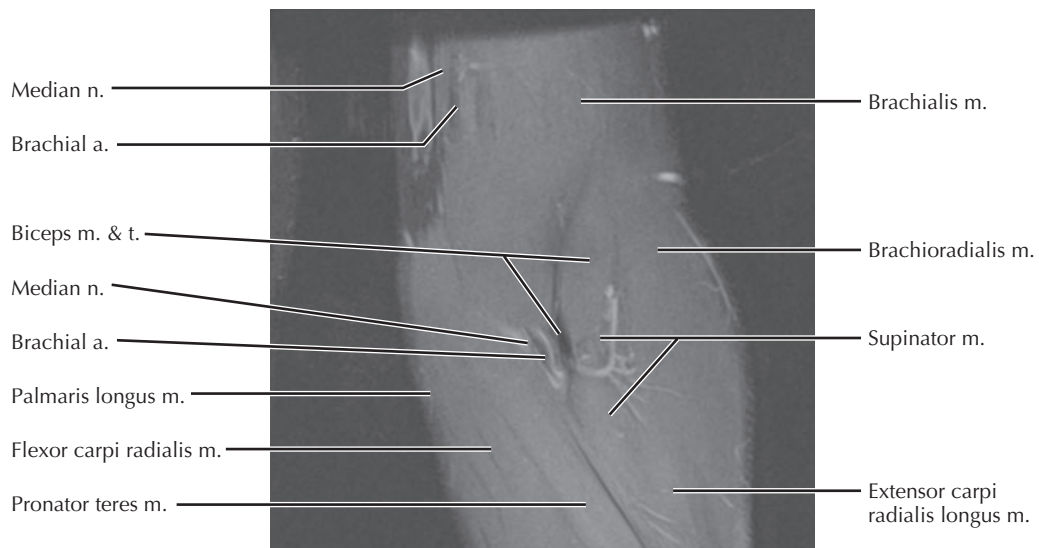
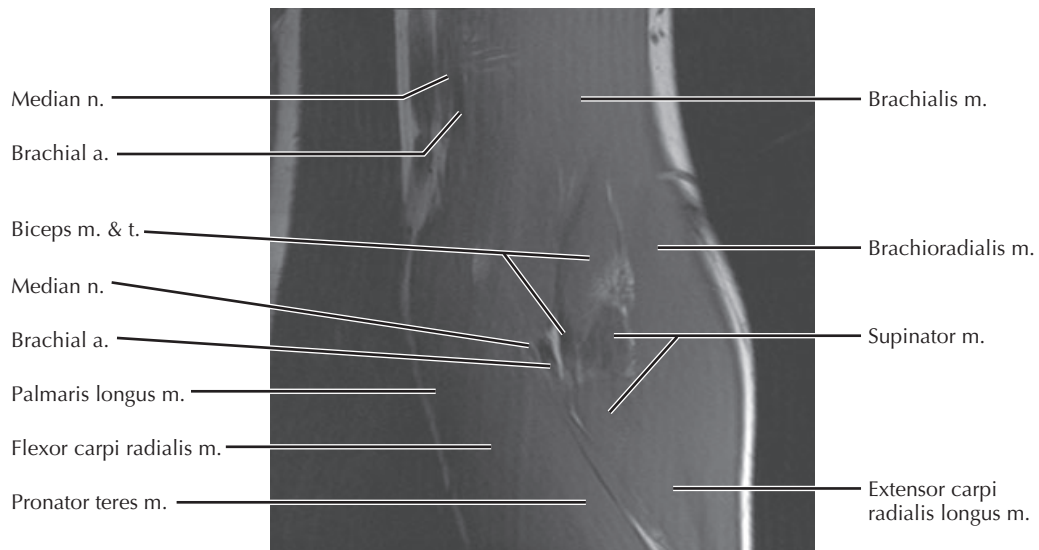
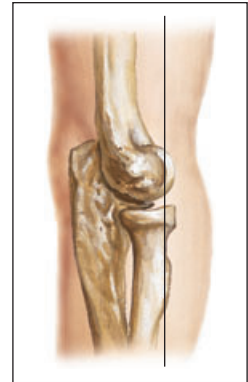
Axial MR images of the elbow should include this most distal image, to demonstrate the insertion of the biceps tendon on the tuberosity.

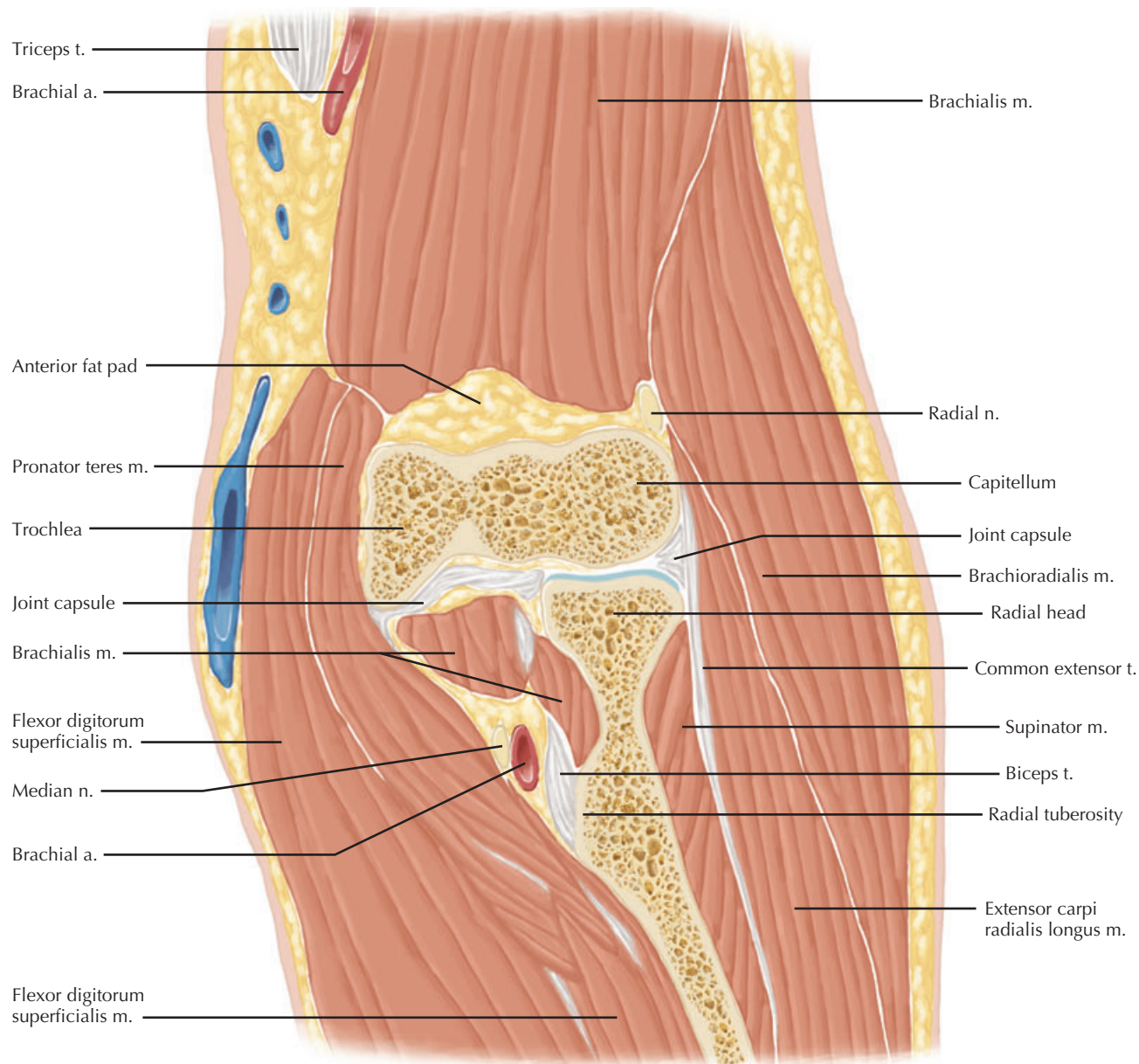




PATHOLOGIC PROCESS

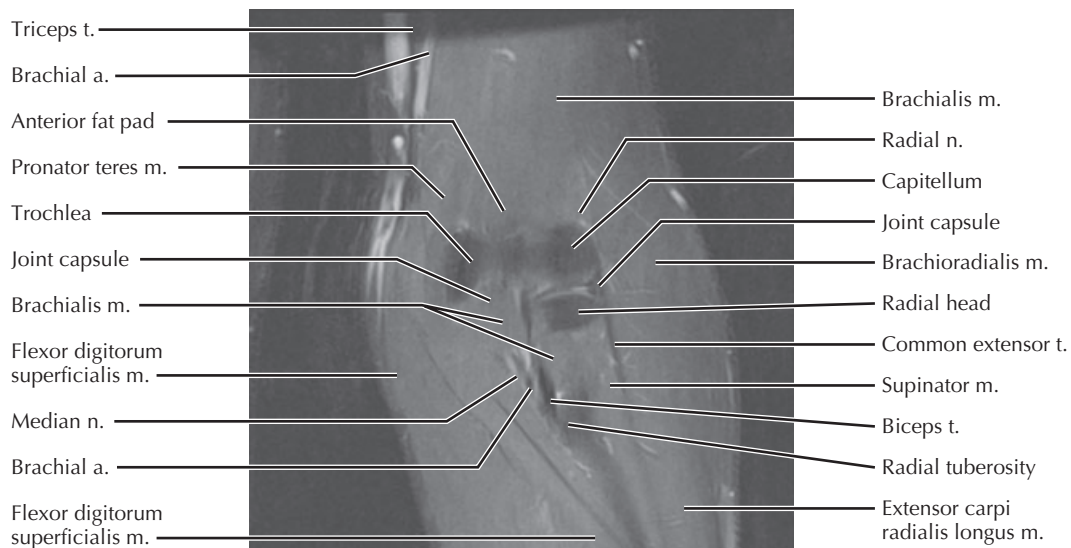
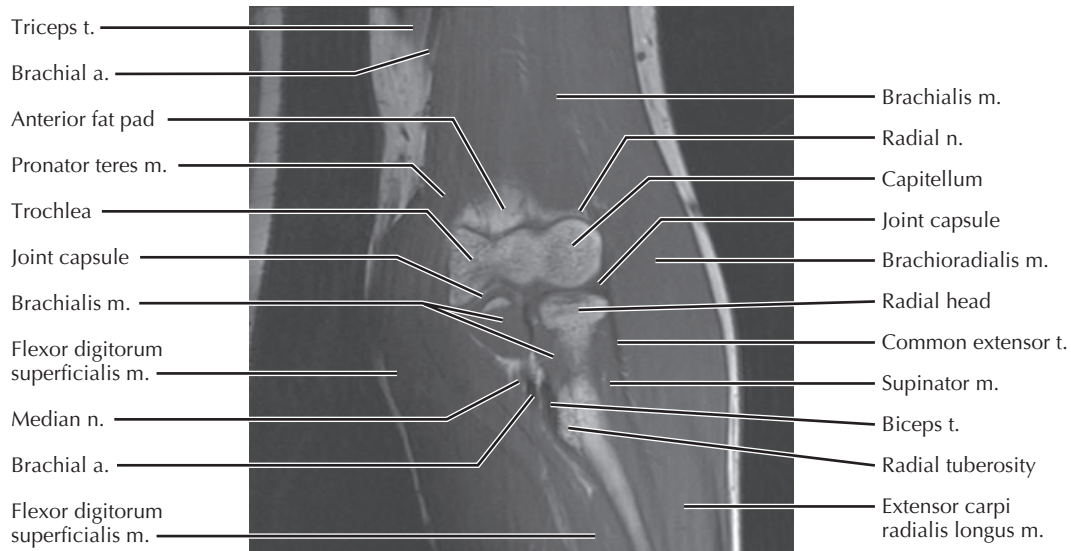
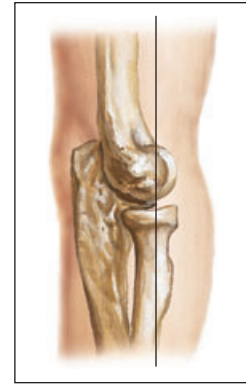
The bicipital aponeurosis is a fibrous structure originating from the distal aspect of the biceps muscle. It functions to keep the biceps tendon in place. A biceps tendon rupture can be easily overlooked on physical examination if the aponeurosis remains intact.

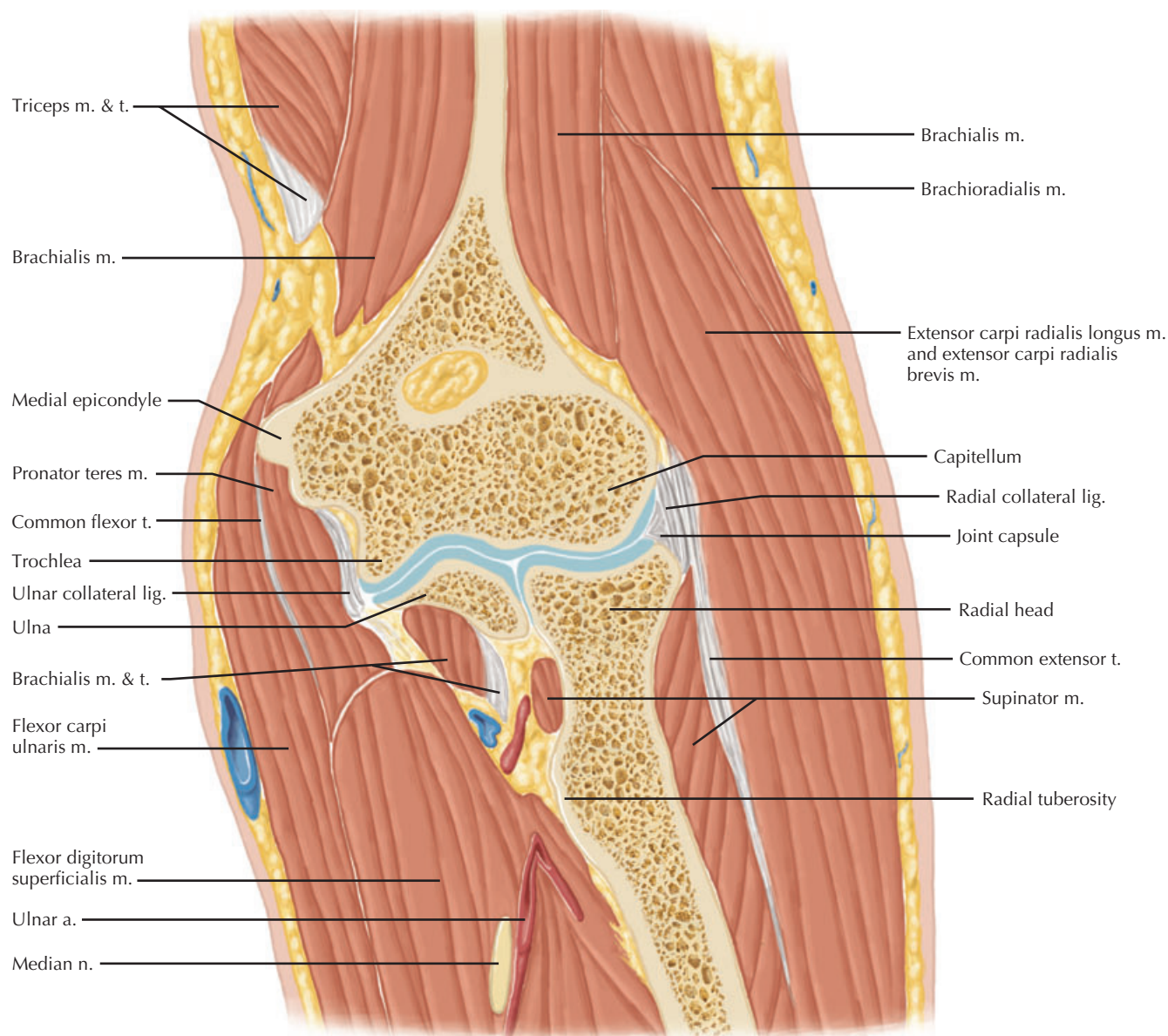




DIAGNOSTIC CONSIDERATION

Coronal images of the elbow should include the biceps tendon inserting onto the radial tuberosity. Biceps ruptures at the elbow most often occur at the insertion. This feature is well visualized on the MR image here.



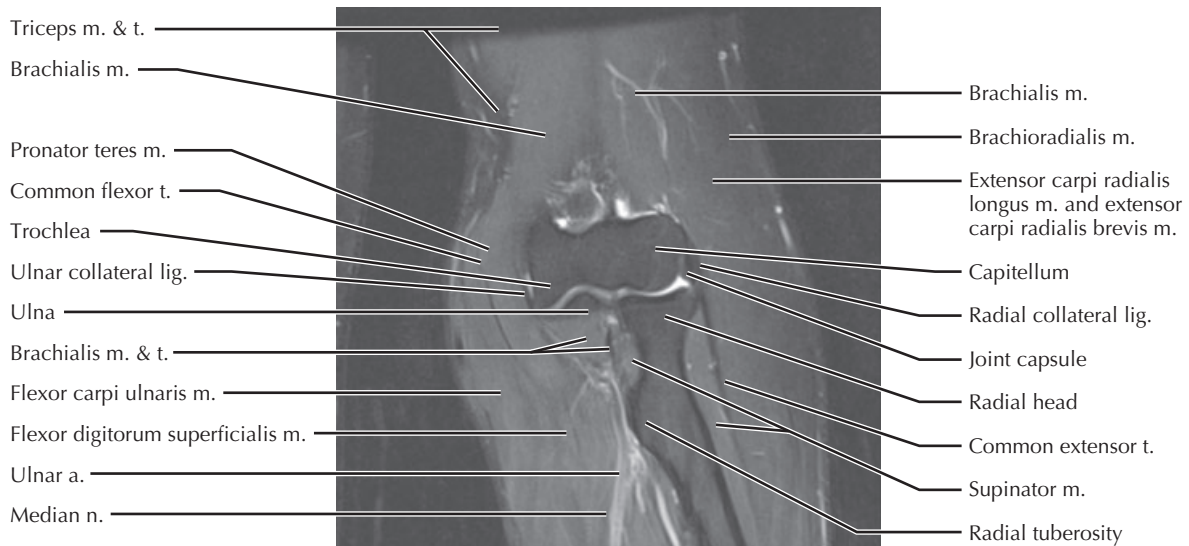
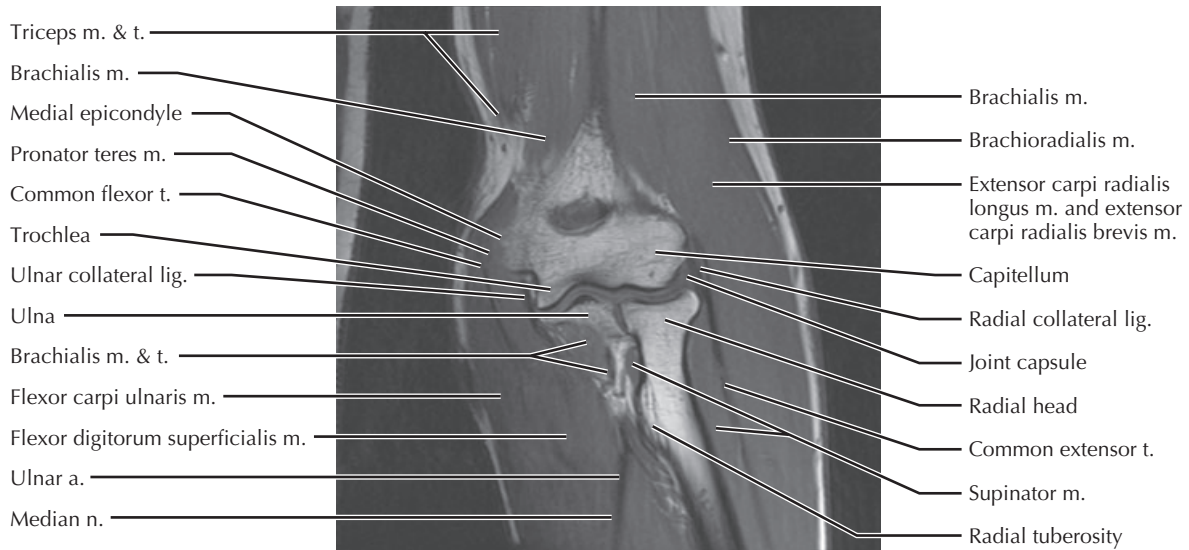
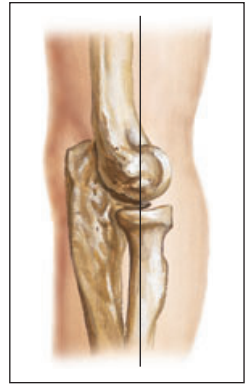


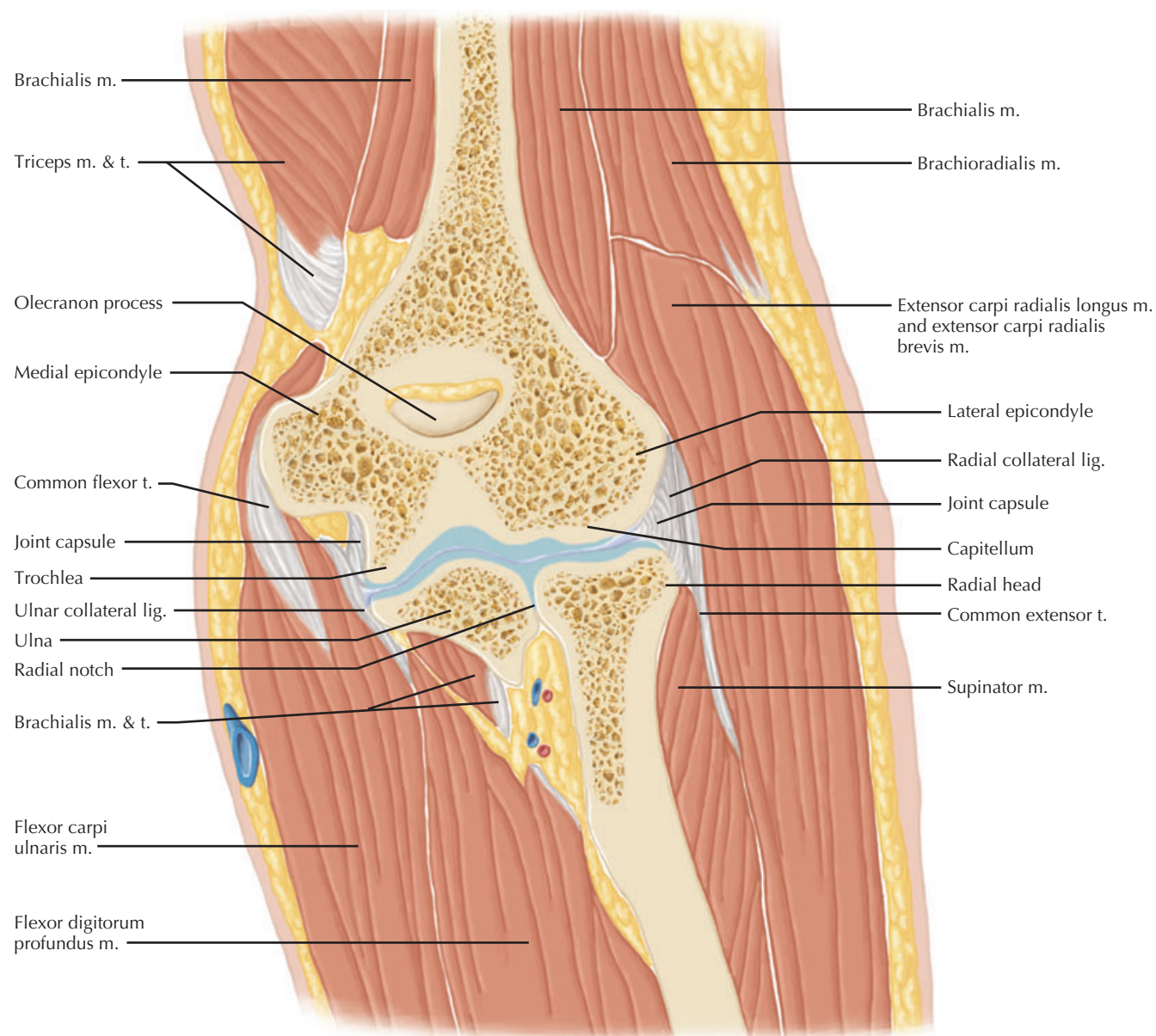
PATHOLOGIC PROCESS

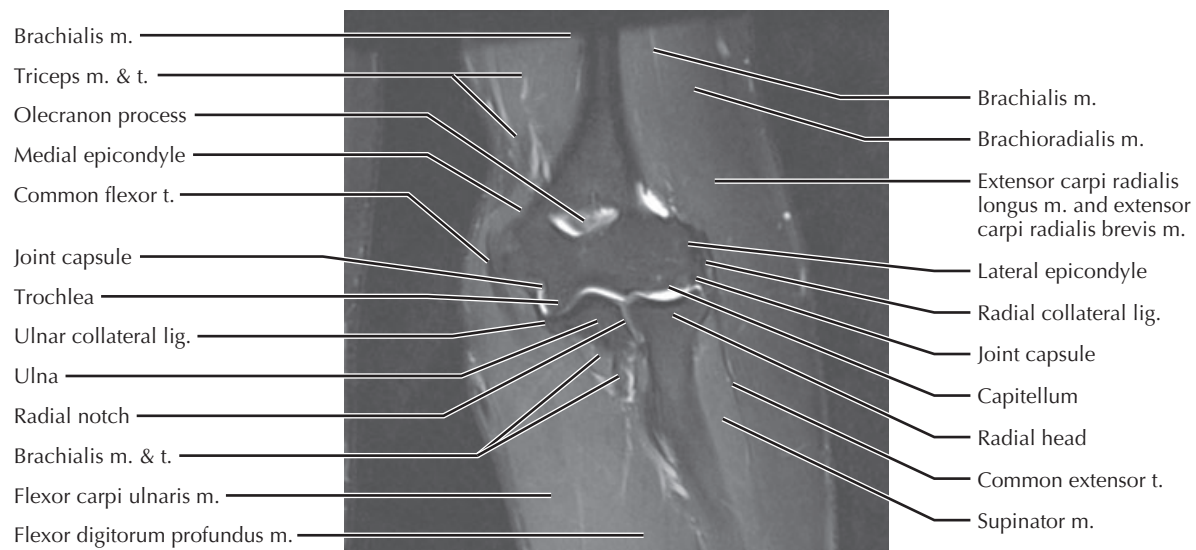
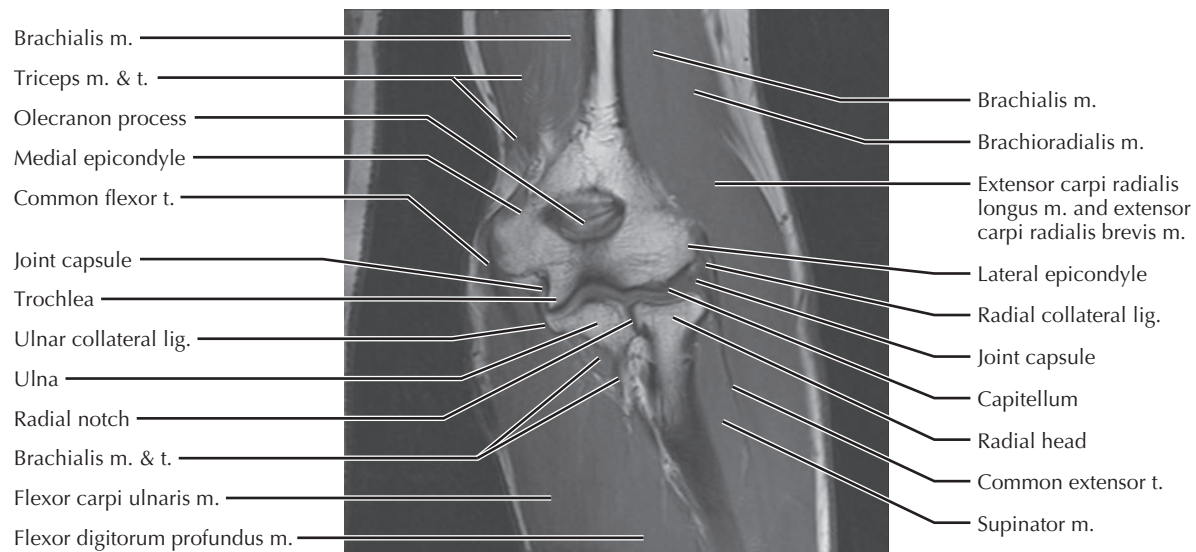
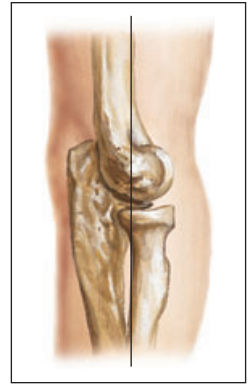
The distal aspect of the ulnar collateral ligament (UCL) should have a tight association with the underlying bone. Partial tears of the UCL demonstrate fluid signal between the ligament and the bone. Injuries of the UCL are well visualized in the coronal plane.

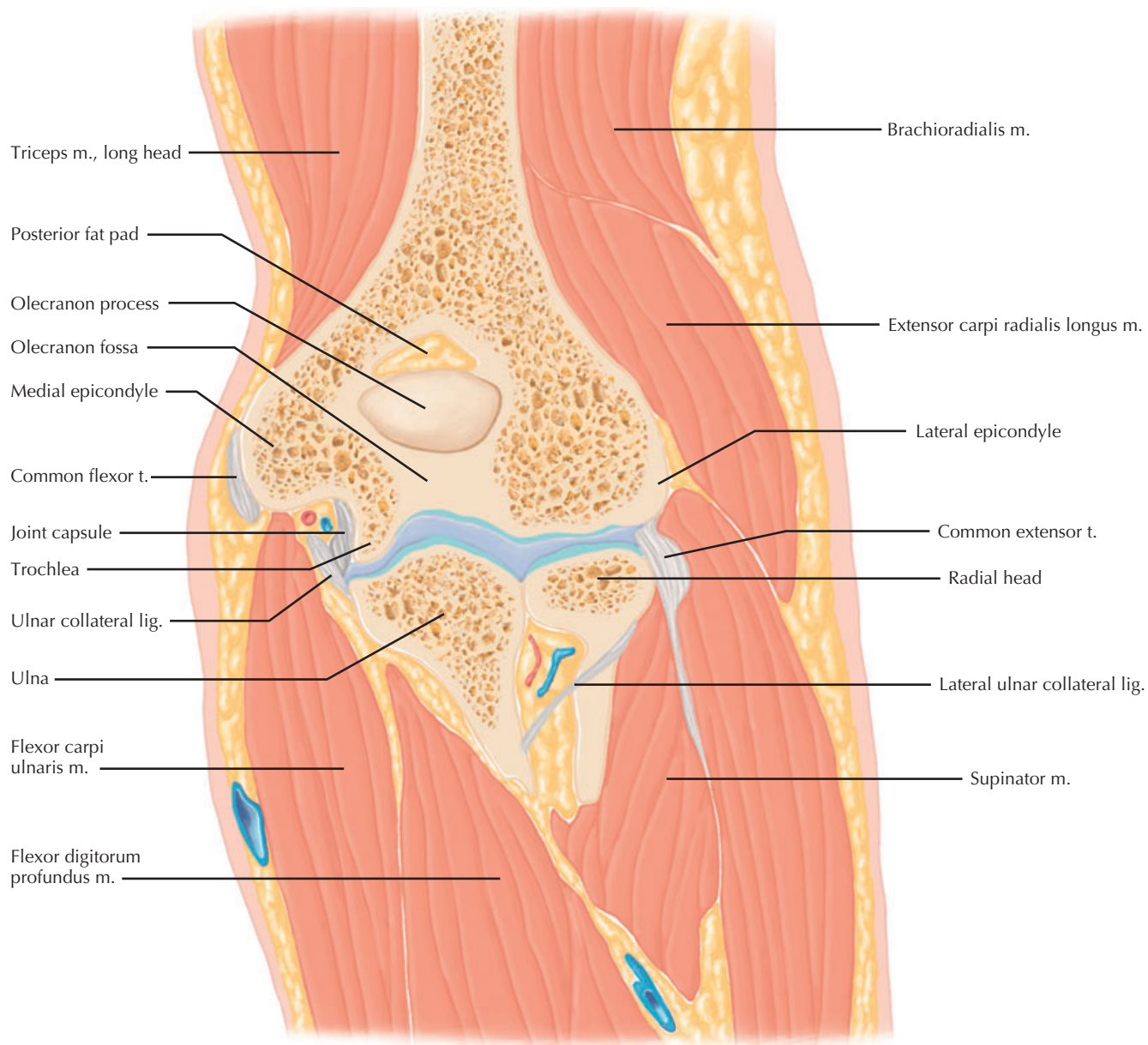
NORMAL ANATOMY

The origin of the common extensor tendon on the lateral epicondyle is difficult to distinguish from the origin of the true radial collateral ligament (radiocollateral ligament). These two structures are closely opposed, but the distal aspect of the radial collateral ligament can be identified inserting onto the annular ligament (joint capsule), while the common extensor tendon extends distally into the extensor muscle mass.



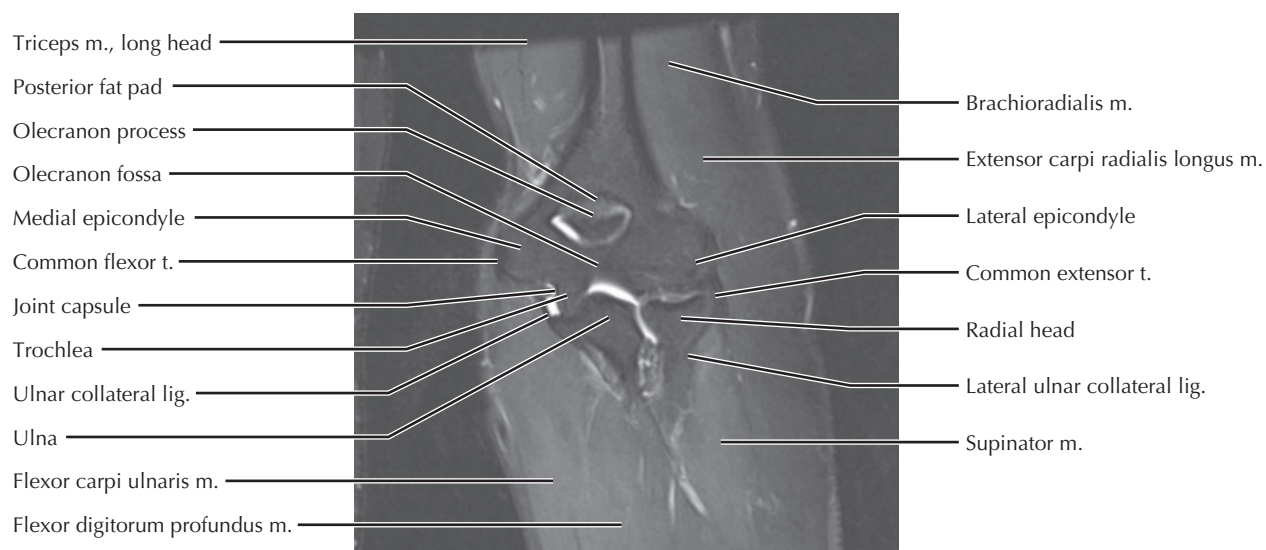
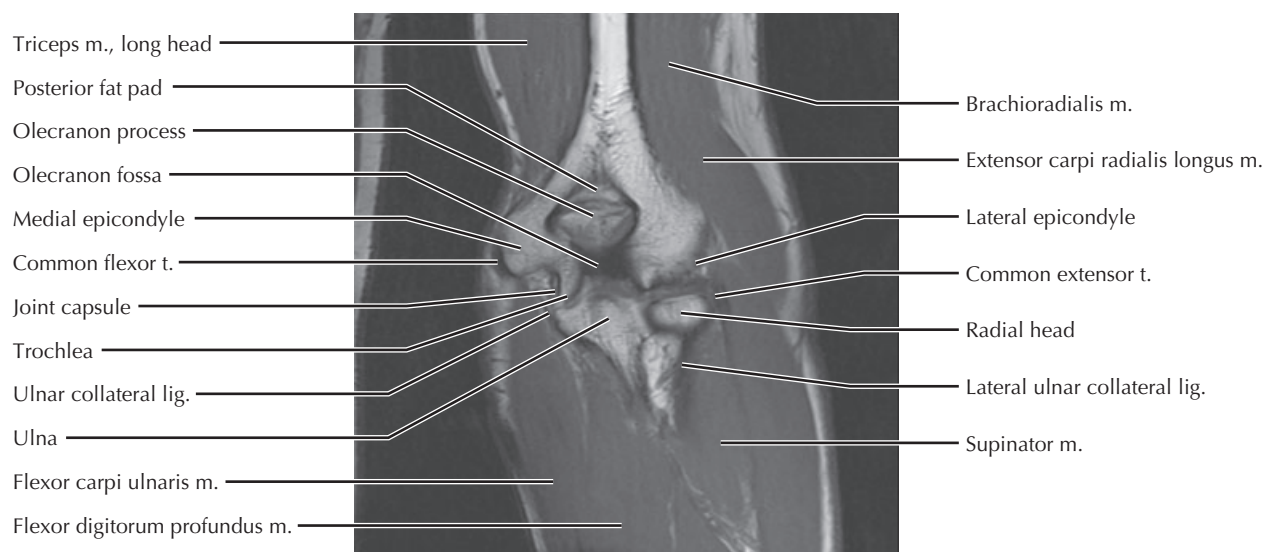
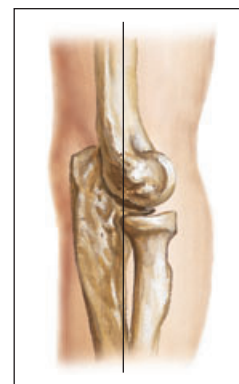


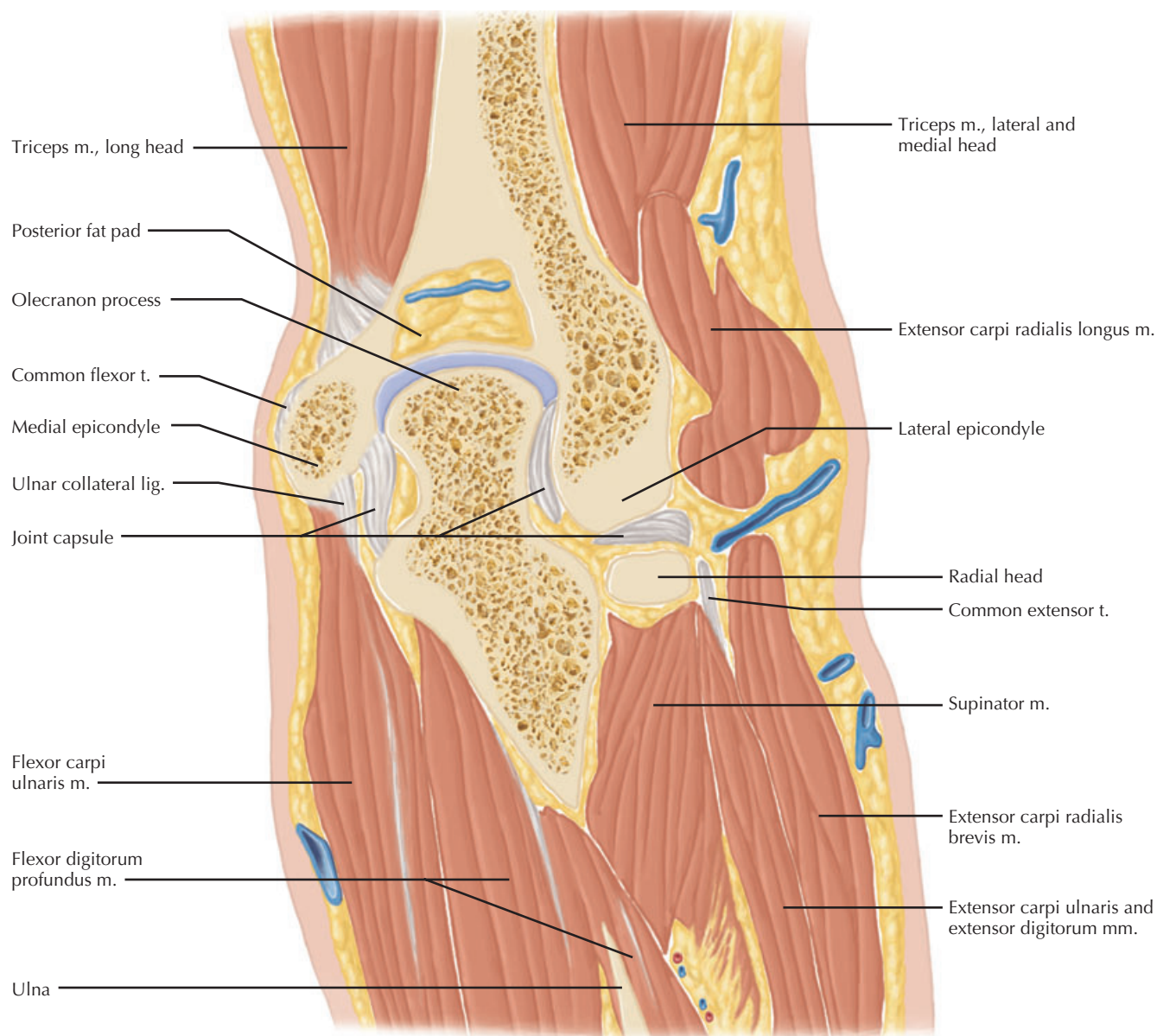




NORMAL ANATOMY

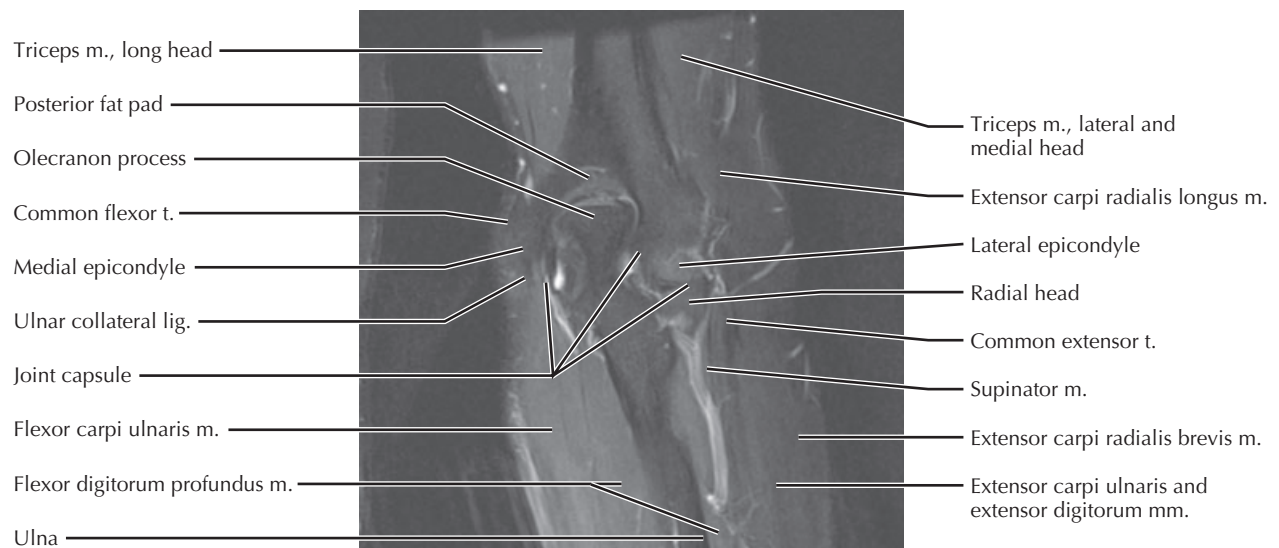
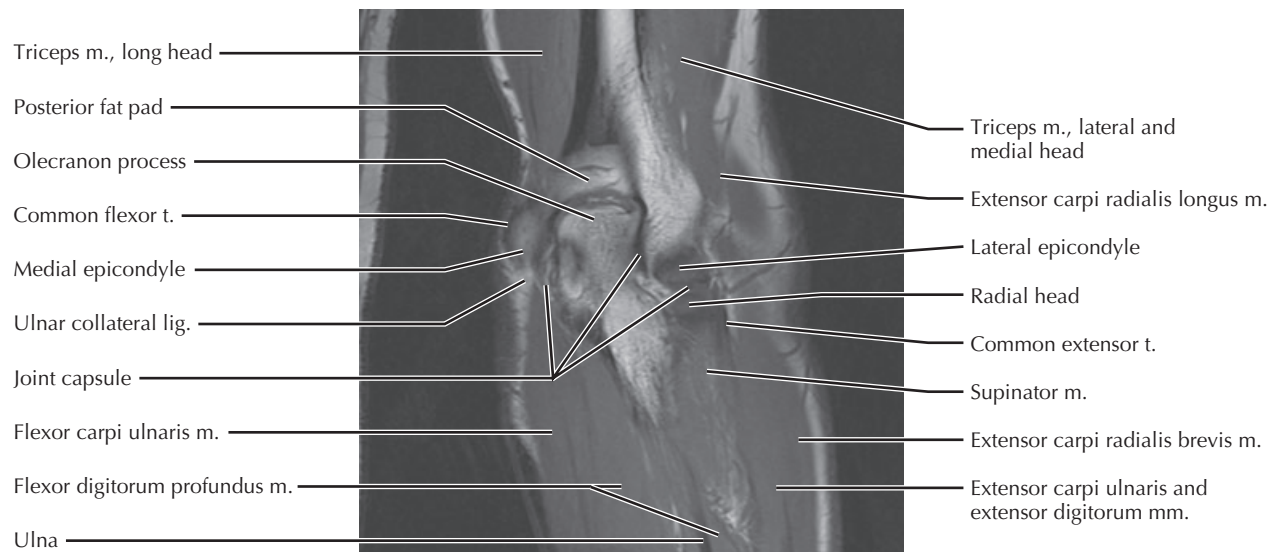
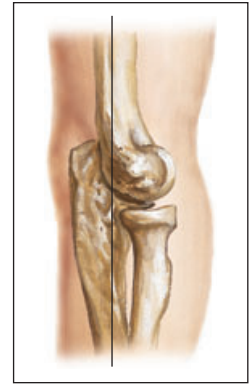
The posterior aspect of the lateral epicondyle has a "pseudodeflect." The bone surface looks irregular only on the coronal view because of the abrupt upslope of the posterior portion of the capitellum. This finding mimics an osteochondral lesion, but there is no cartilage in this location.

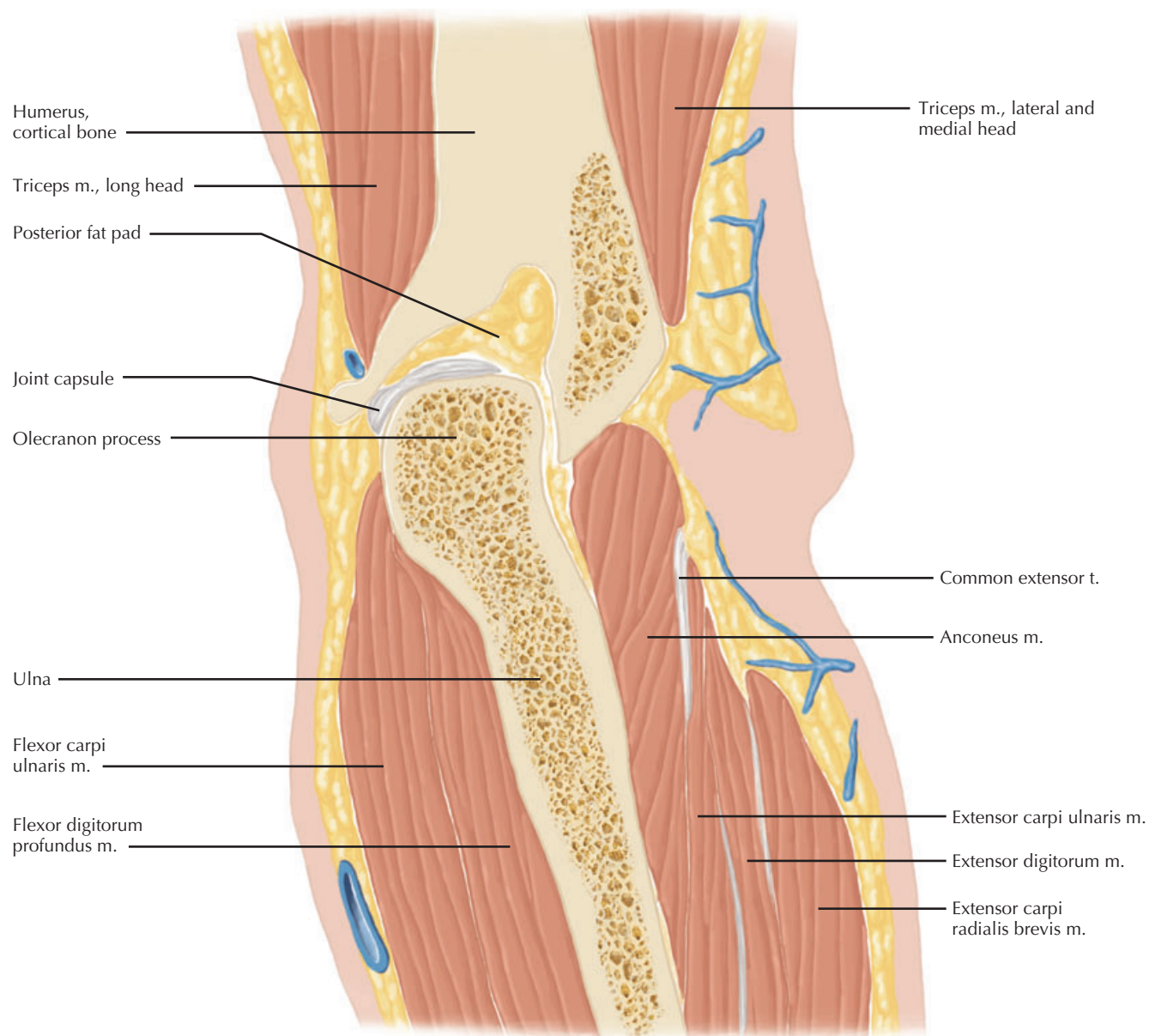


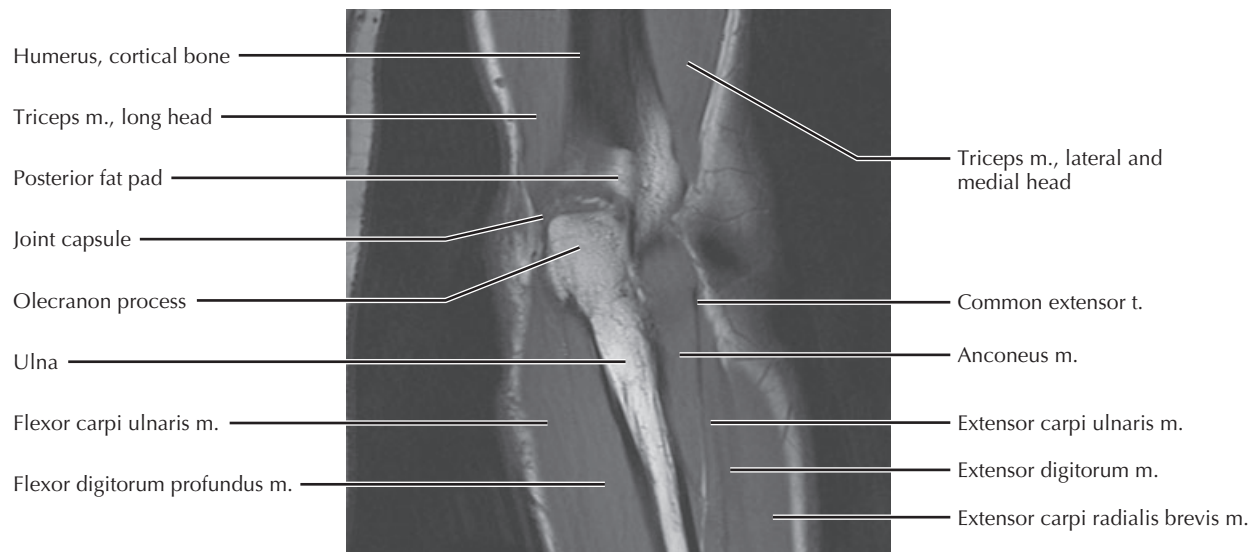
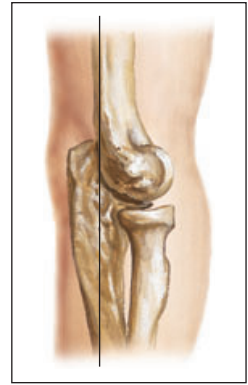


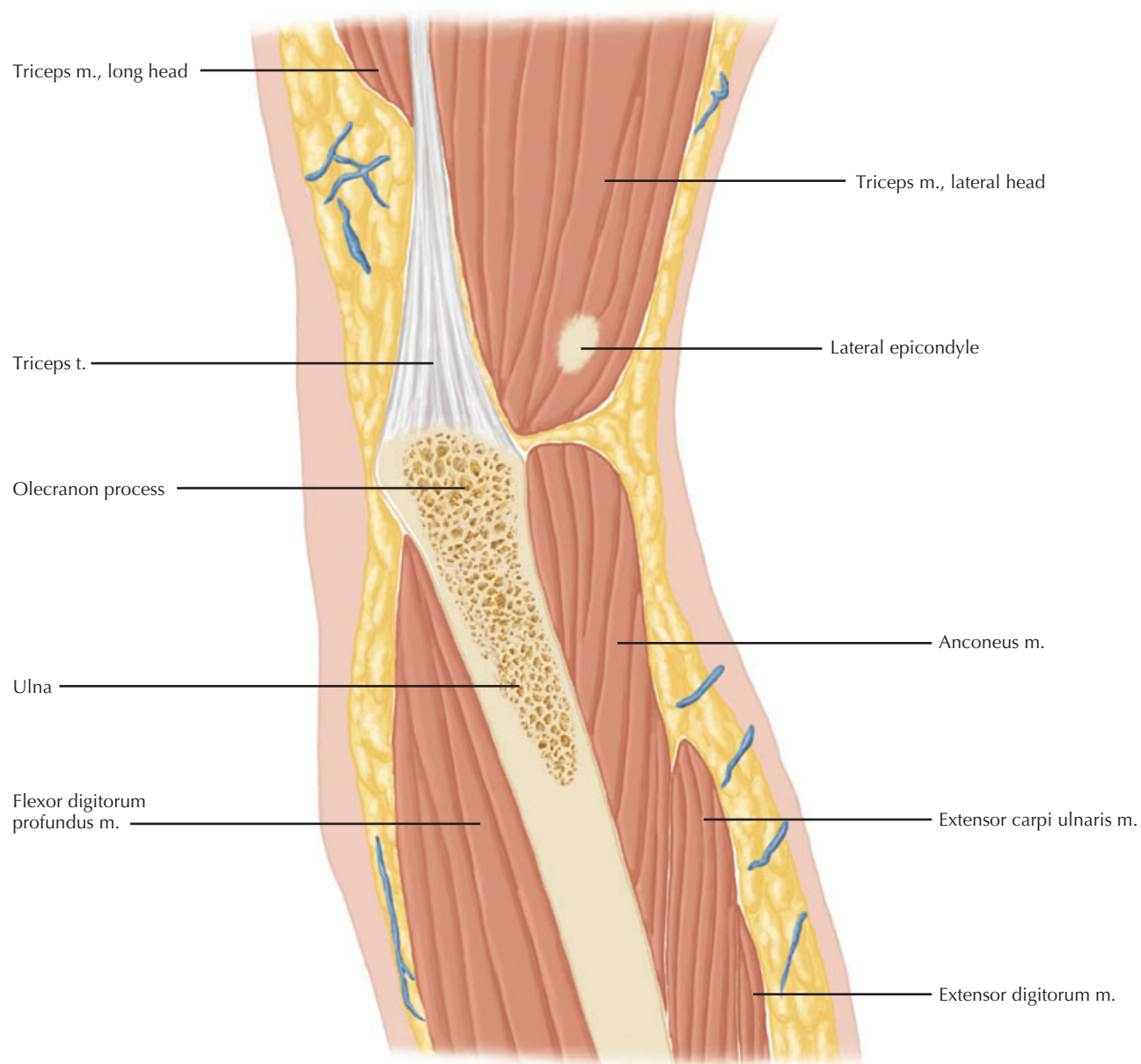
NORMAL ANATOMY

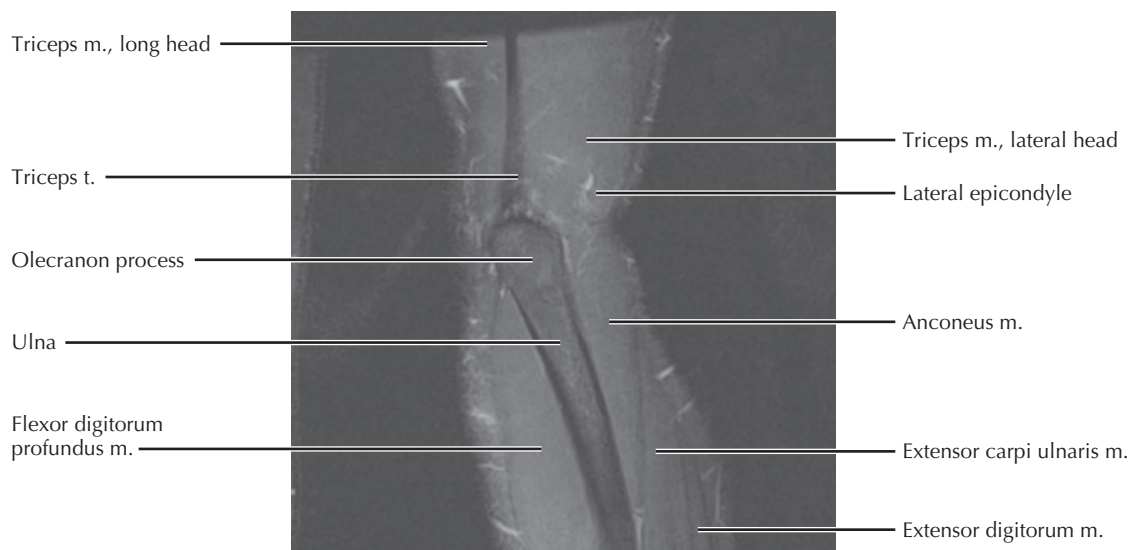
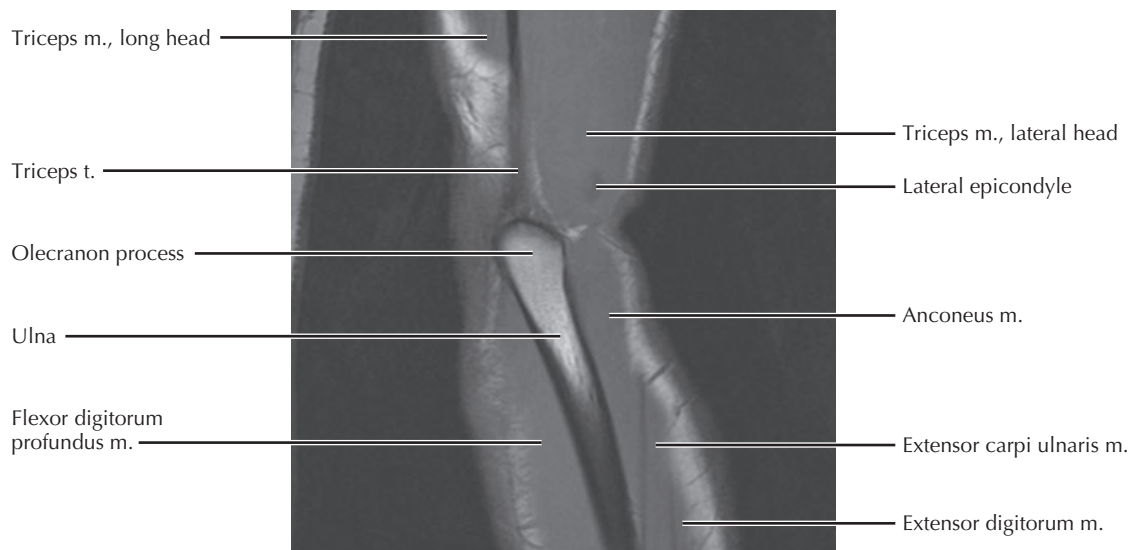
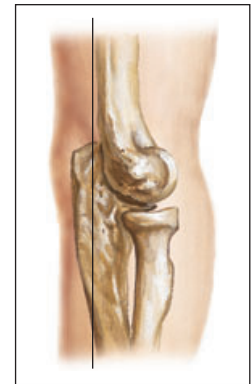
The lateral ulnar collateral ligament (LUCL) is visualized on the posterior coronal images. The LUCL is important to identify because it maintains radioulnar joint congruency as well as radiocapitellar joint congruency.

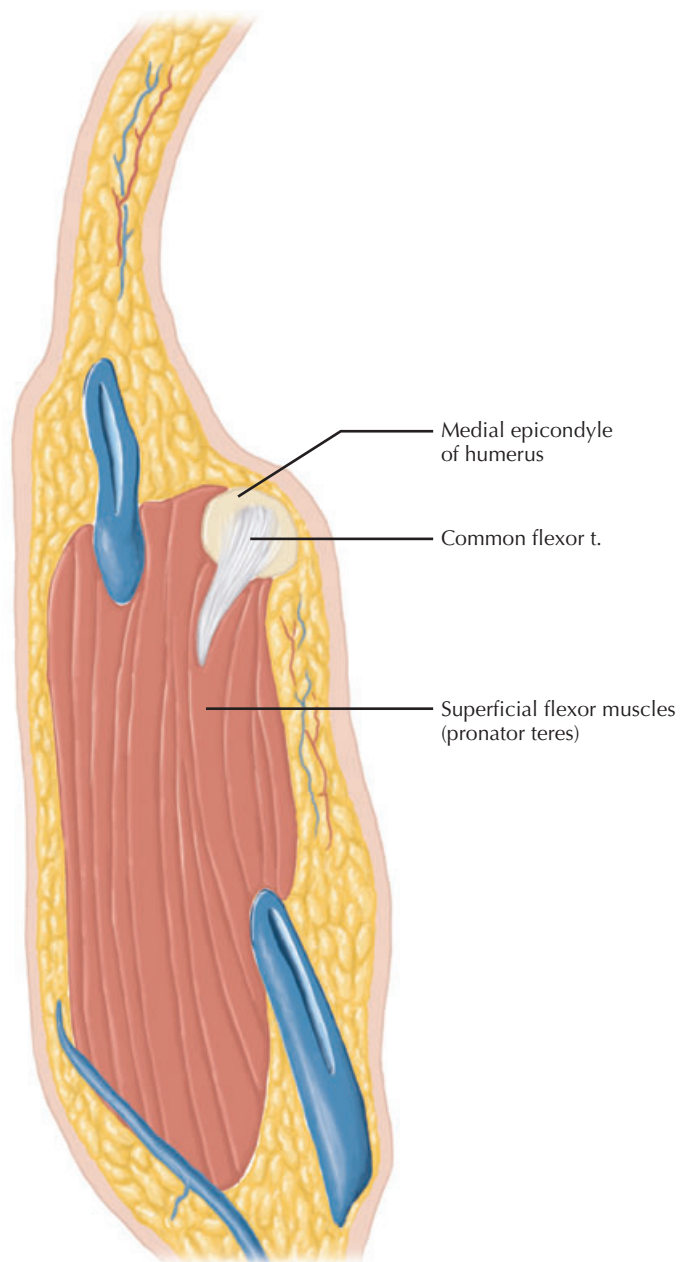


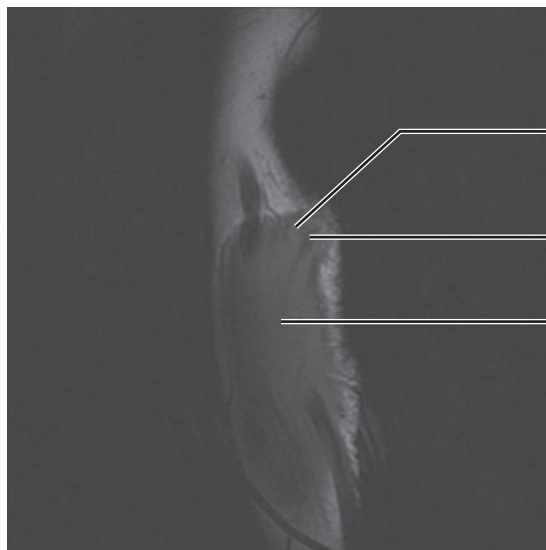








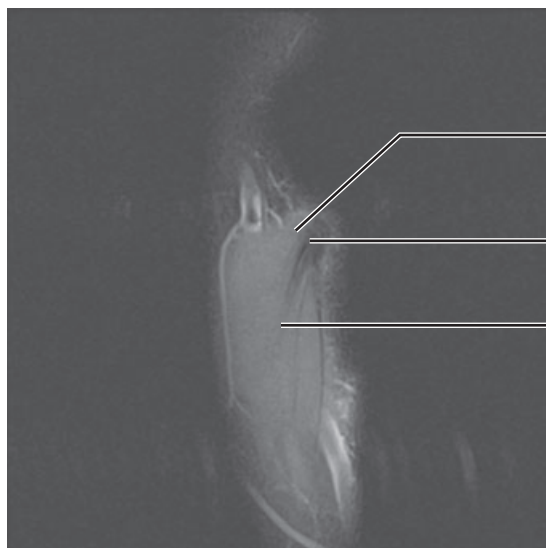




Medial epicondyle
of humerus

Common flexor t.

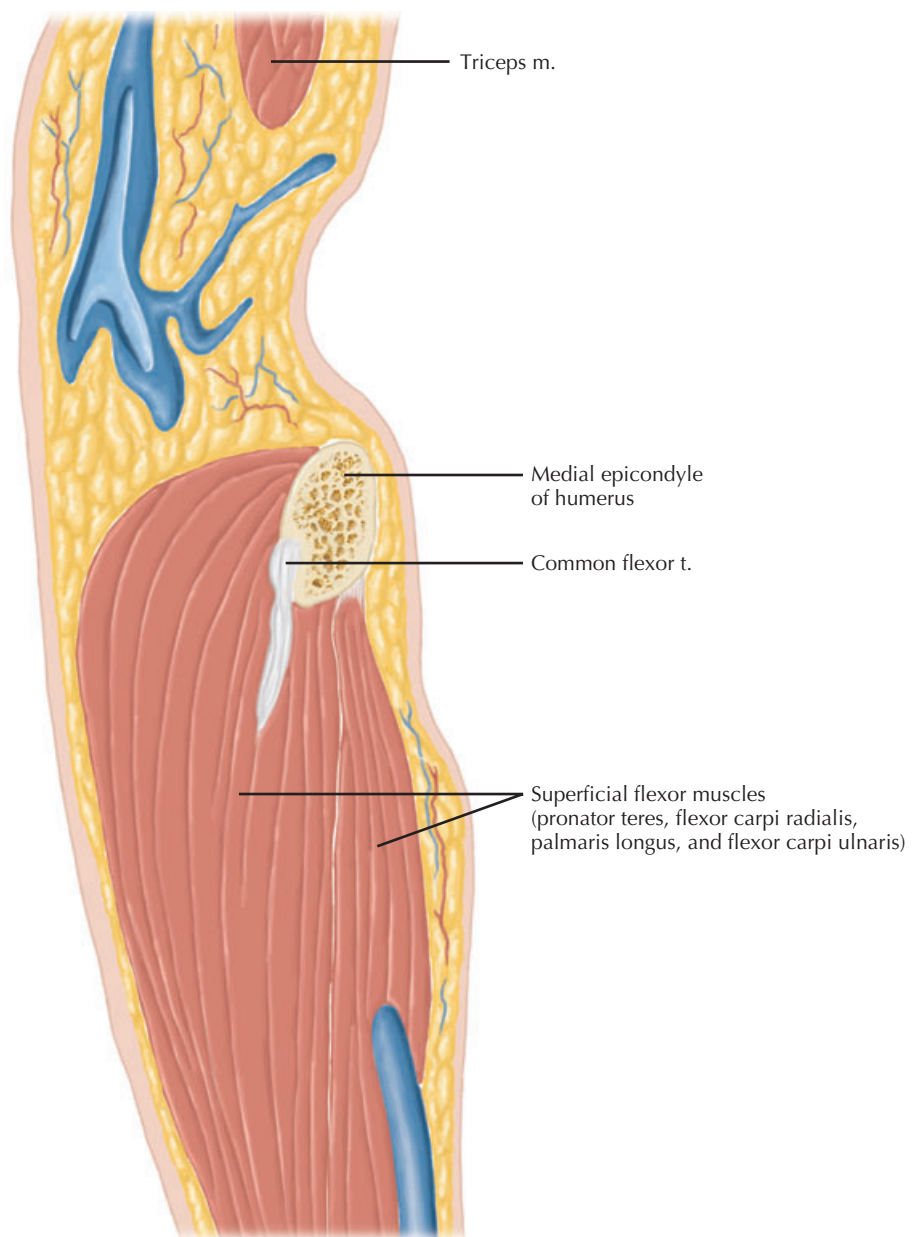
Superficial flexor muscles
(pronator teres)

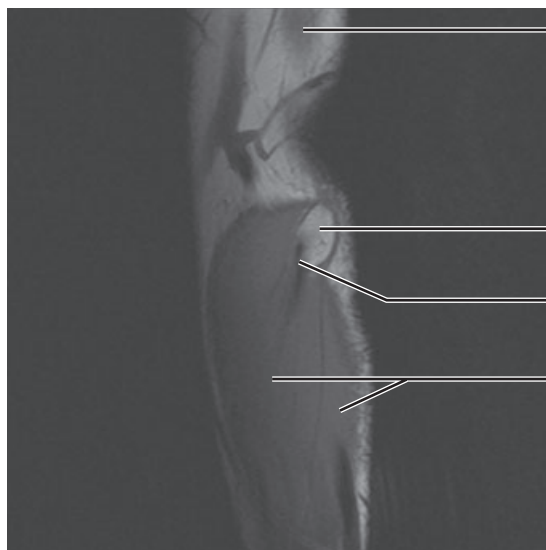


Medial epicondyle
of humerus

Common flexor t.

Superficial flexor muscles
(pronator teres)



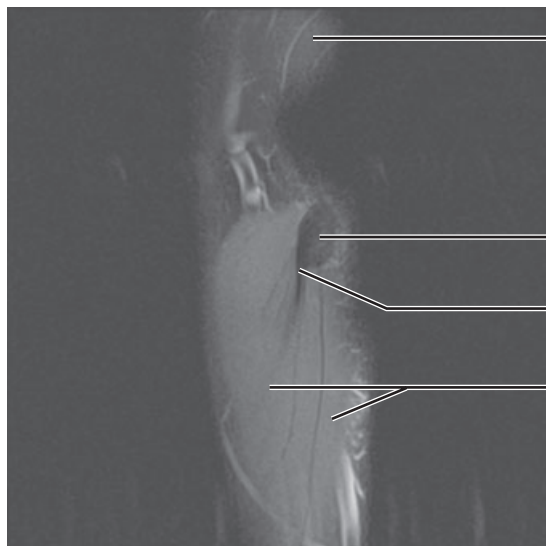


Triceps m.

Medial epicondyle
of humerus

Common flexor t.

Superficial flexor muscles
(pronator teres, flexor carpi
radialis, palmaris longus, and
flexor carpi ulnaris)

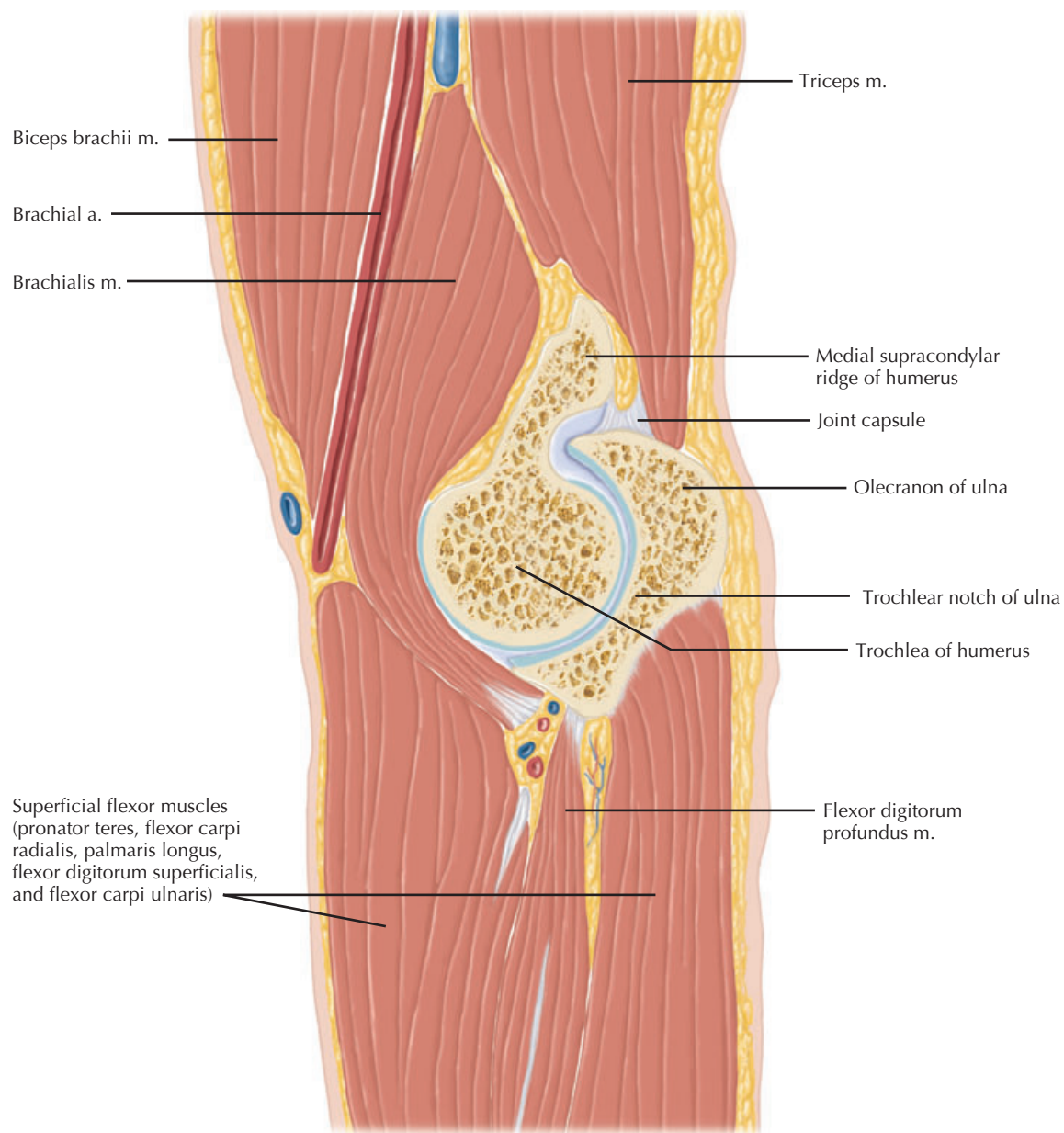


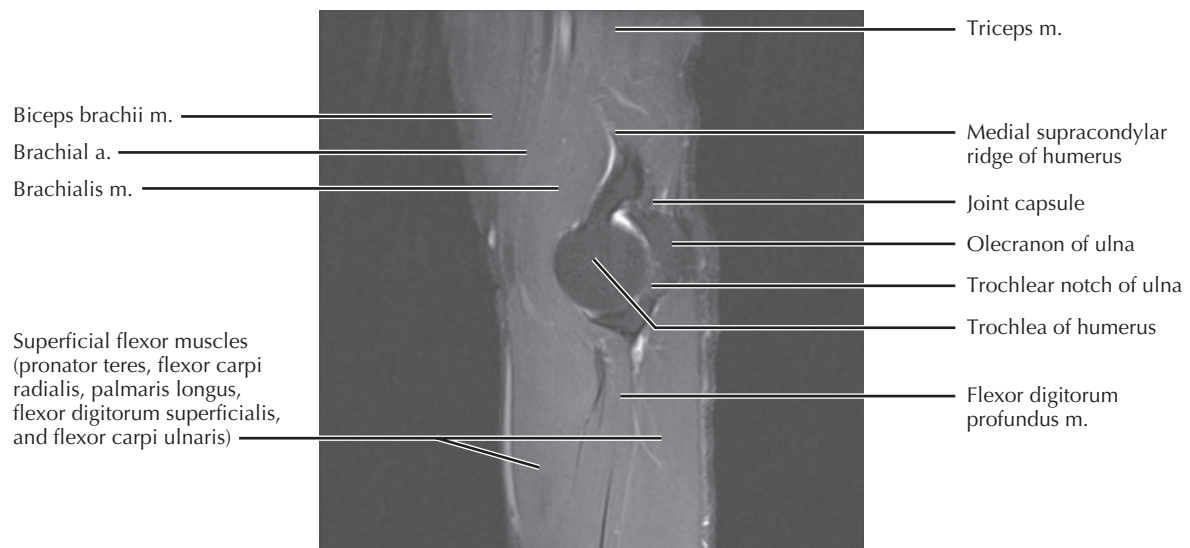
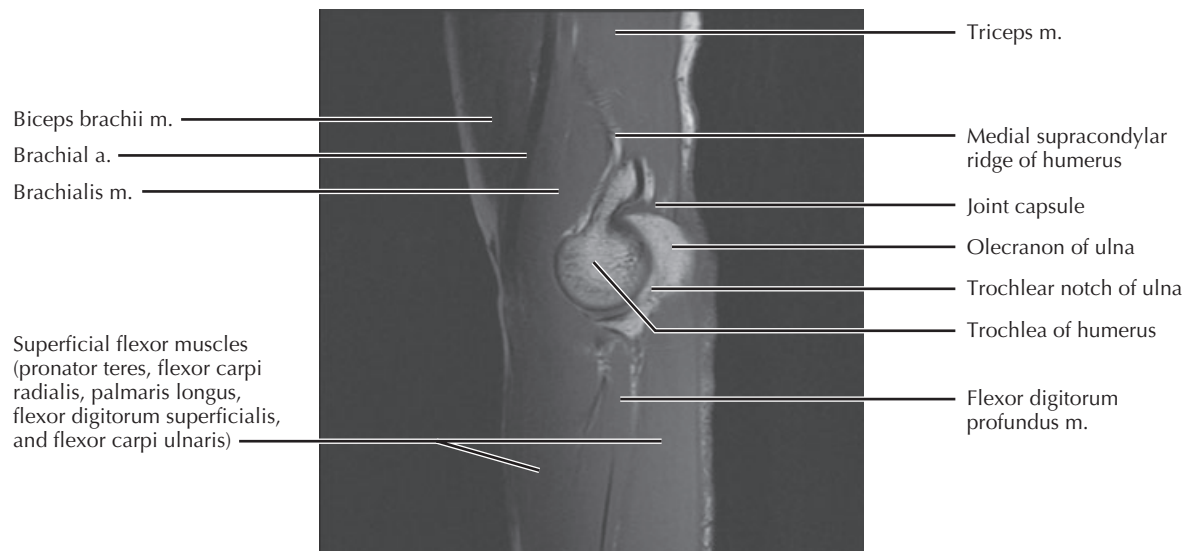
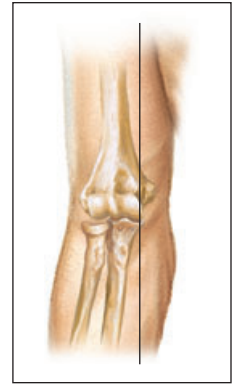
Triceps m.

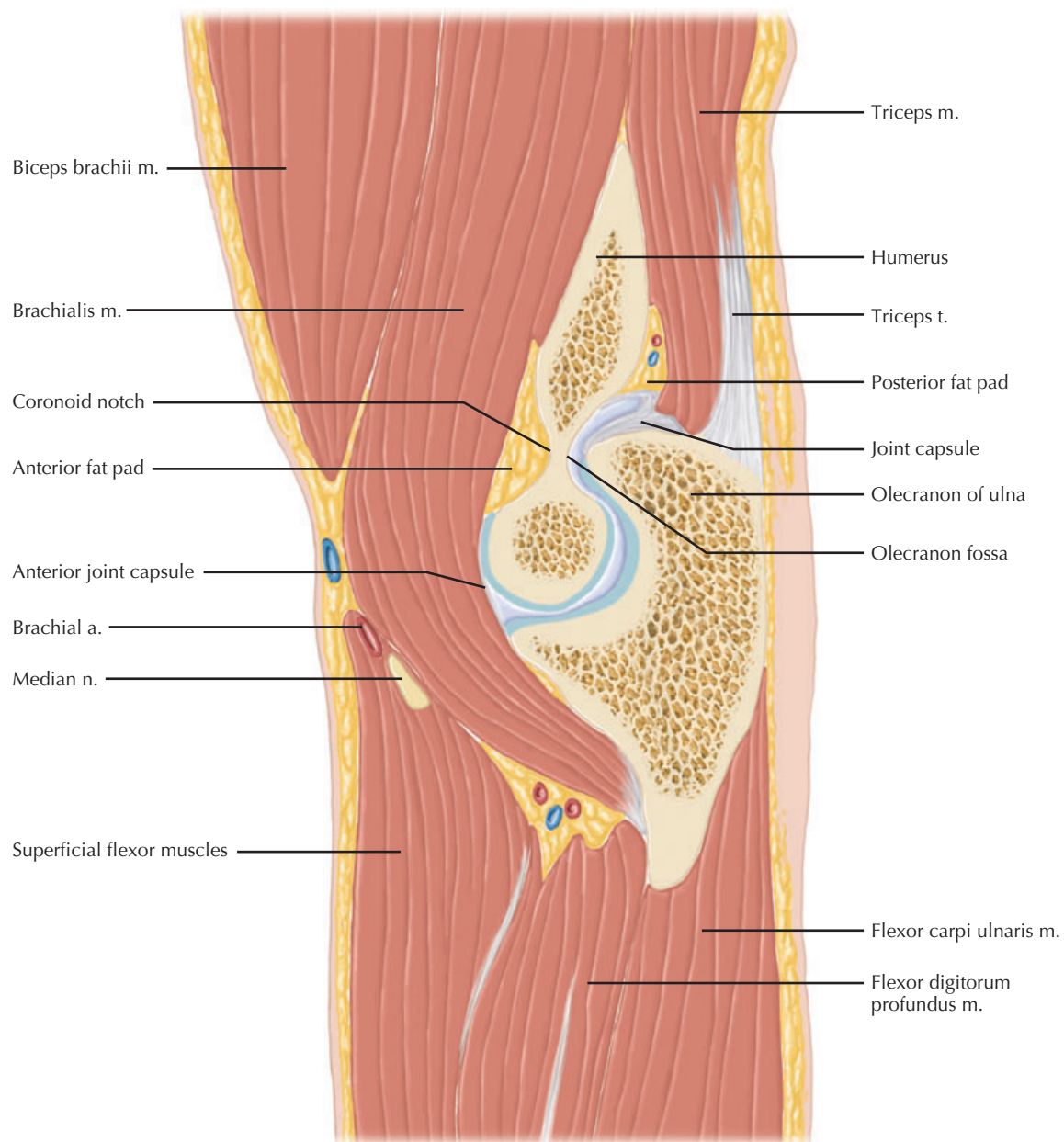
Medial epicondyle
of humerus

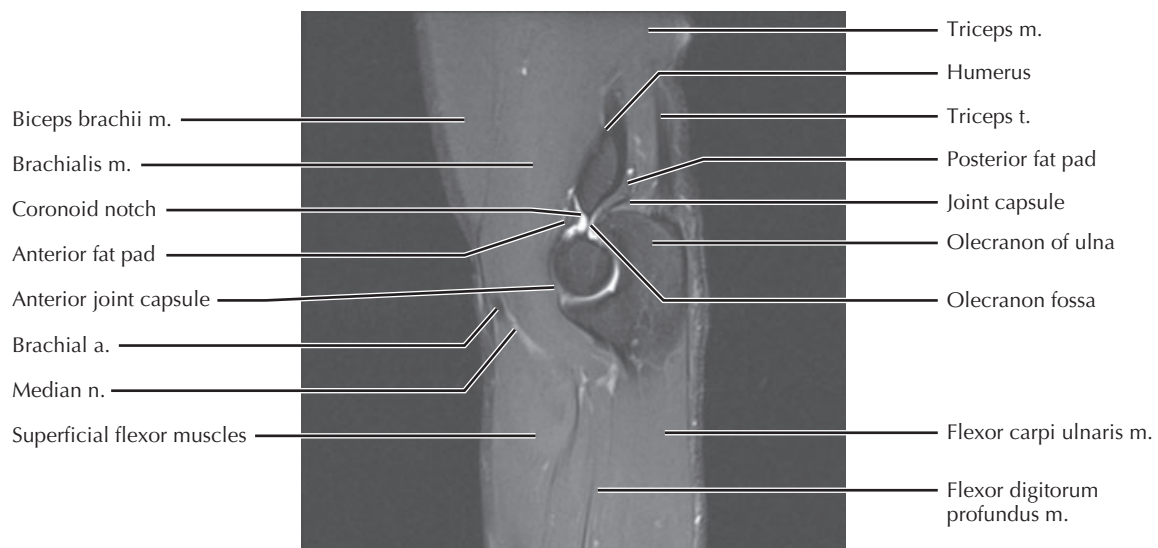
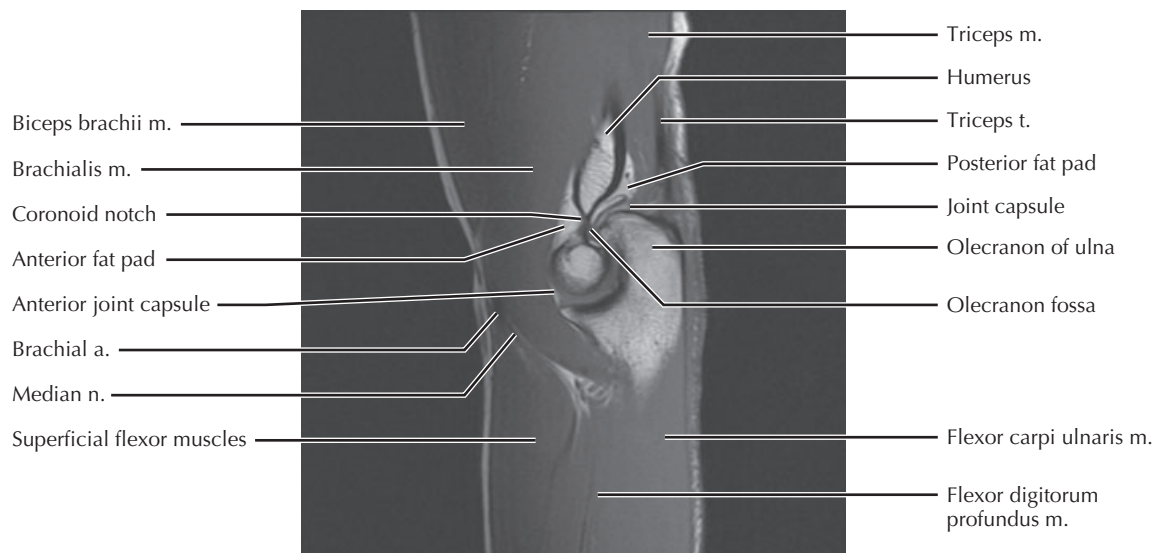
Common flexor t.

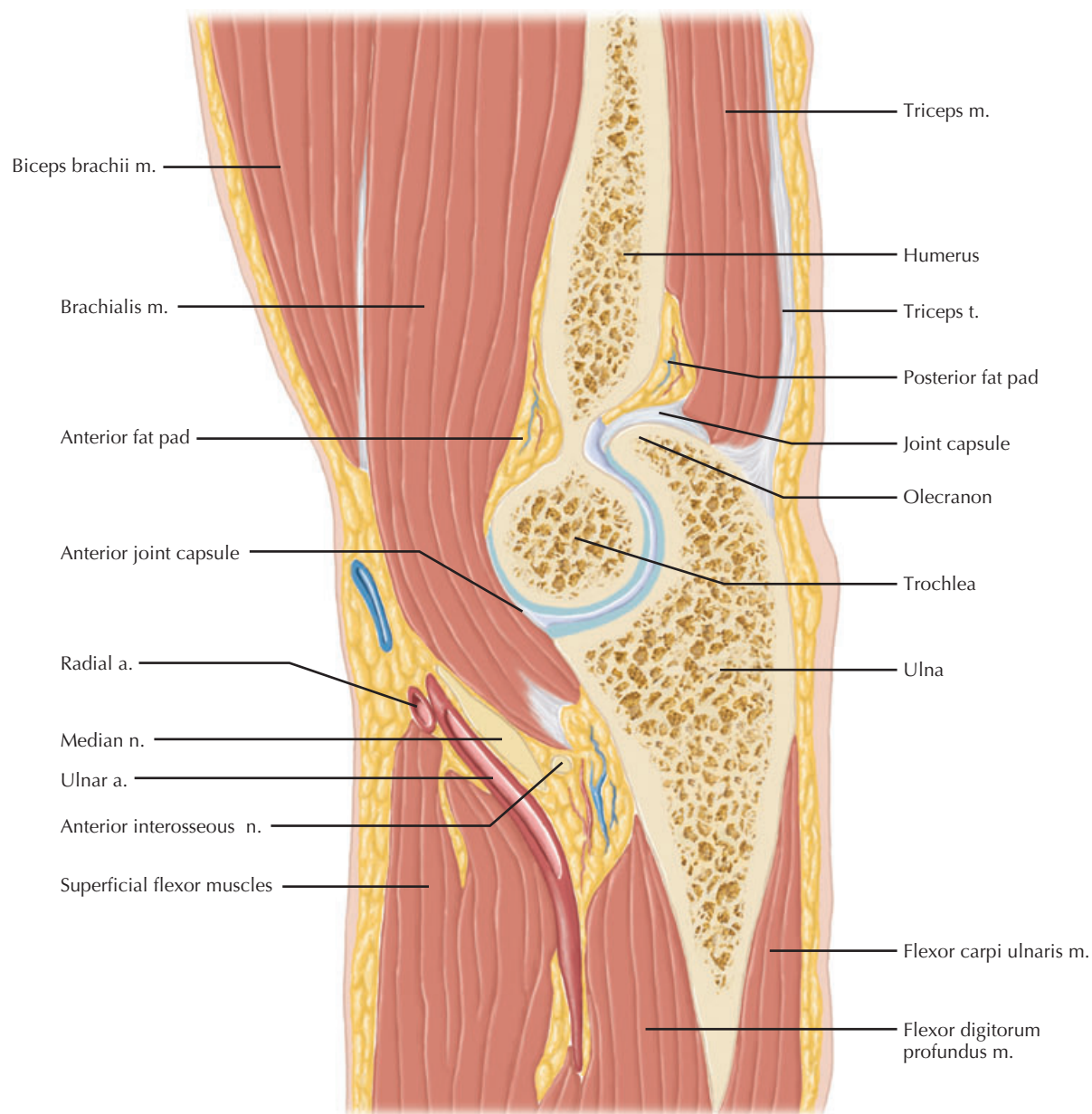
Superficial flexor muscles
(pronator teres, flexor carpi
radialis, palmaris longus, and
flexor carpi ulnaris)

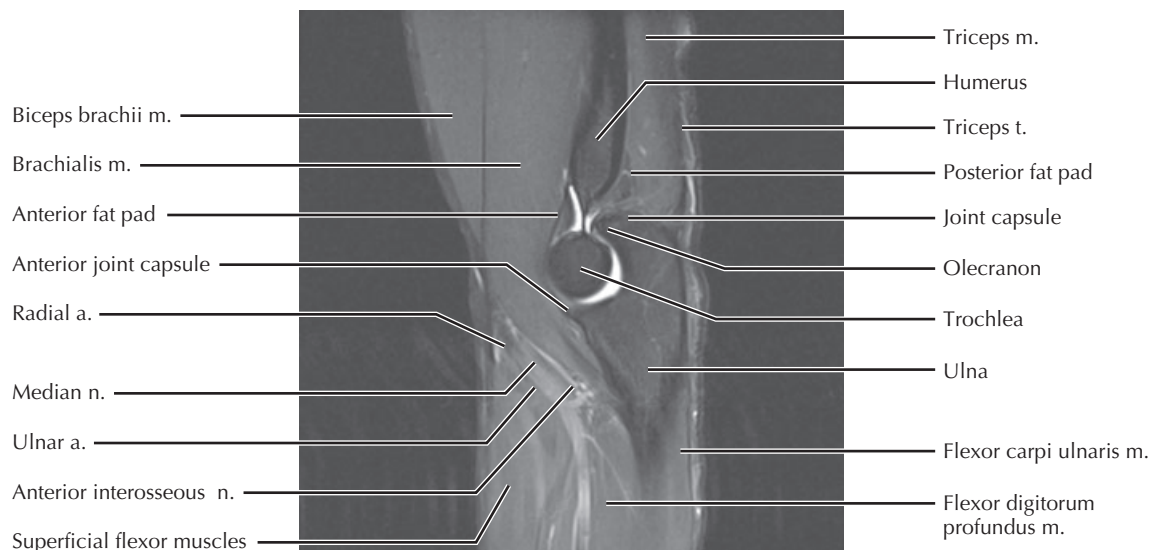


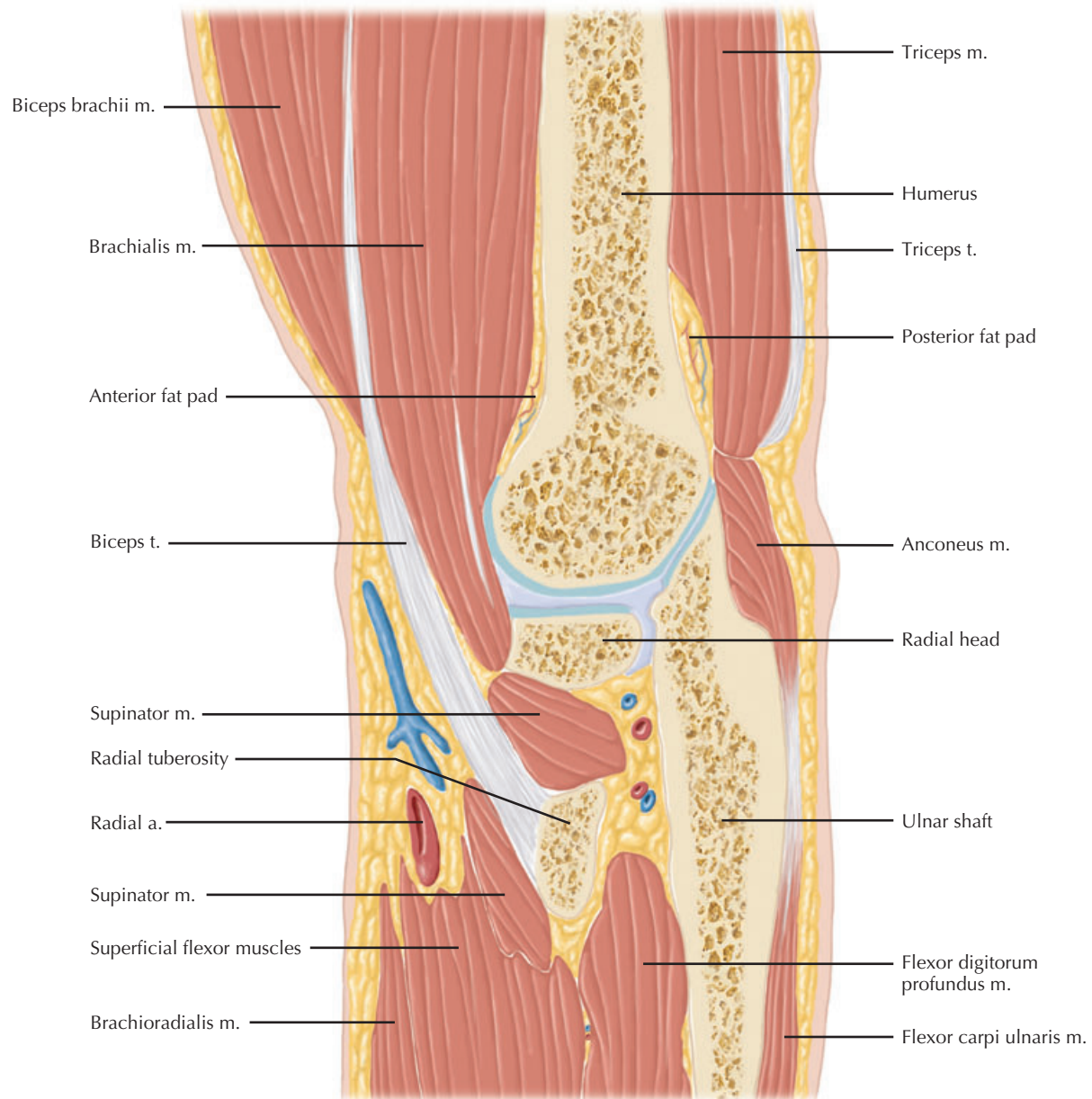






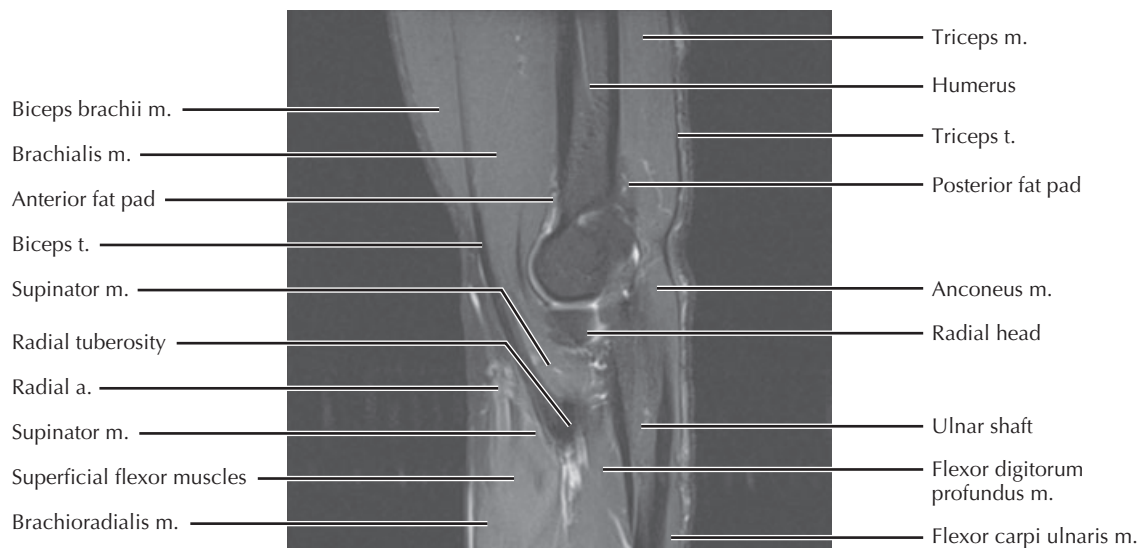
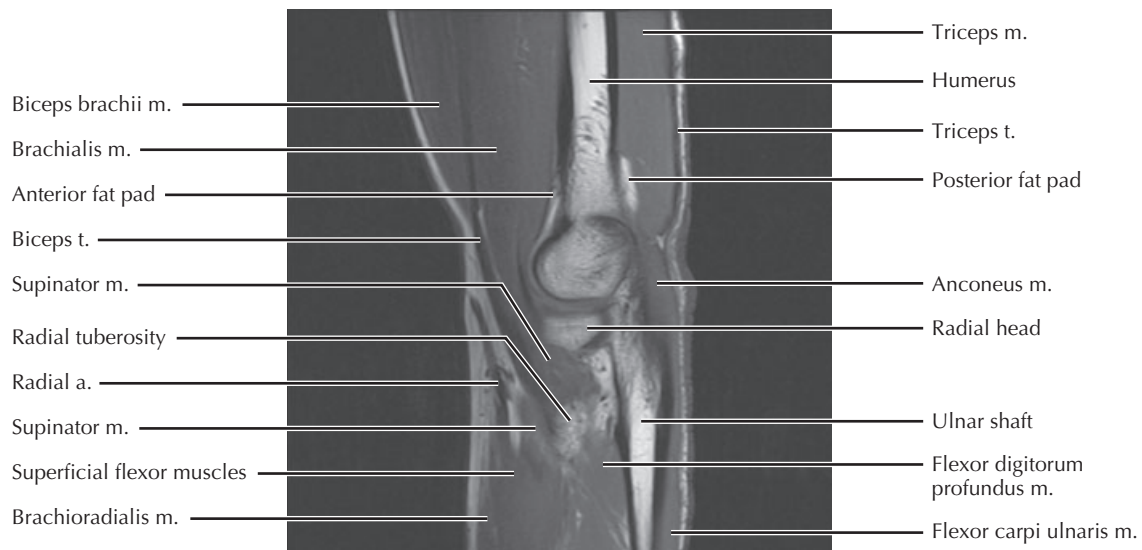
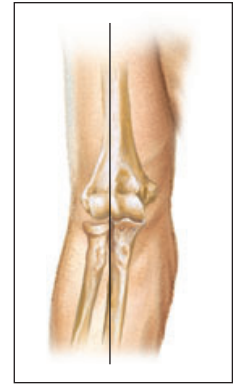


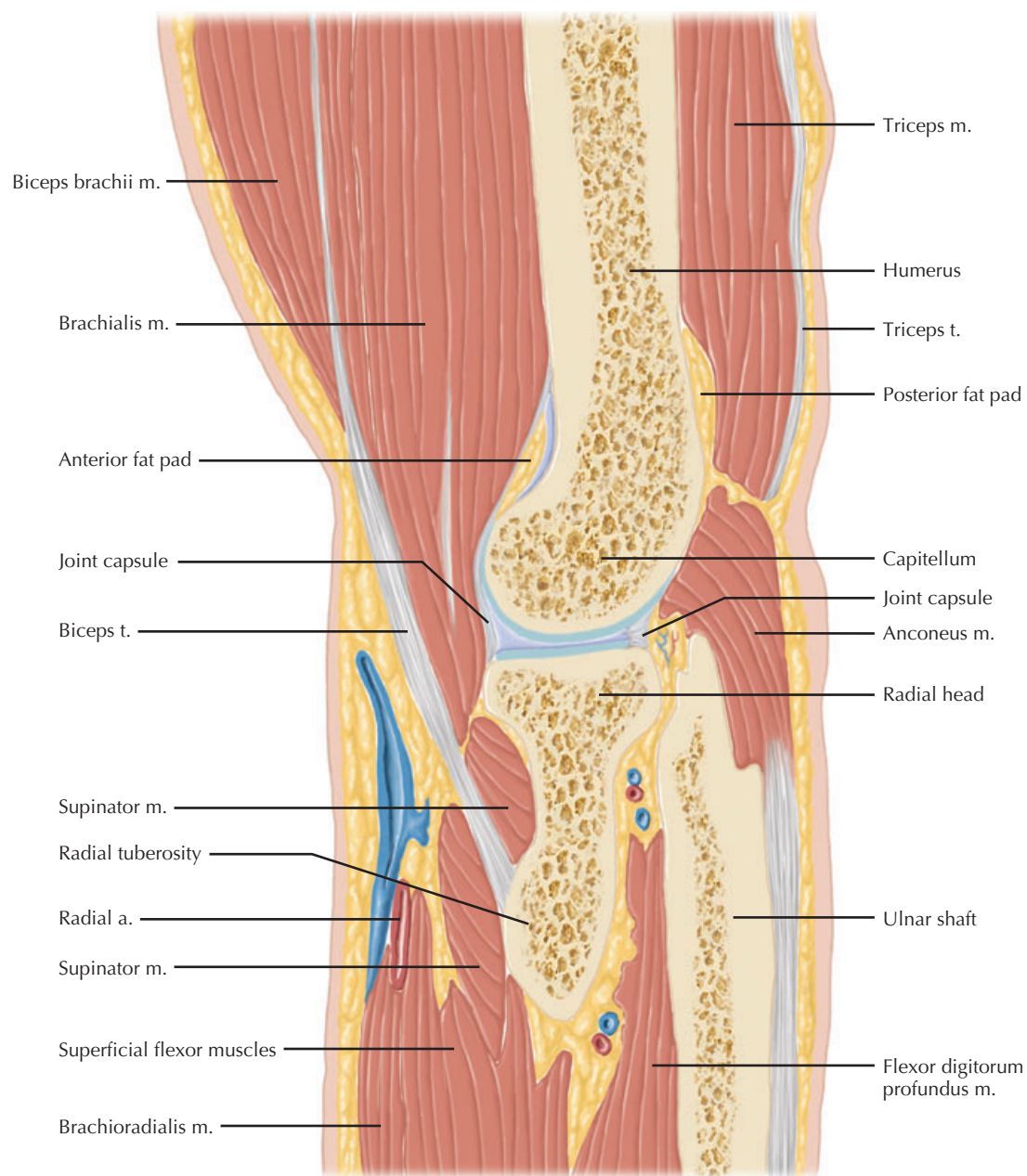


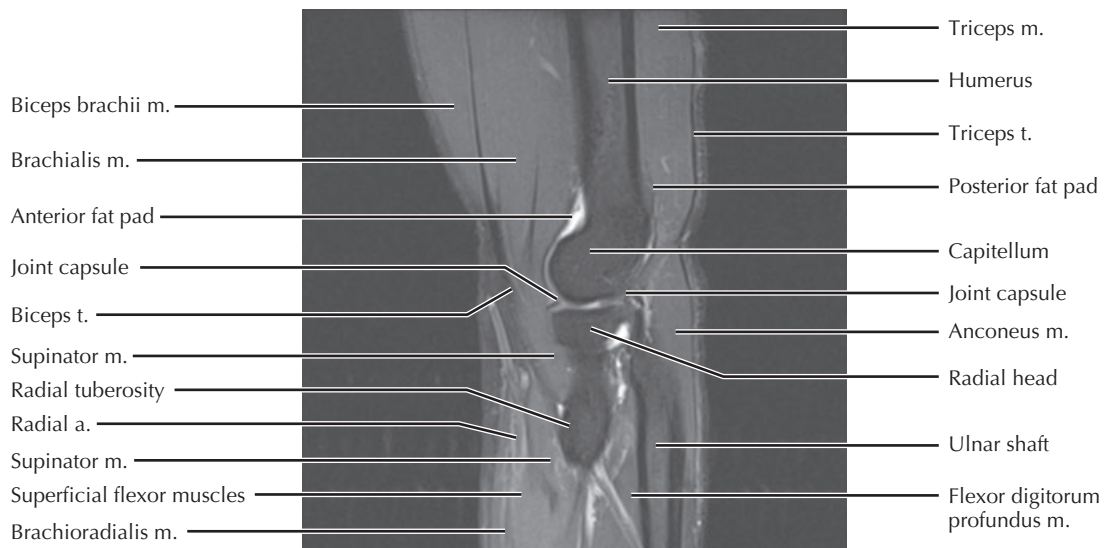
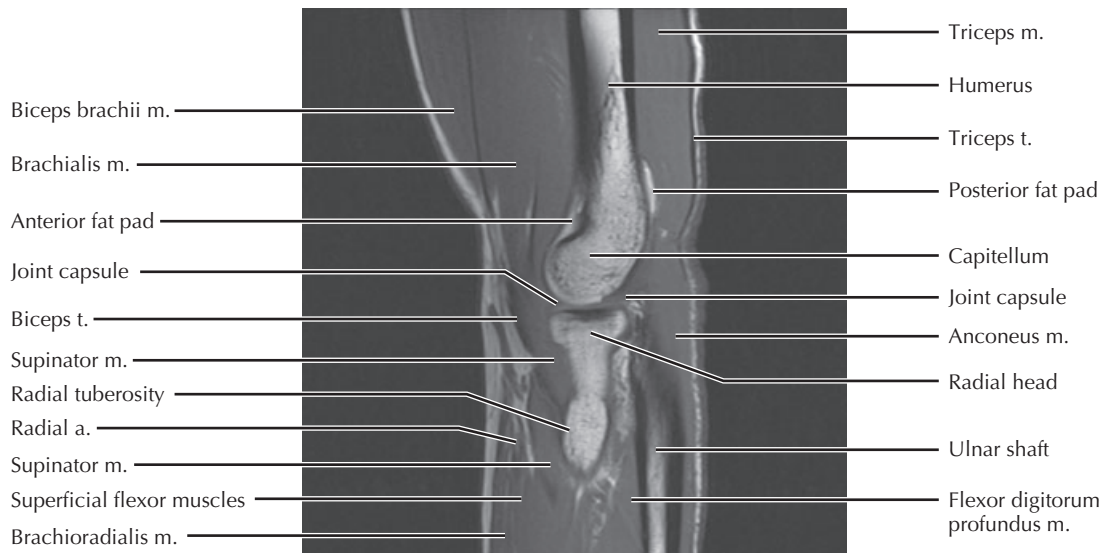


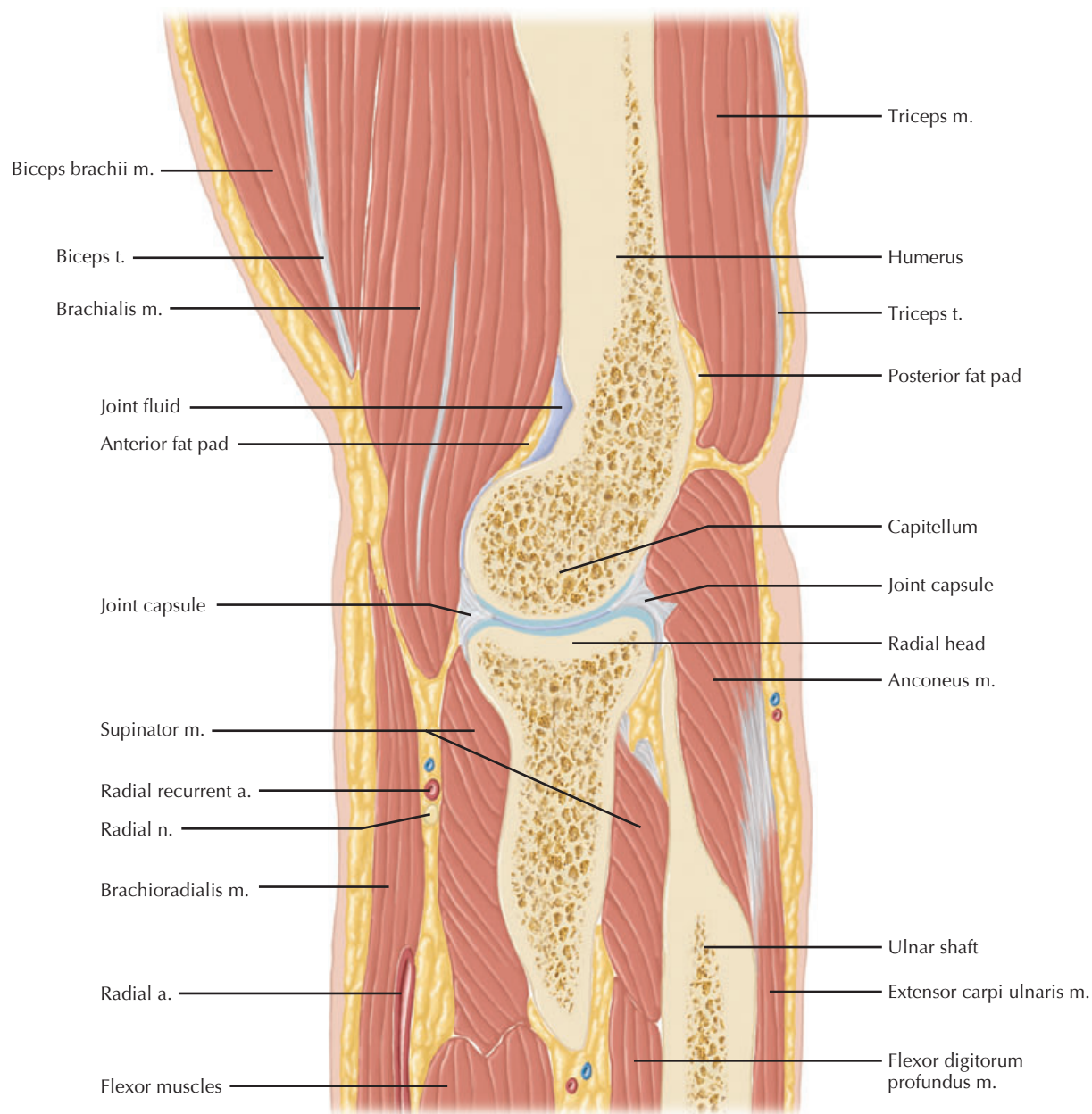
PATHOLOGIC PROCESS

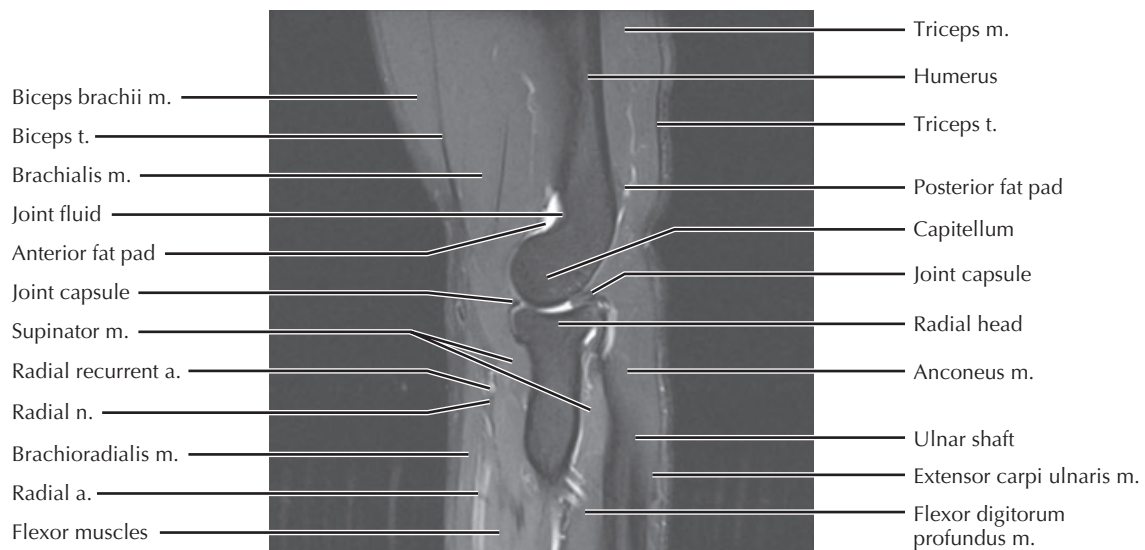
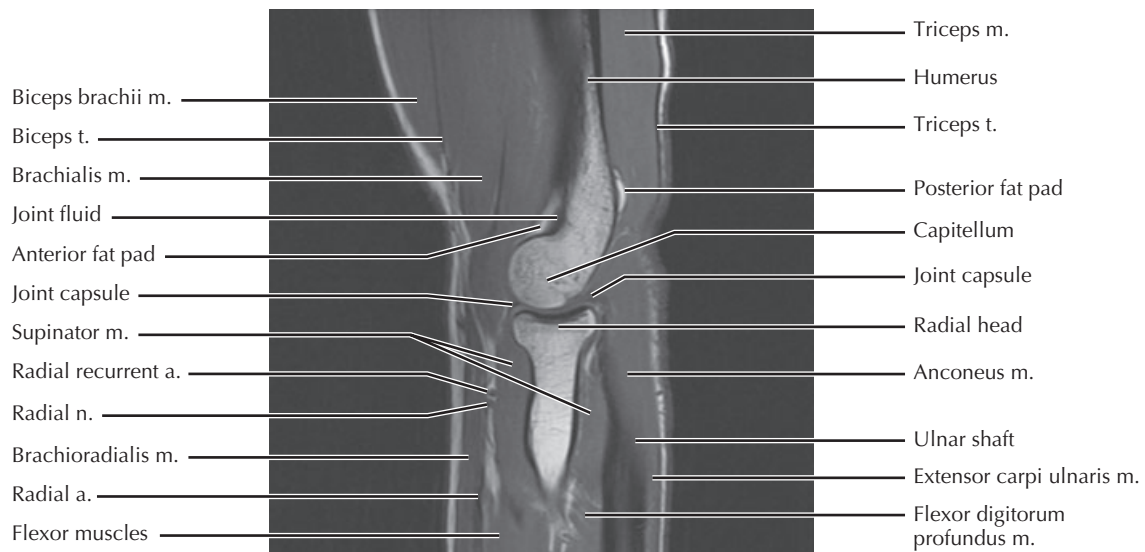
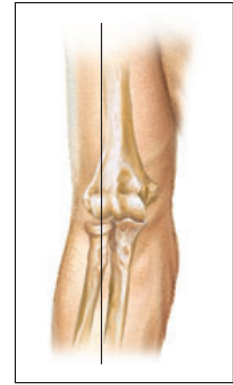
In the setting of a biceps tendon tear, the gap and retraction of the tendon are best measured in sagittal plane.

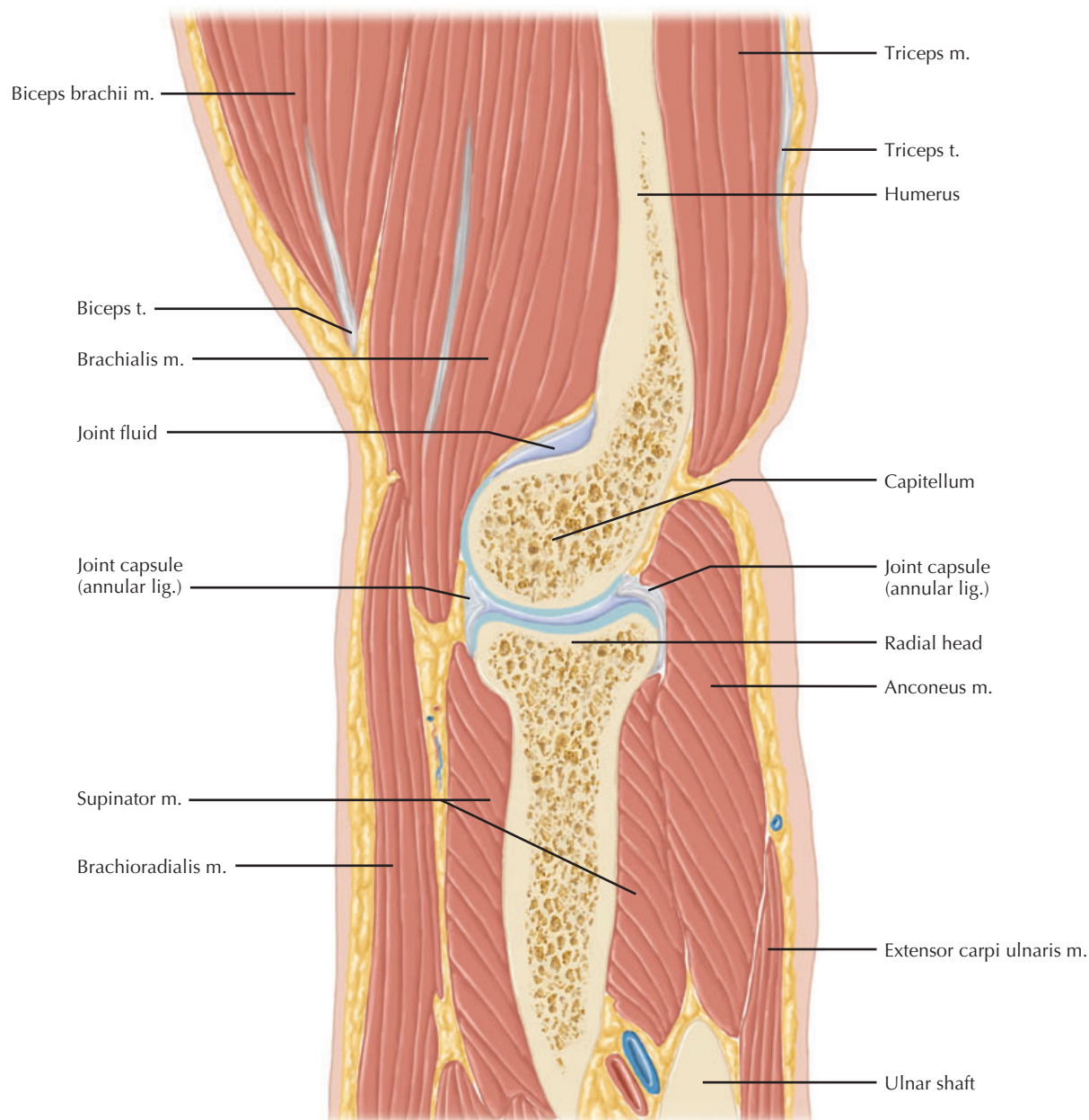






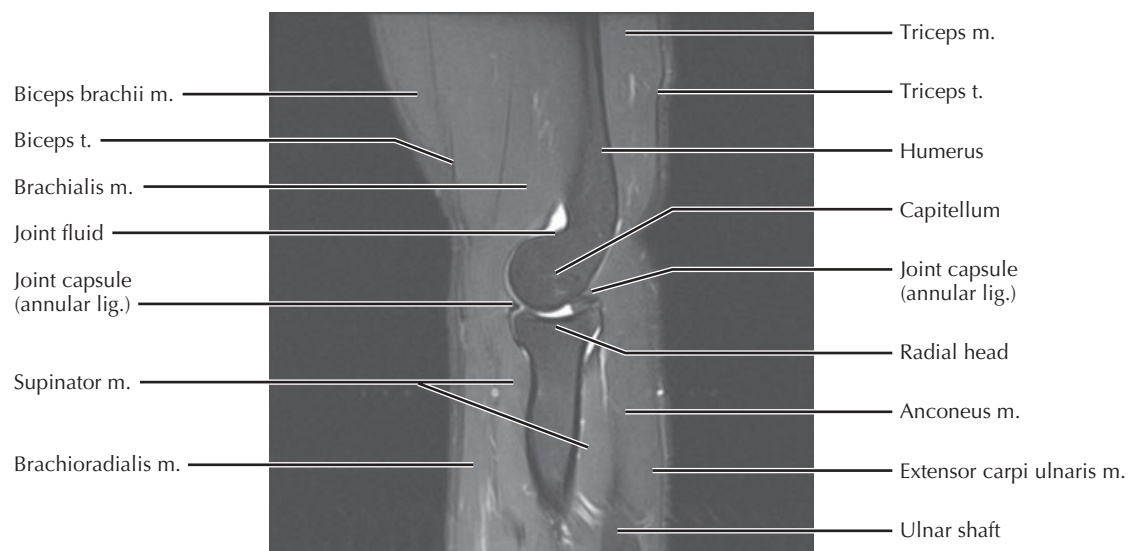
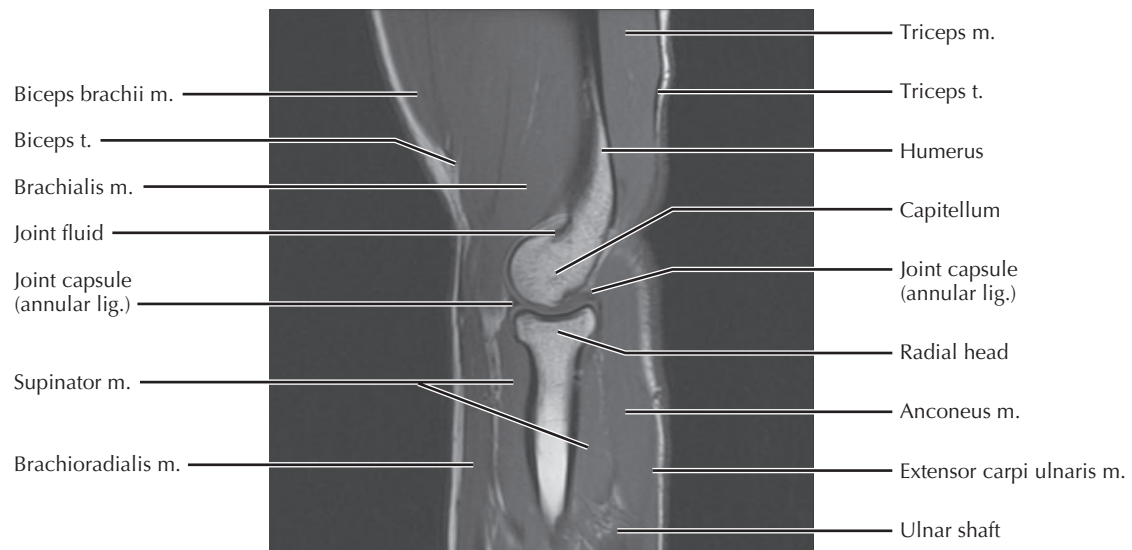
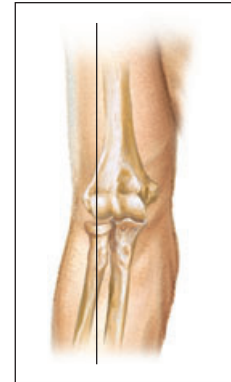


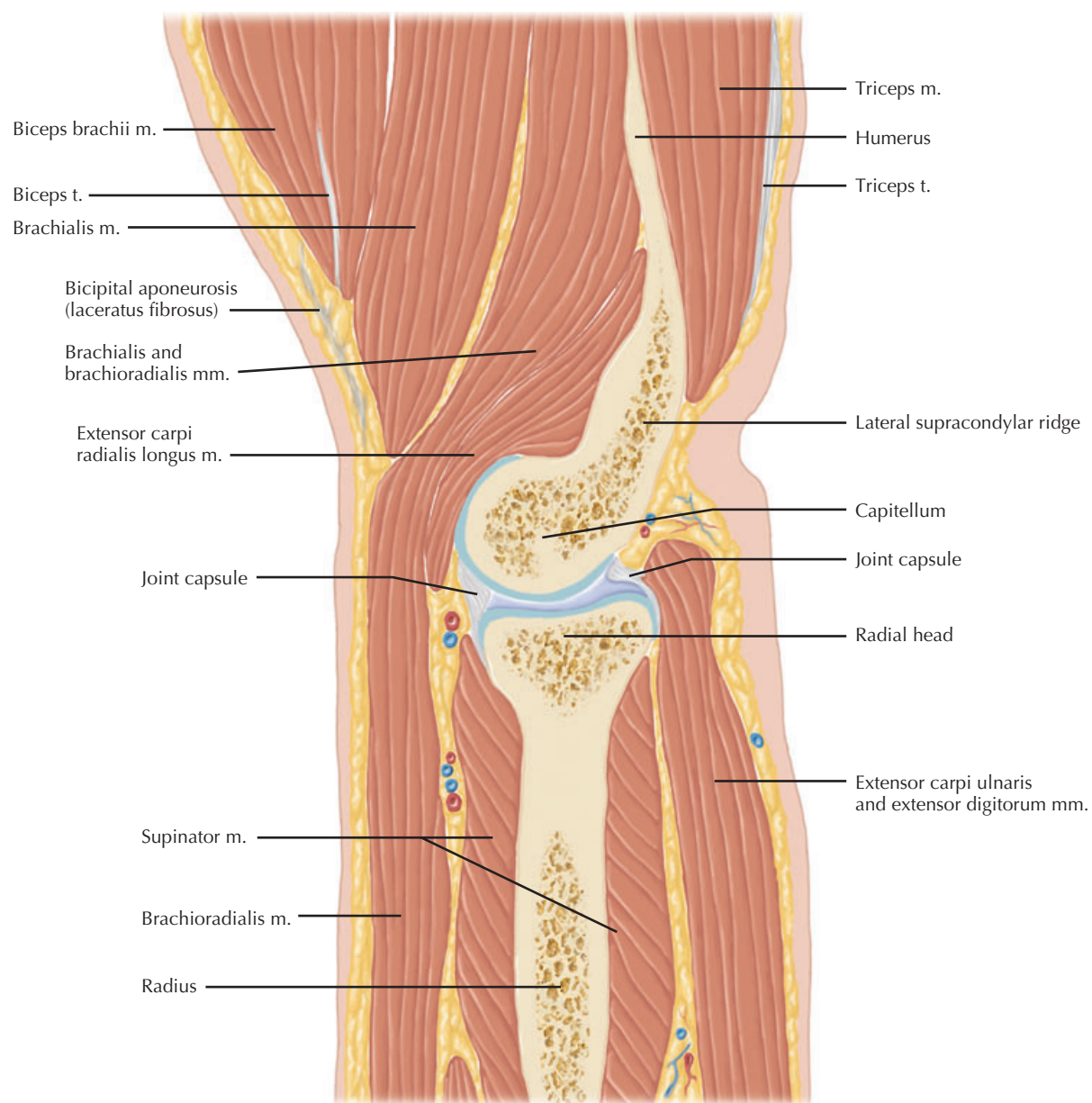


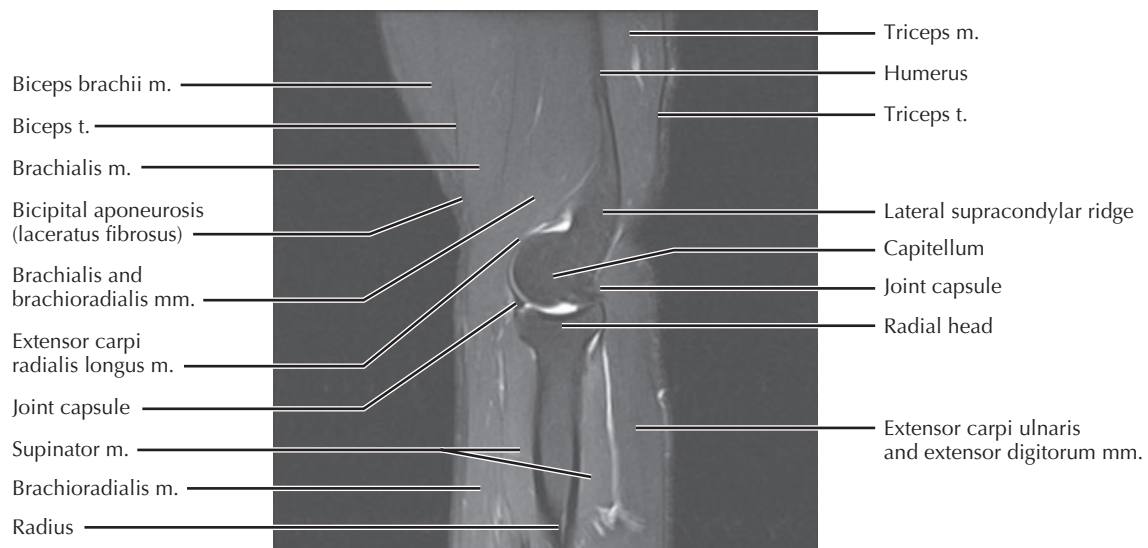
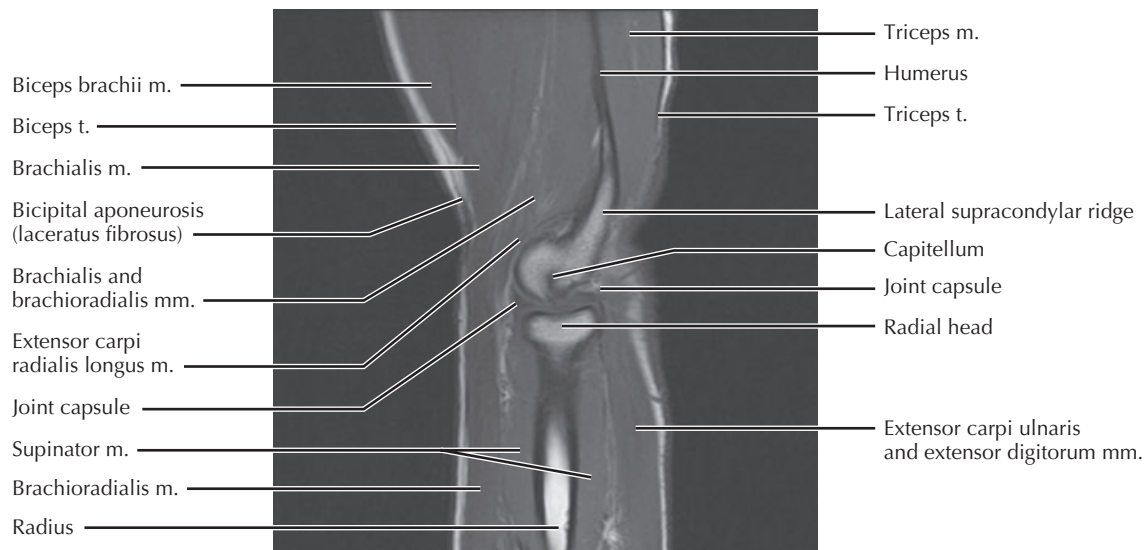
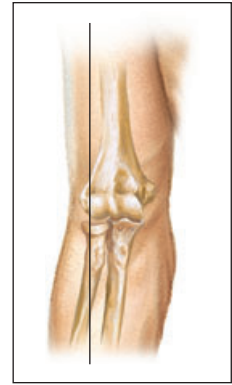


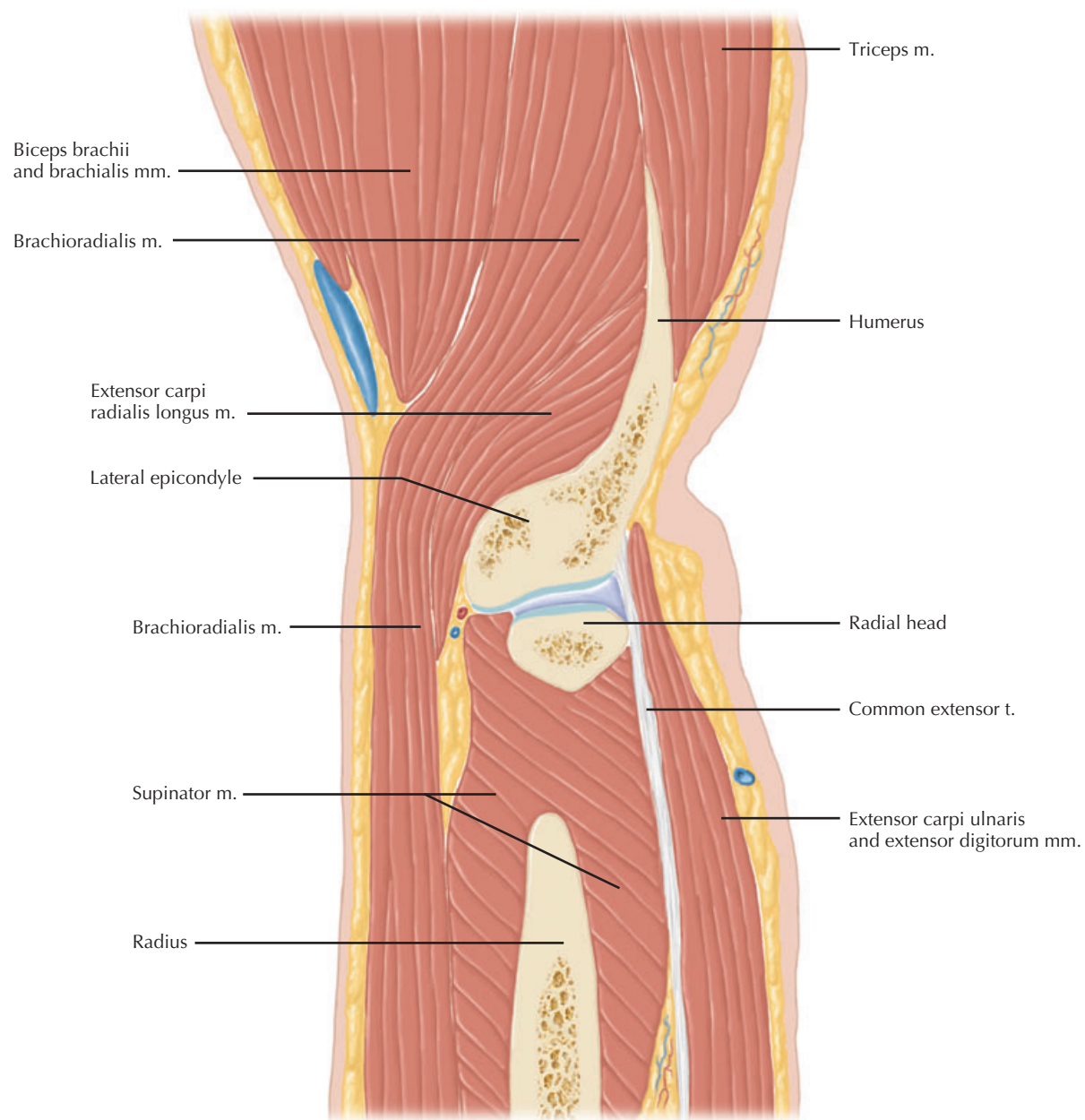
NORMAL ANATOMY

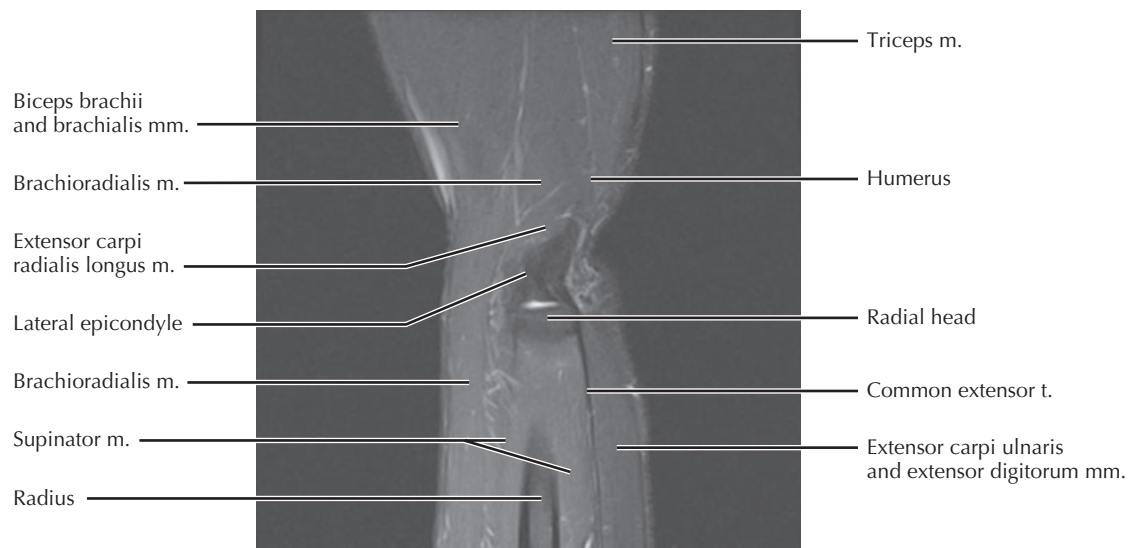
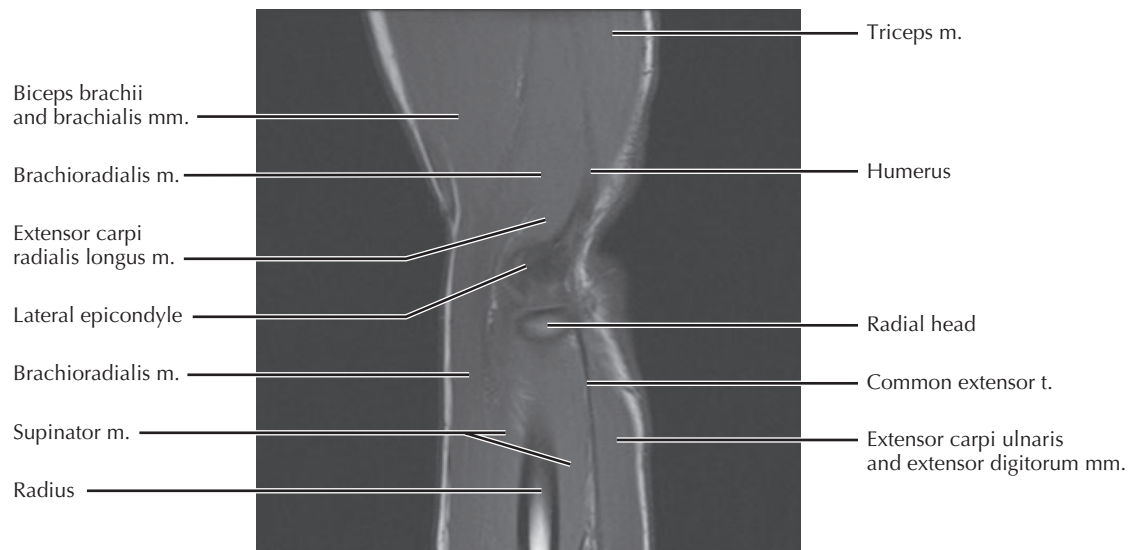
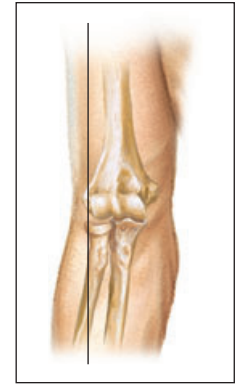
During elbow extension, such as occurs during throwing, the posteriorly located intra-articular tissue (synovial fold) can become entrapped between the radius and capitellum. Repetitive injury can lead to thickening of this tissue and painful elbow extension.

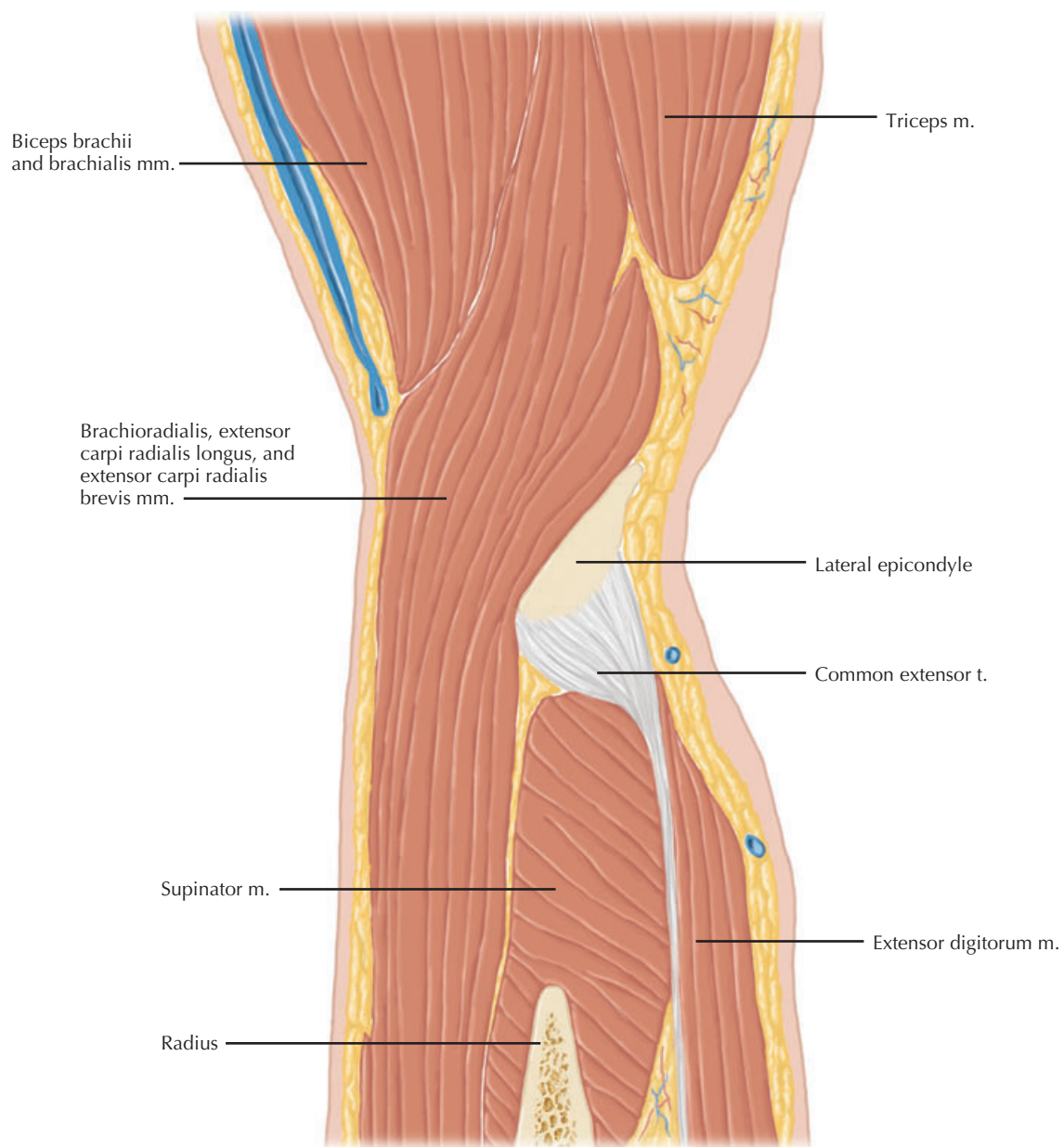


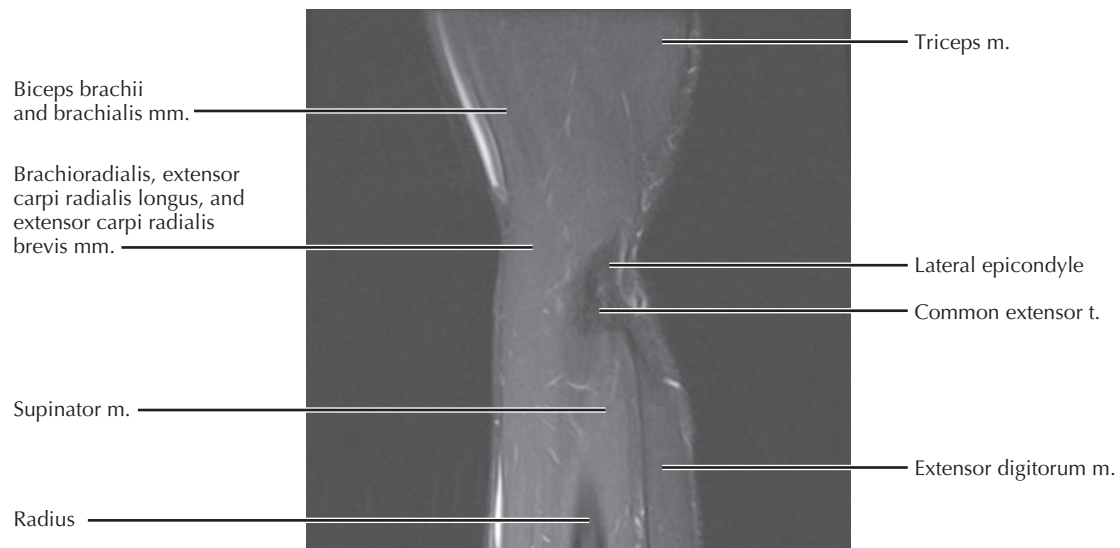
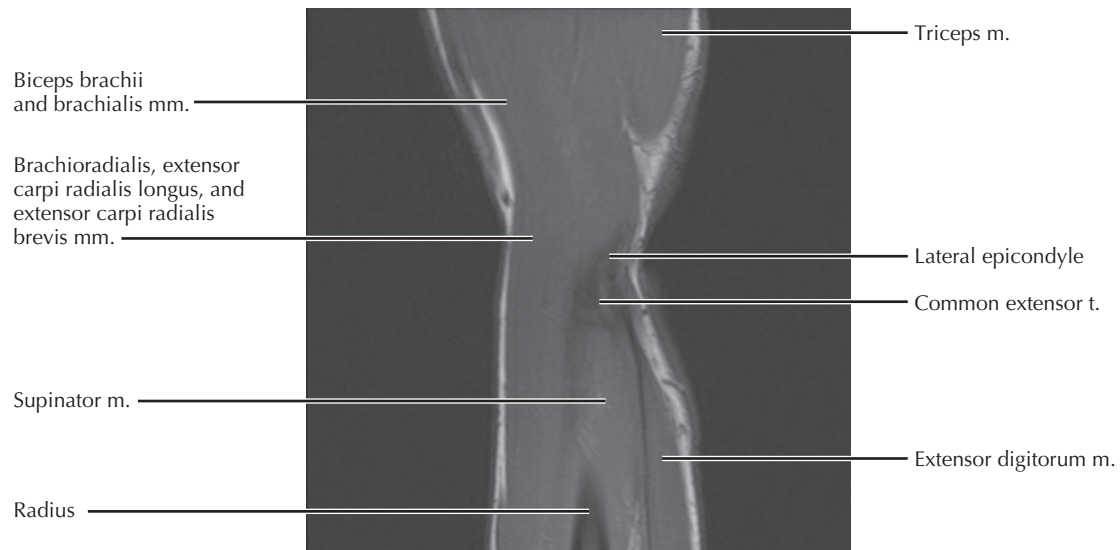
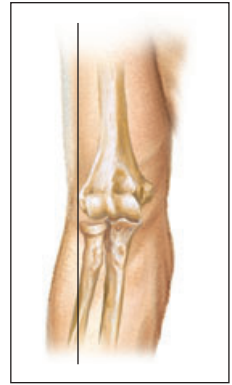










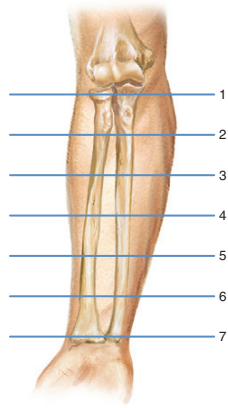


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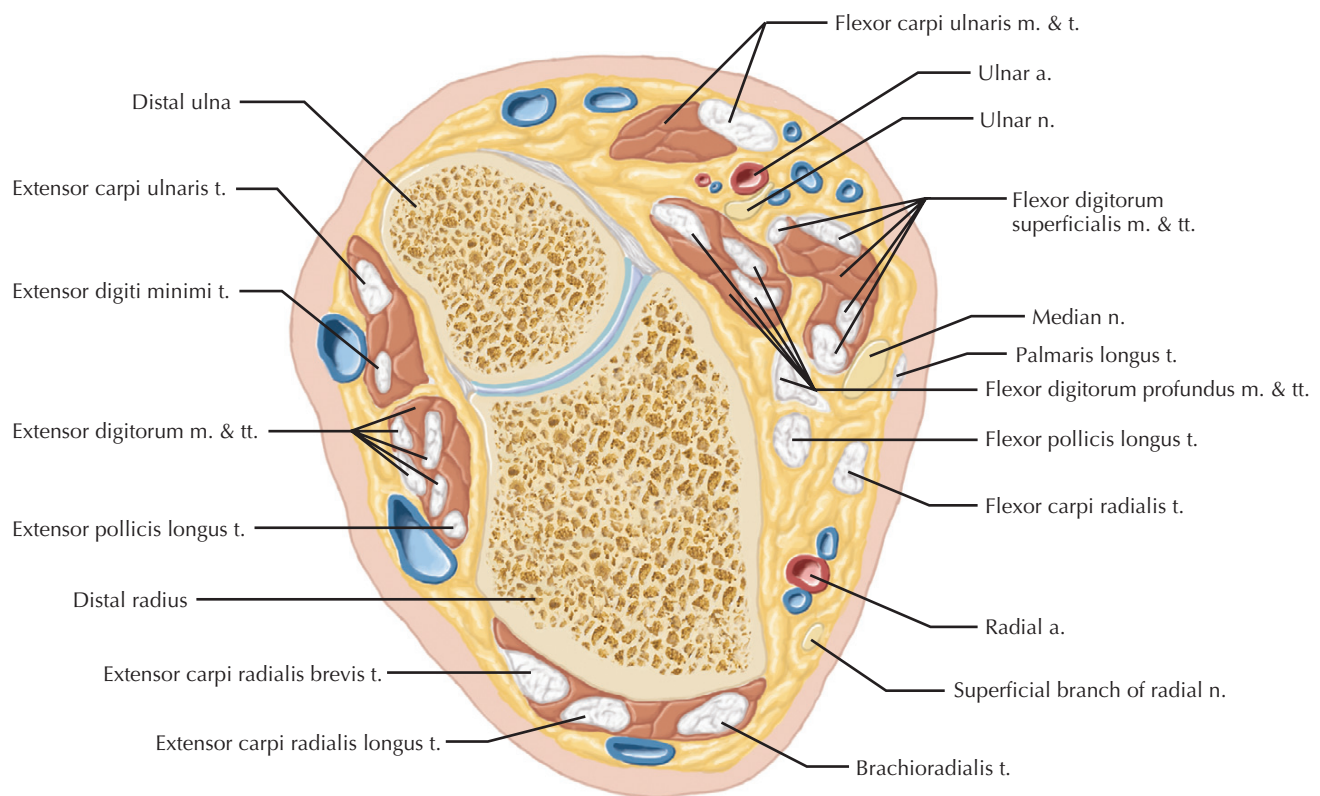
Chapter

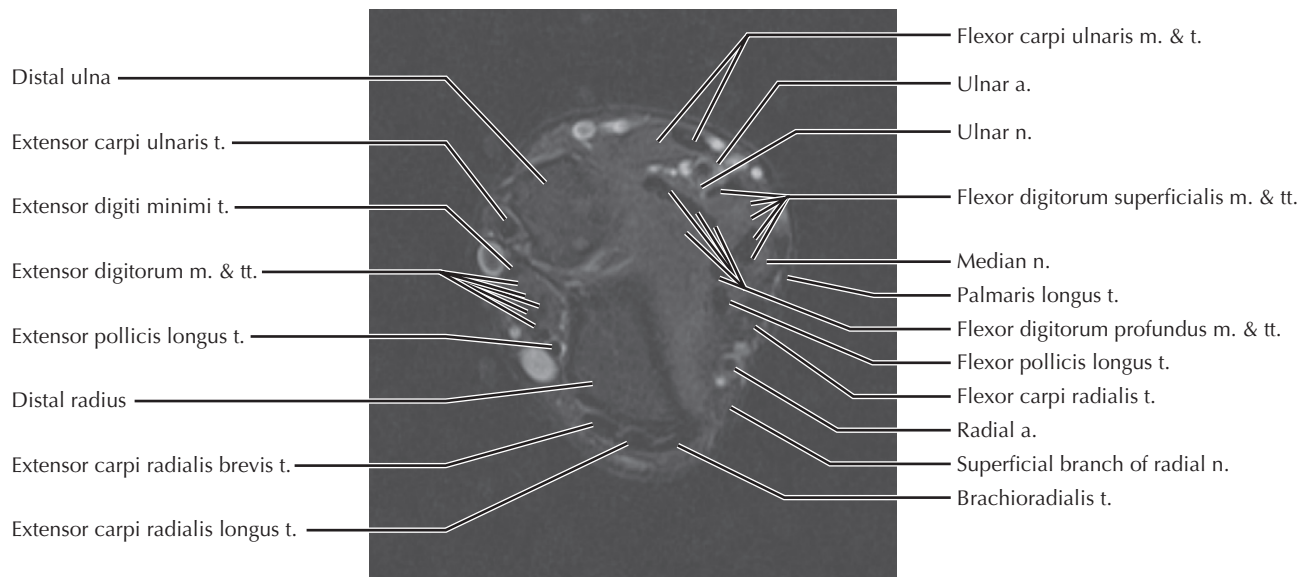
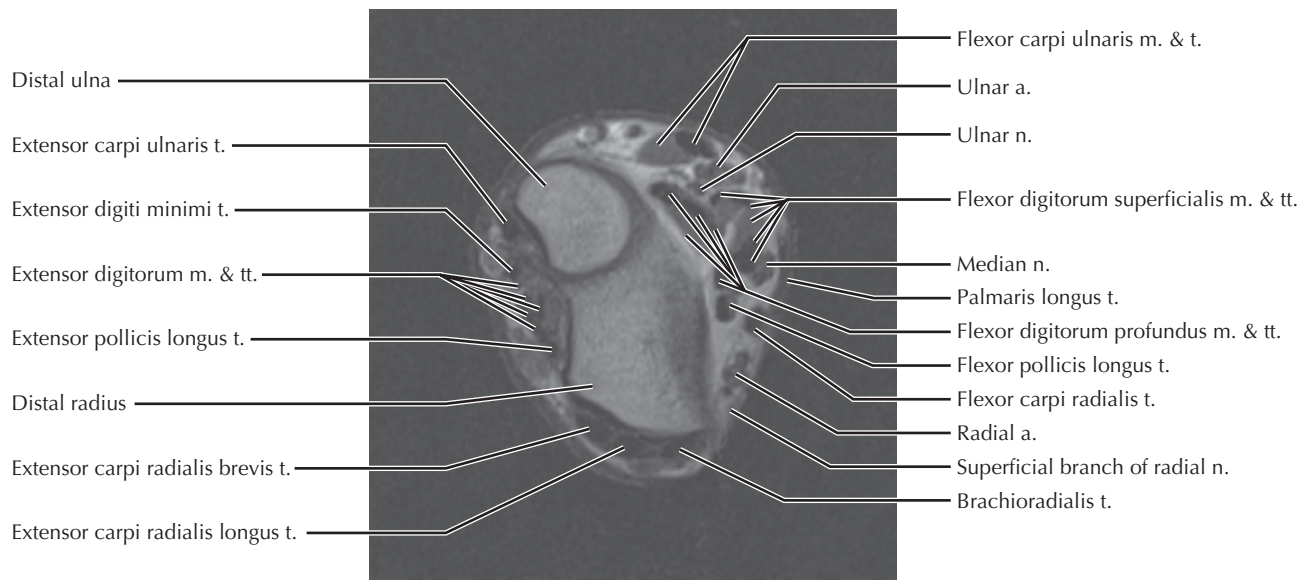
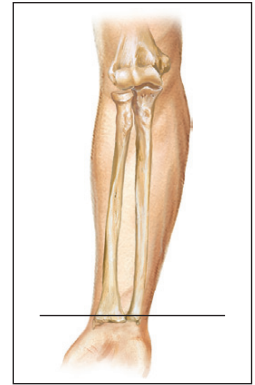
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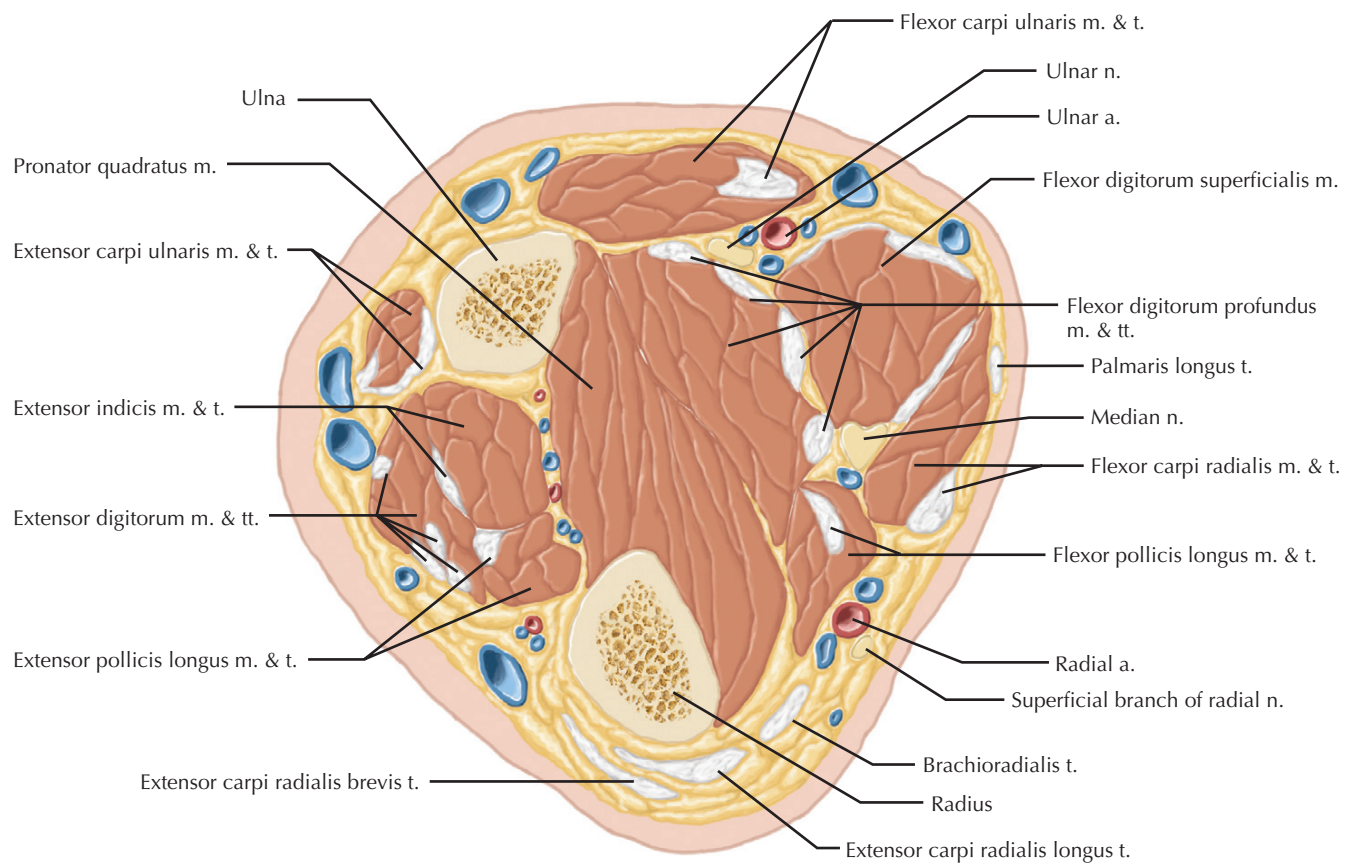
FOREARM

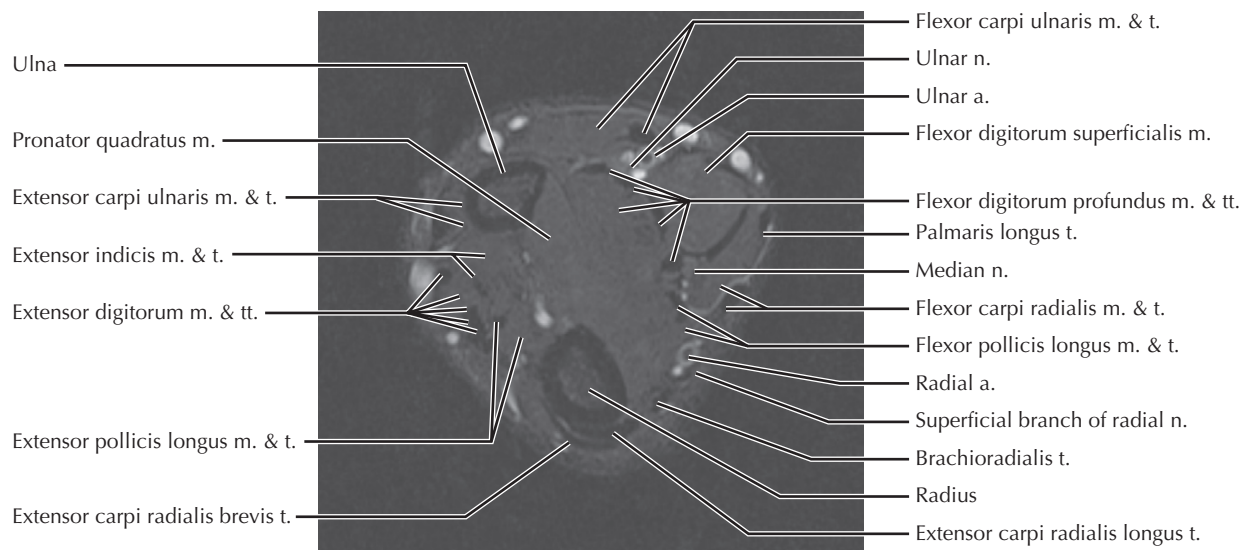
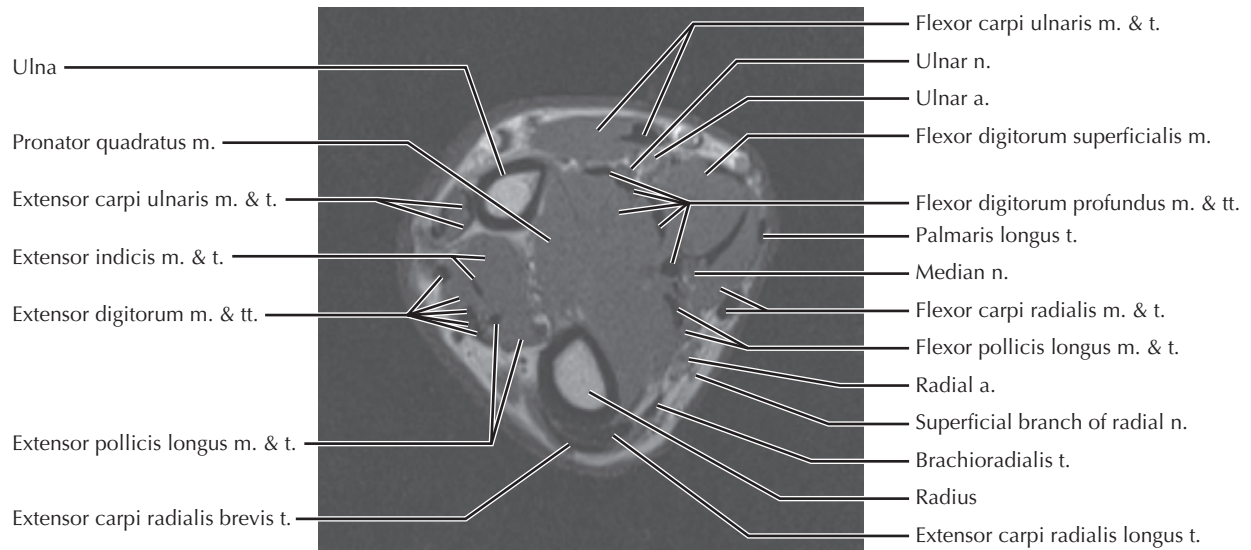
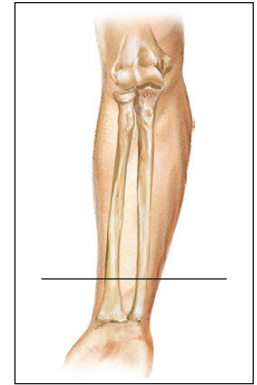


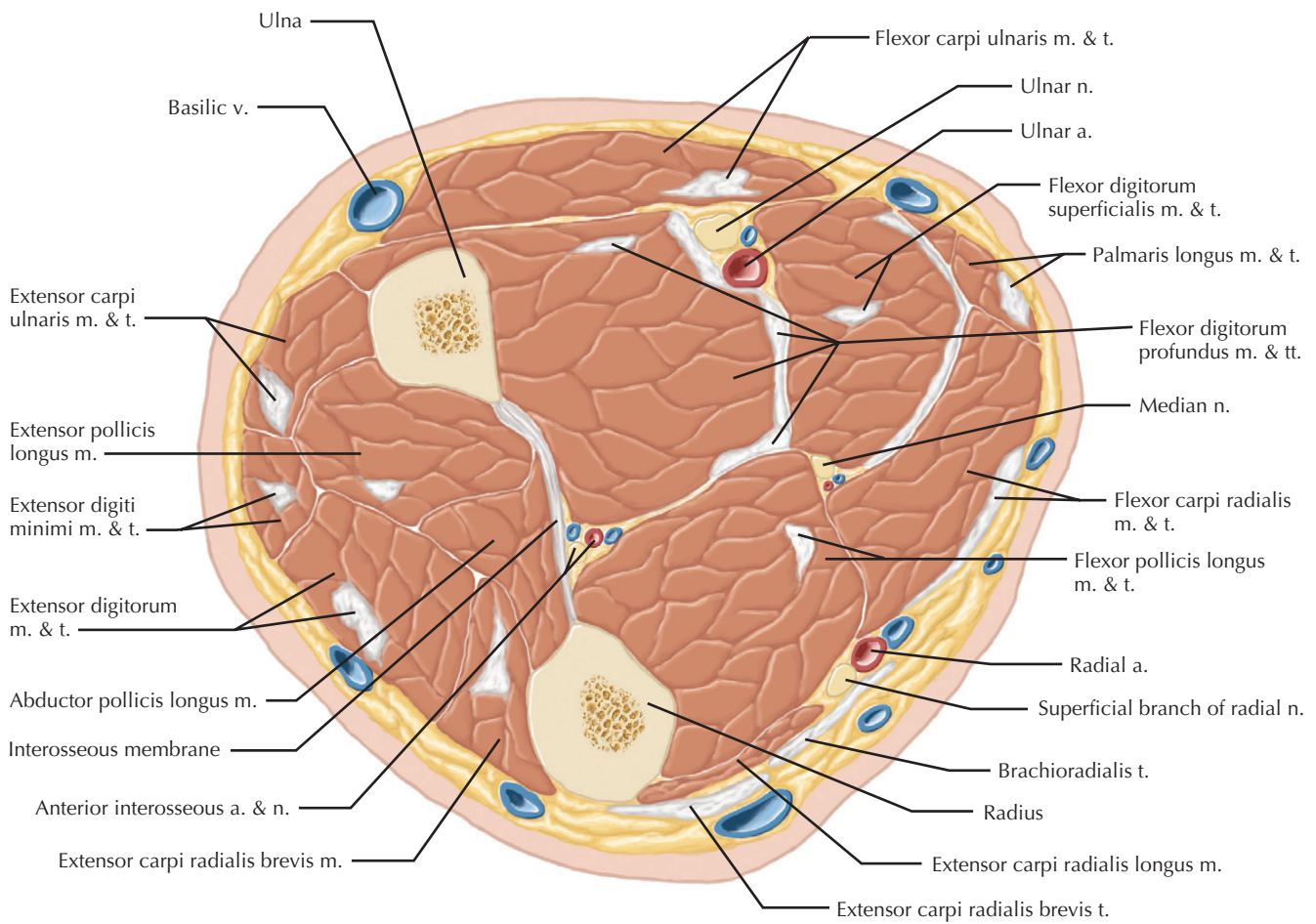
AXIAL 150

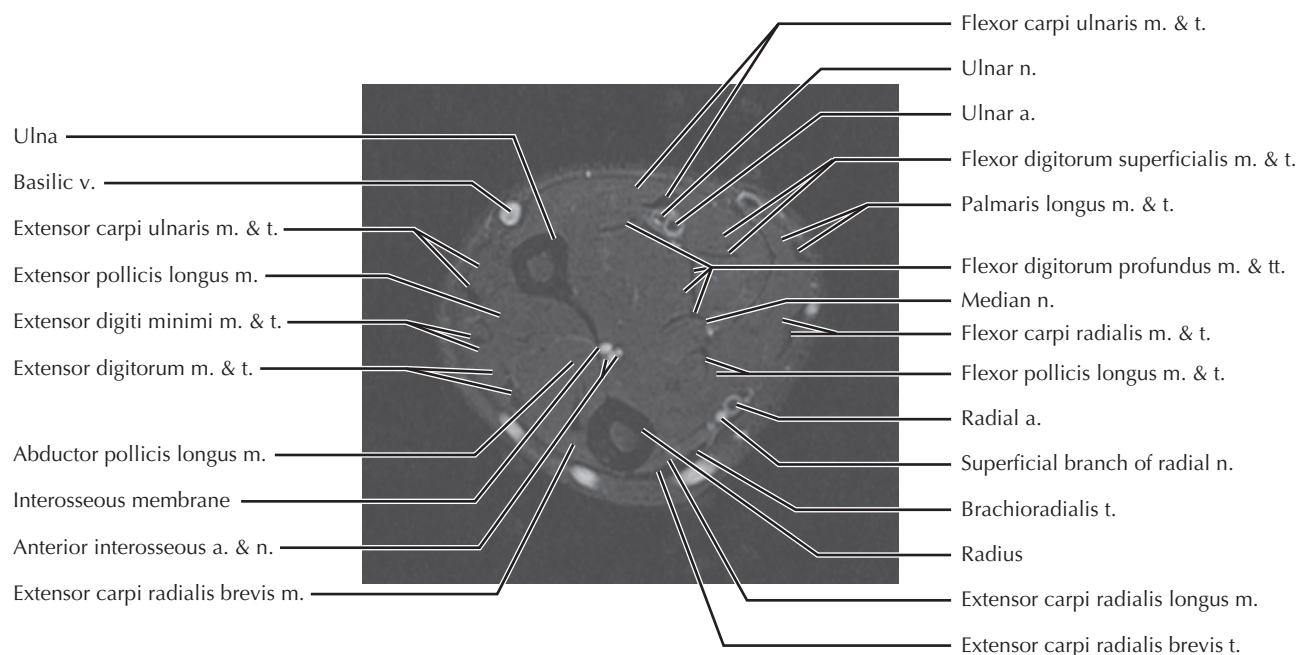
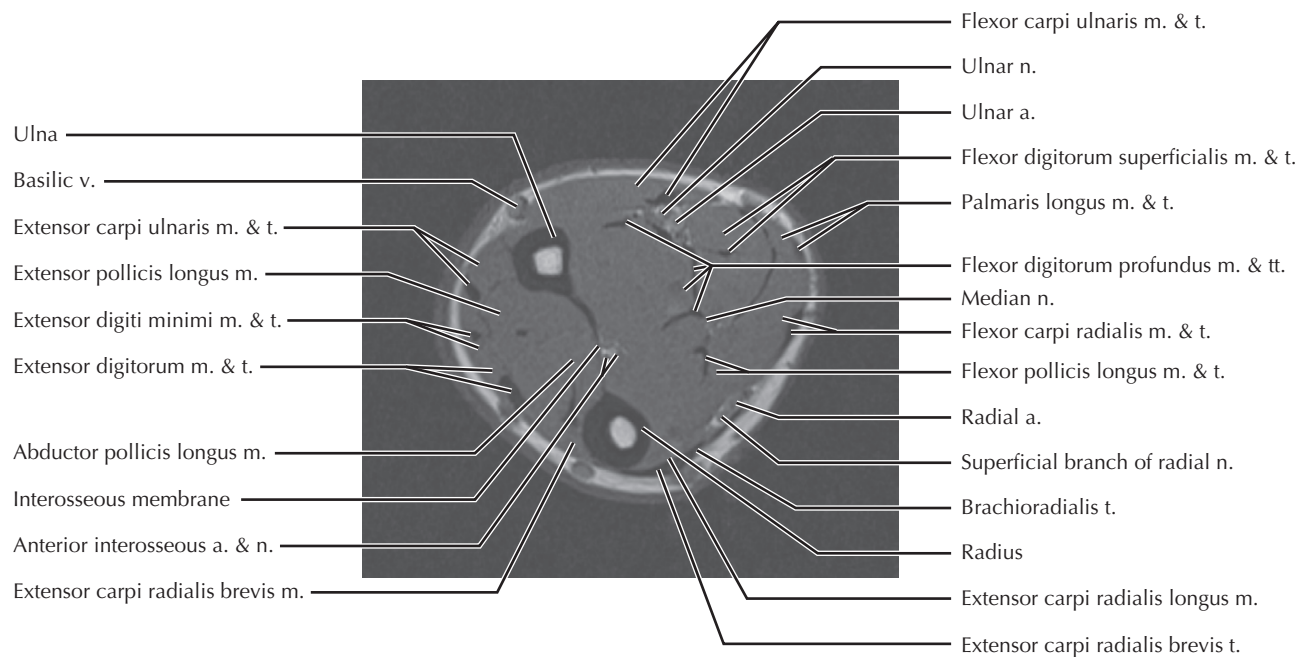
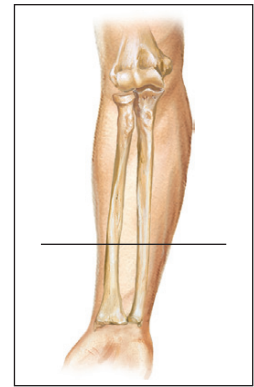


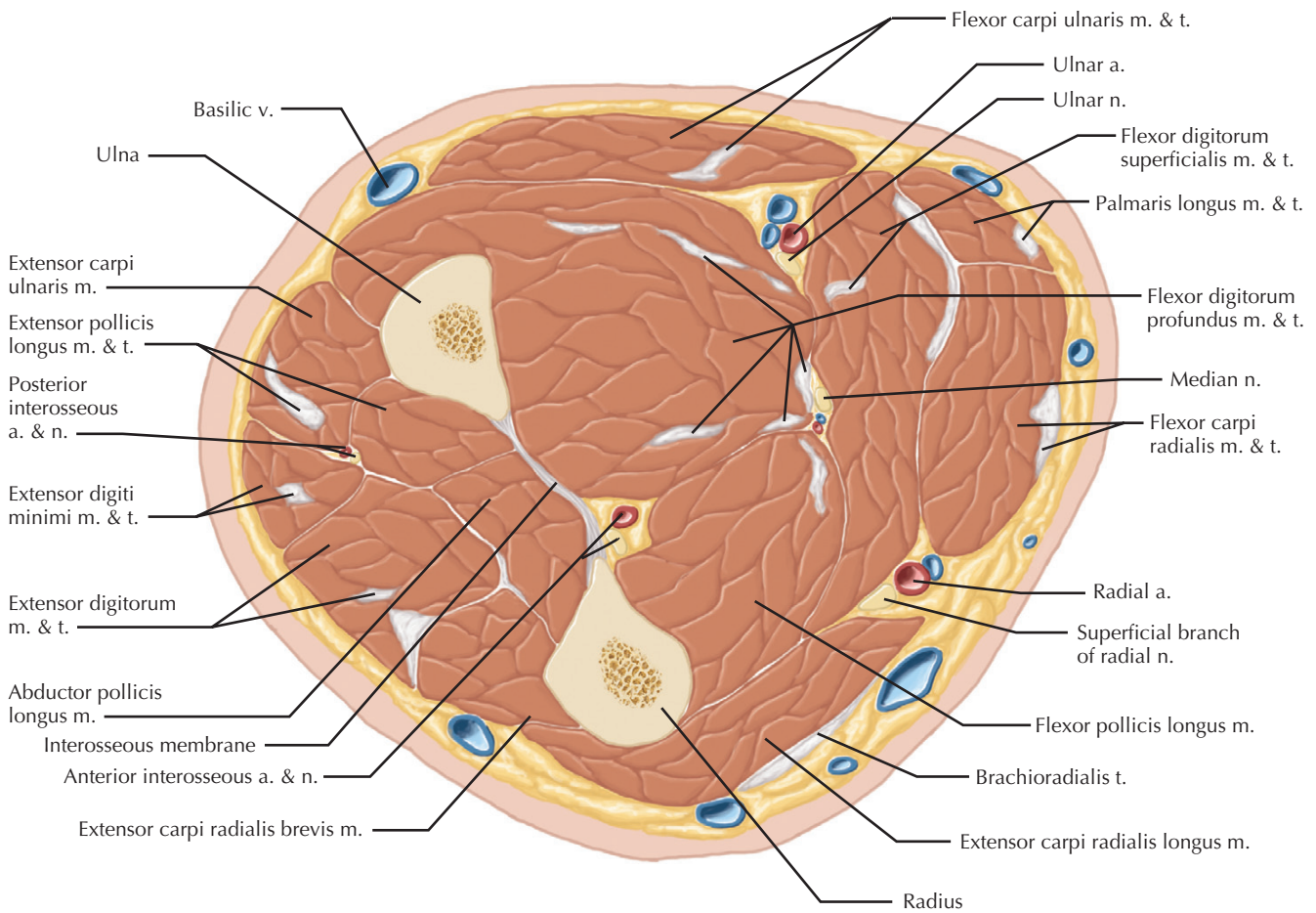


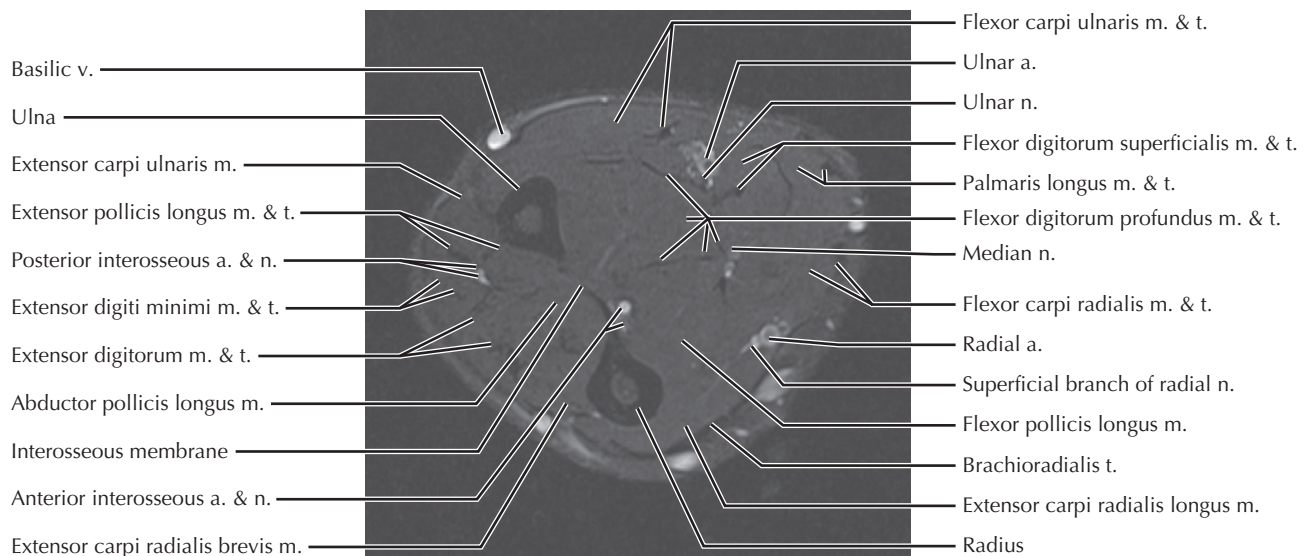
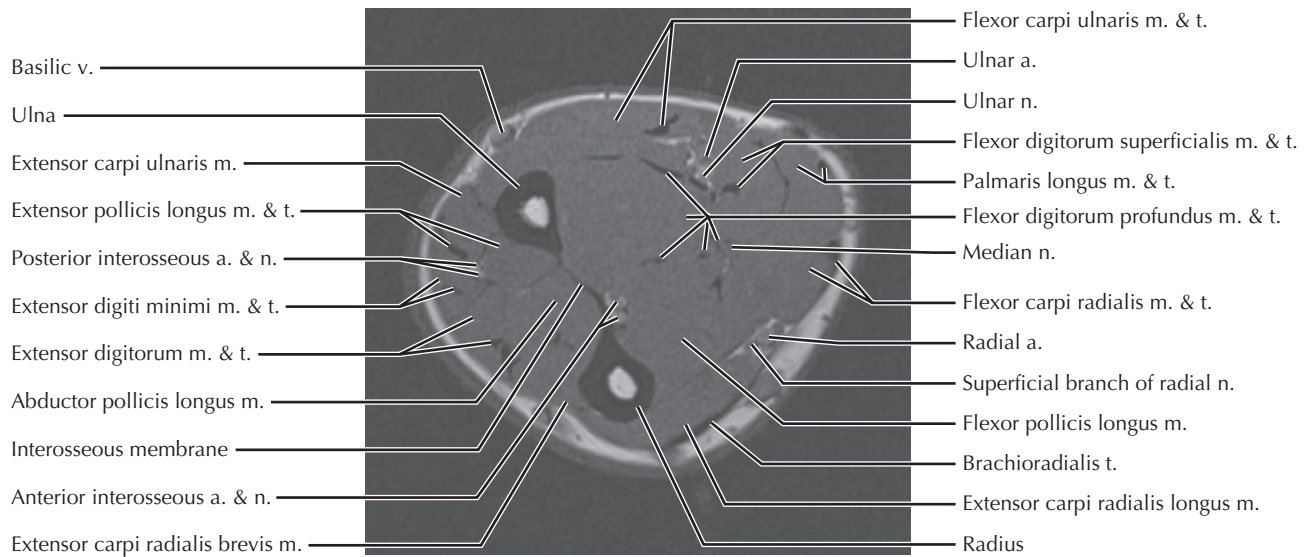
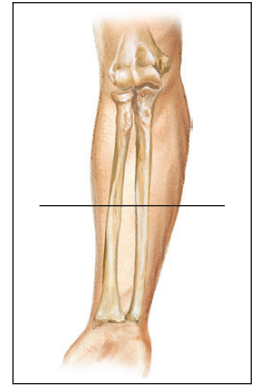


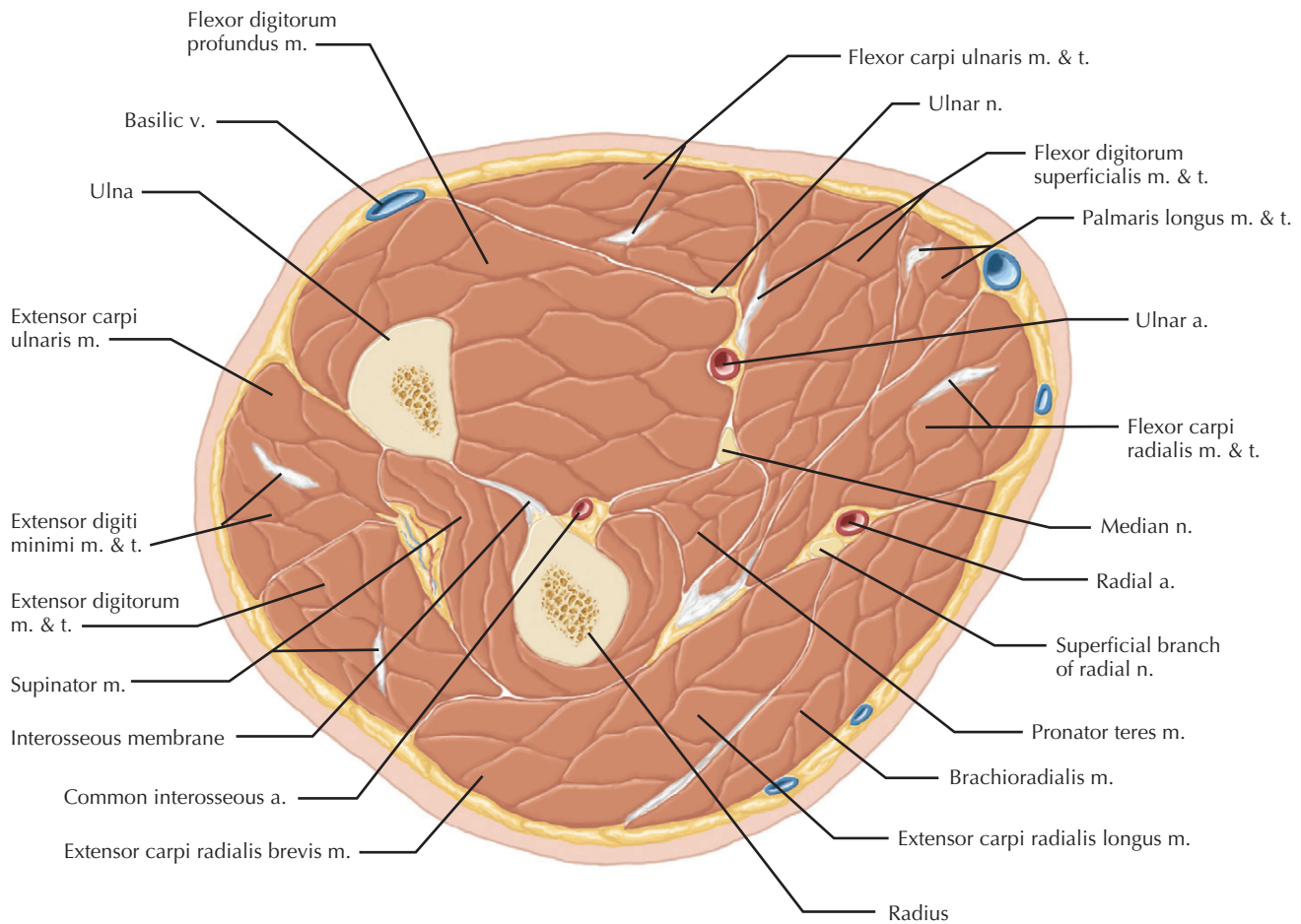








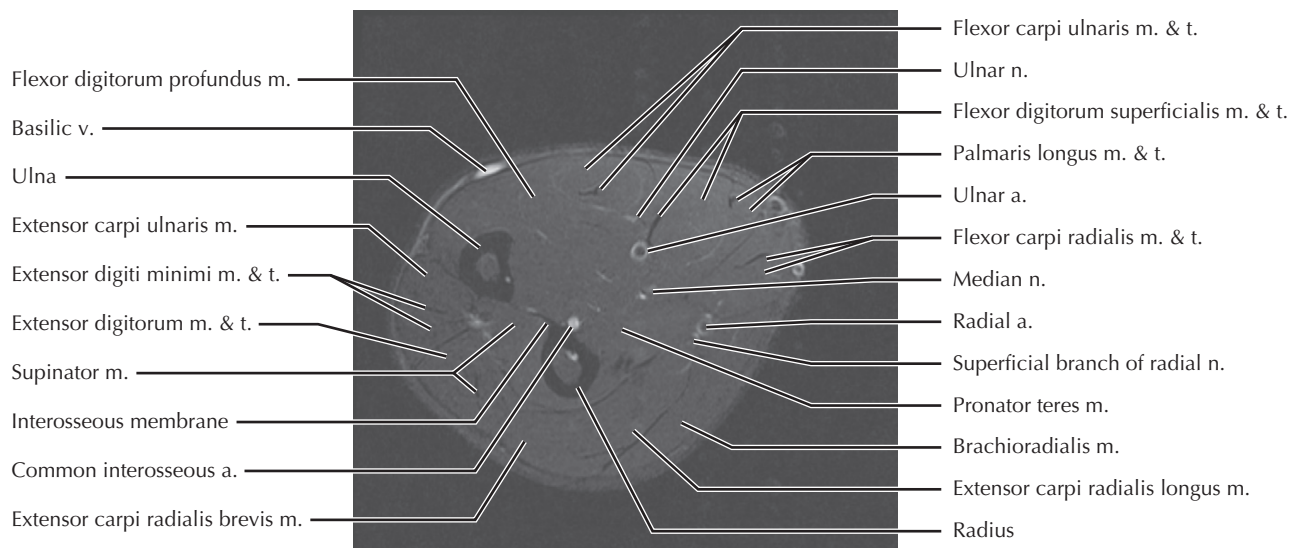
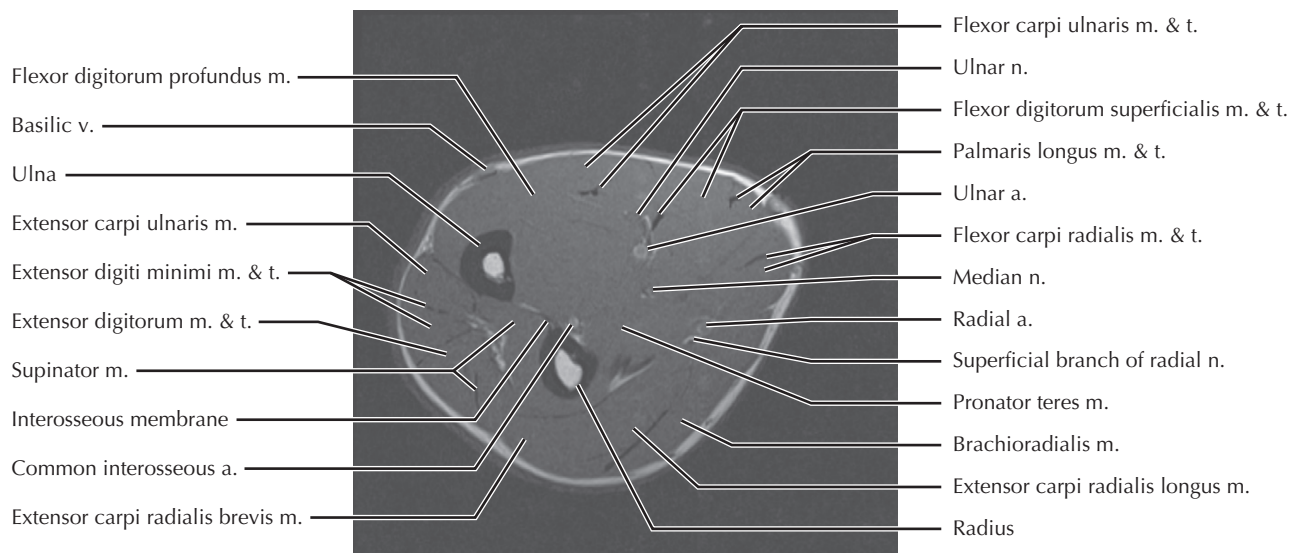
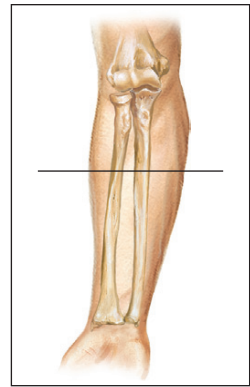


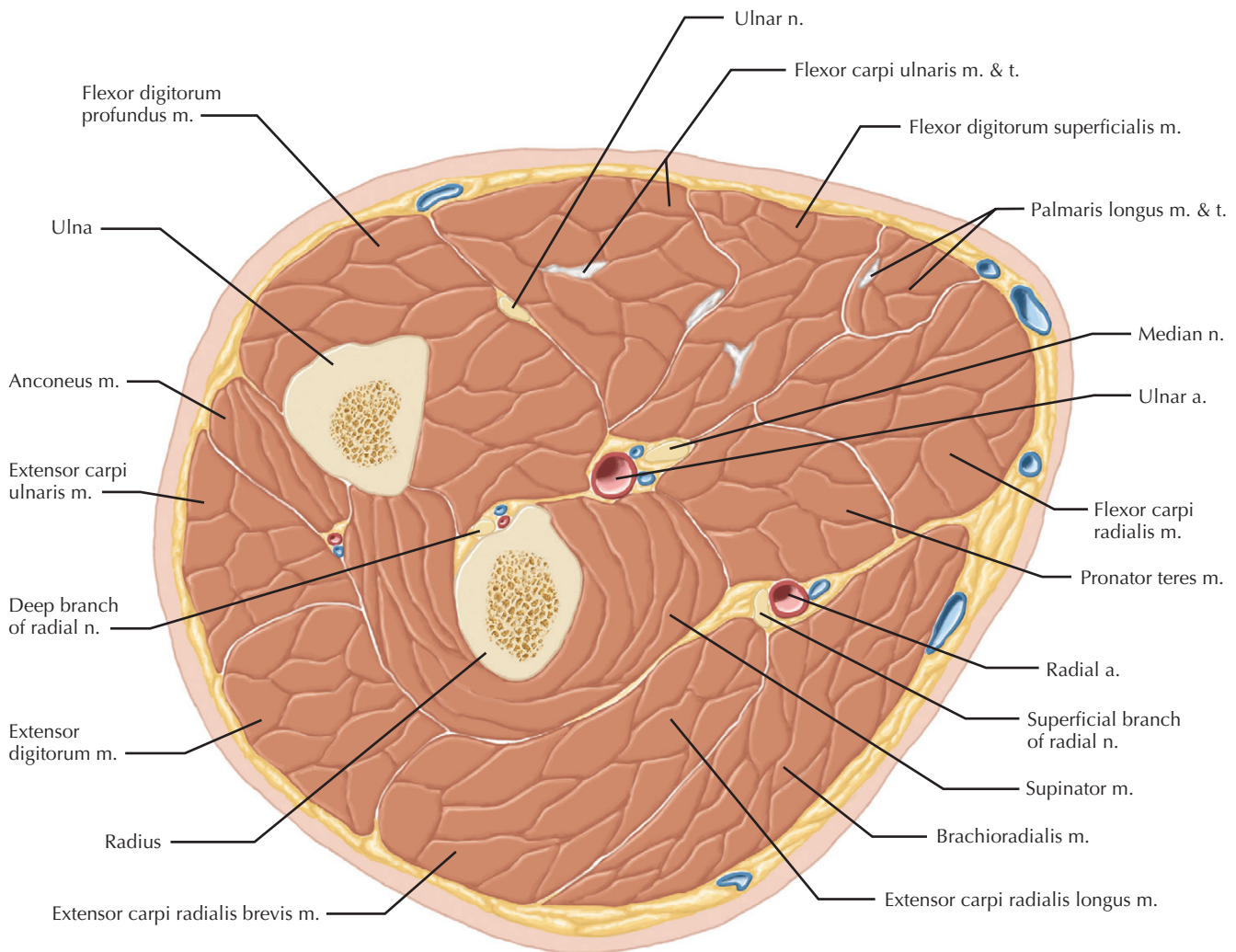


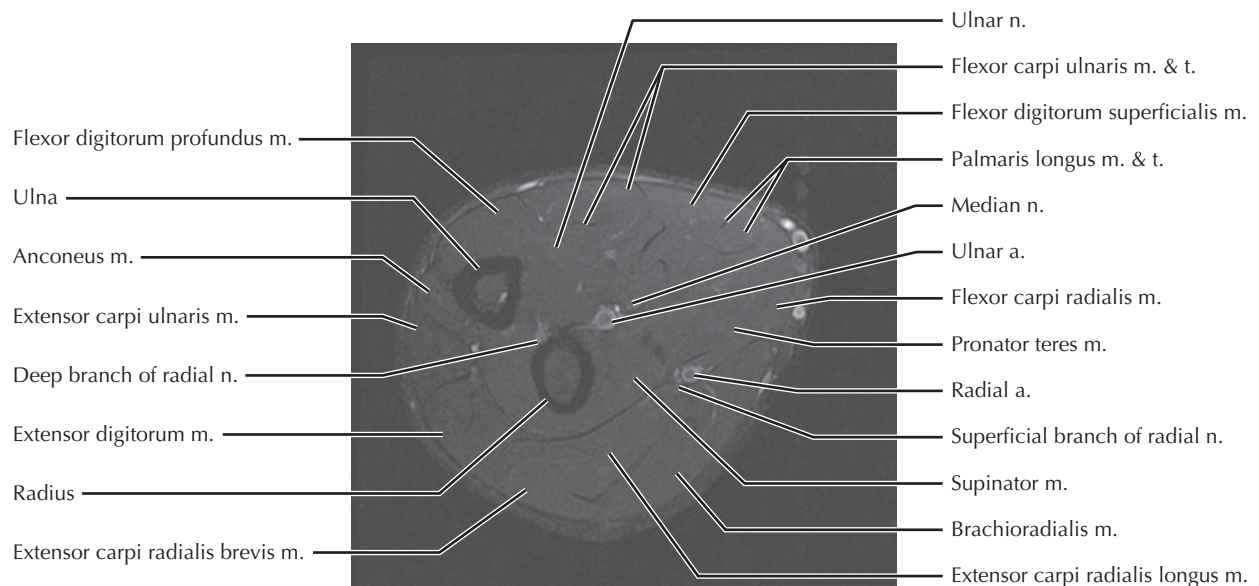
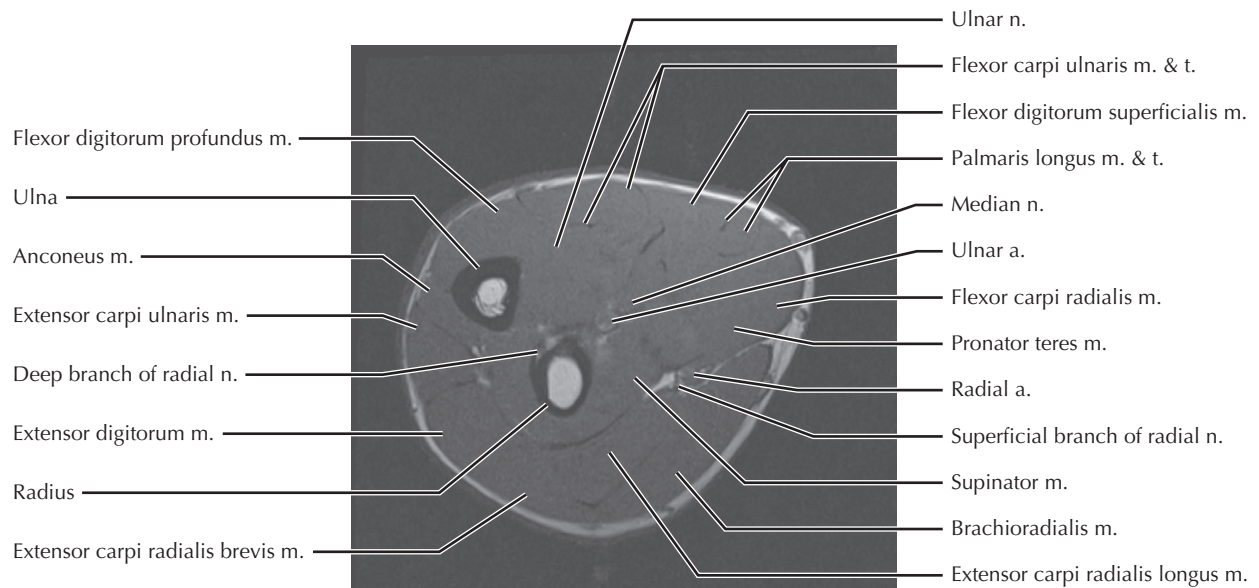
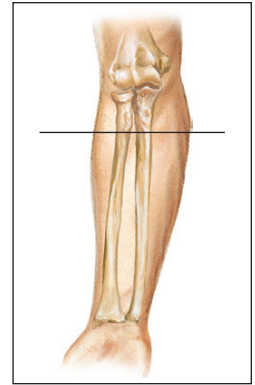
PATHOLOGIC PROCESS

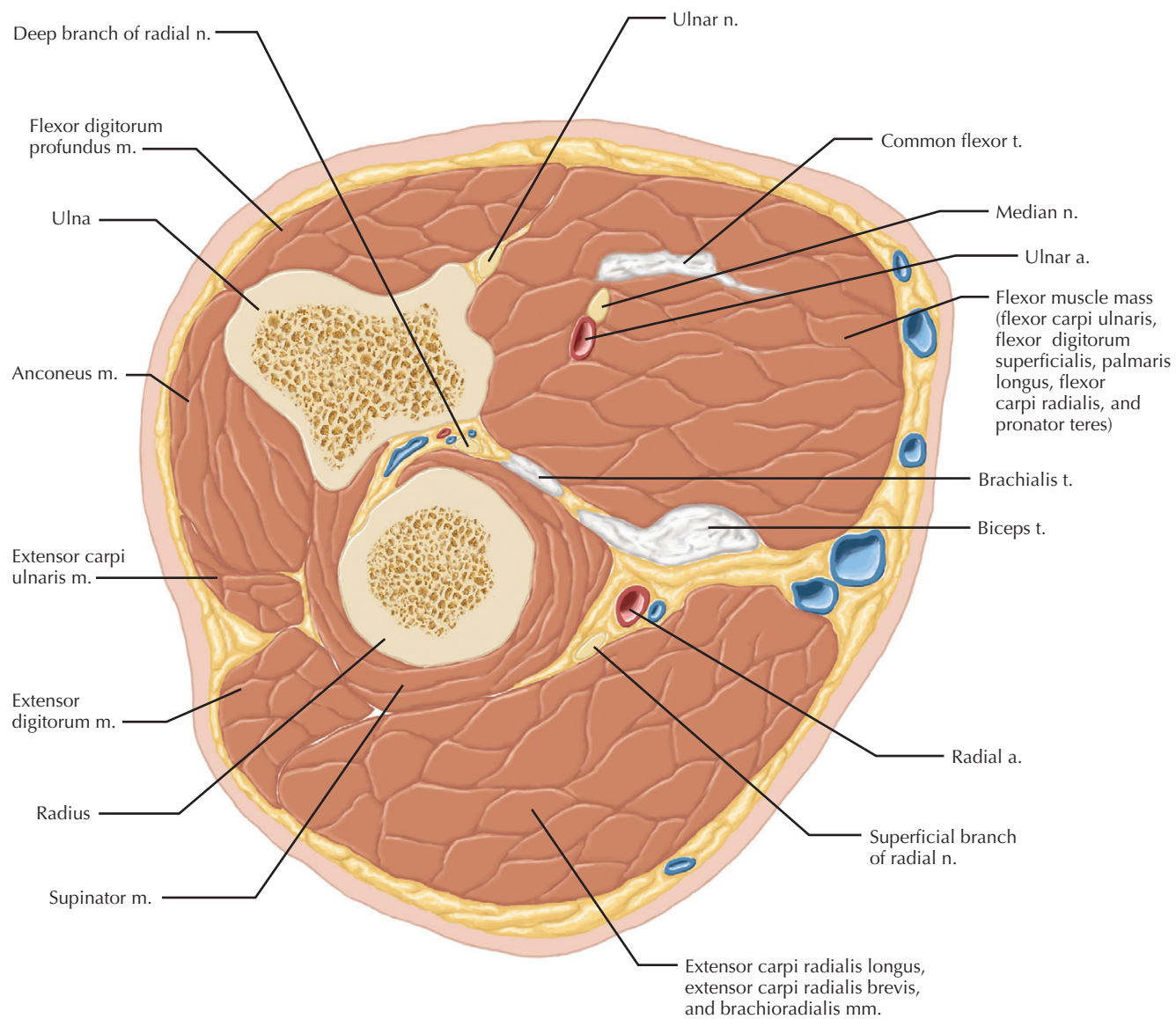
The median, ulnar, and radial nerves supply the muscles of the forearm and hand. Entrapment of a nerve can lead to neurogenic edema and is usually caused by a mass or fibrous band. Abnormal signal throughout the muscle belly on T2-weighted MR images can be attributed to neurogenic edema and should prompt examination of the appropriate nerve more proximally.

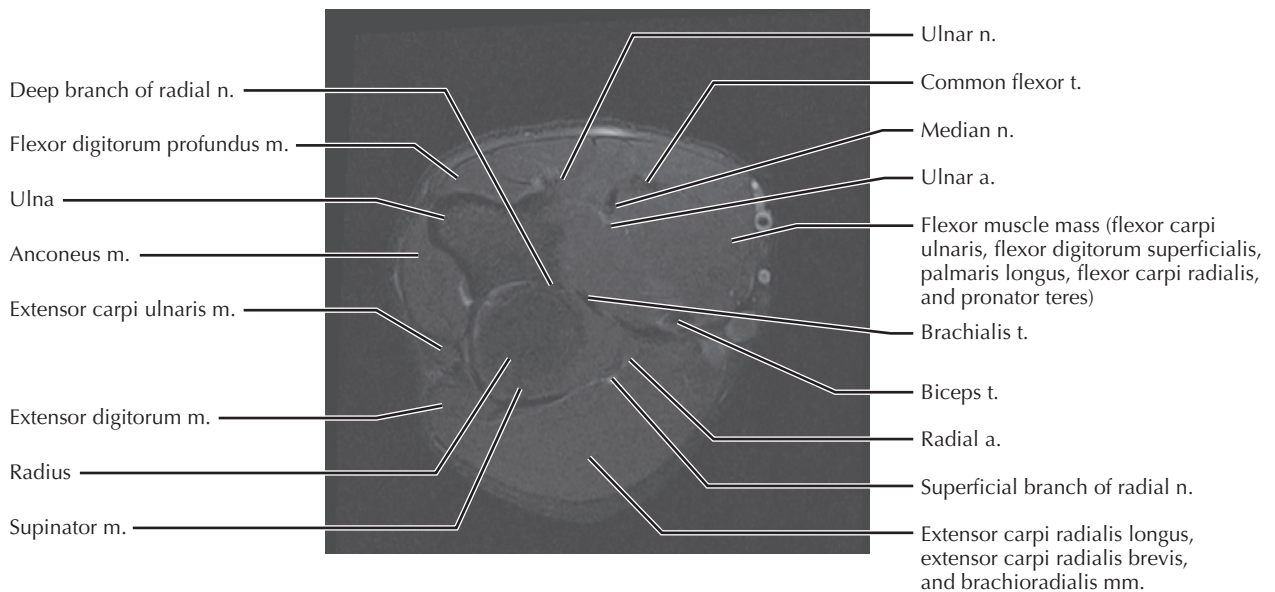
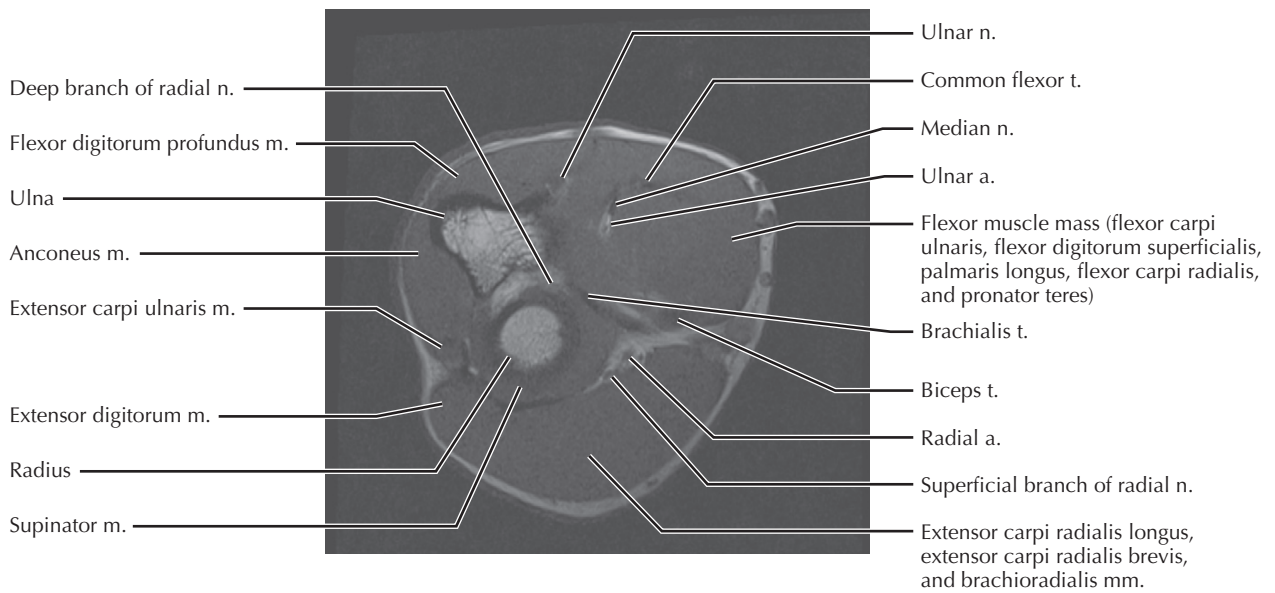
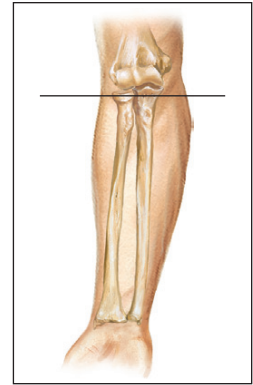
The flexor digitorum superficialis, palmaris longus, flexor carpi radialis, and pronator teres muscles and half the flexor digitorum profundus muscle are innervated by the median nerve. The flexor carpi ulnaris and half the flexor digitorum profundus receive the ulnar nerve. The brachioradialis, extensor carpi radialis longus, extensor carpi radialis brevis, supinator, extensor digitorum, extensor digiti minimi, and extensor carpi ulnaris muscles are innervated by the radial nerve.









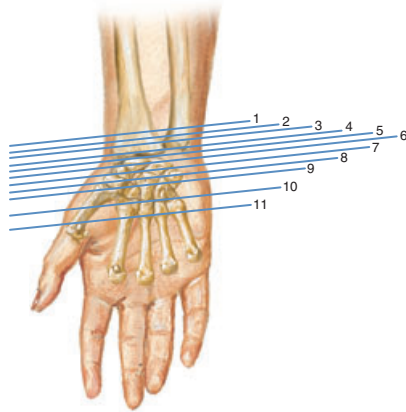


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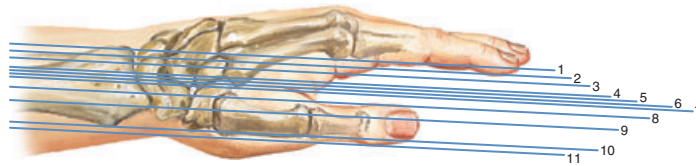
Chapter

6

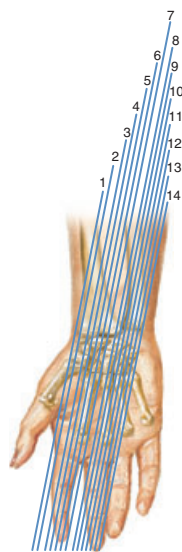
WRIST



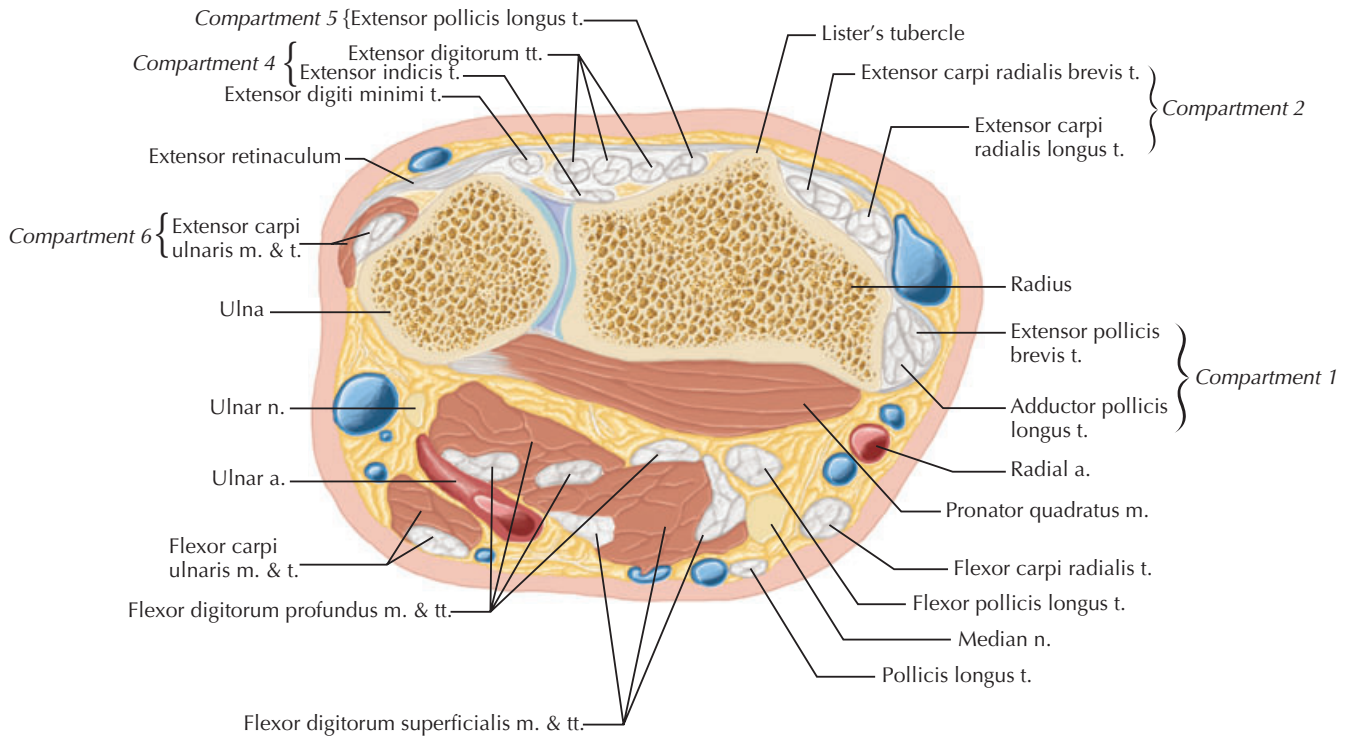
AXIAL 166



CORONAL 188



SAGITTAL 210



NORMAL ANATOMY

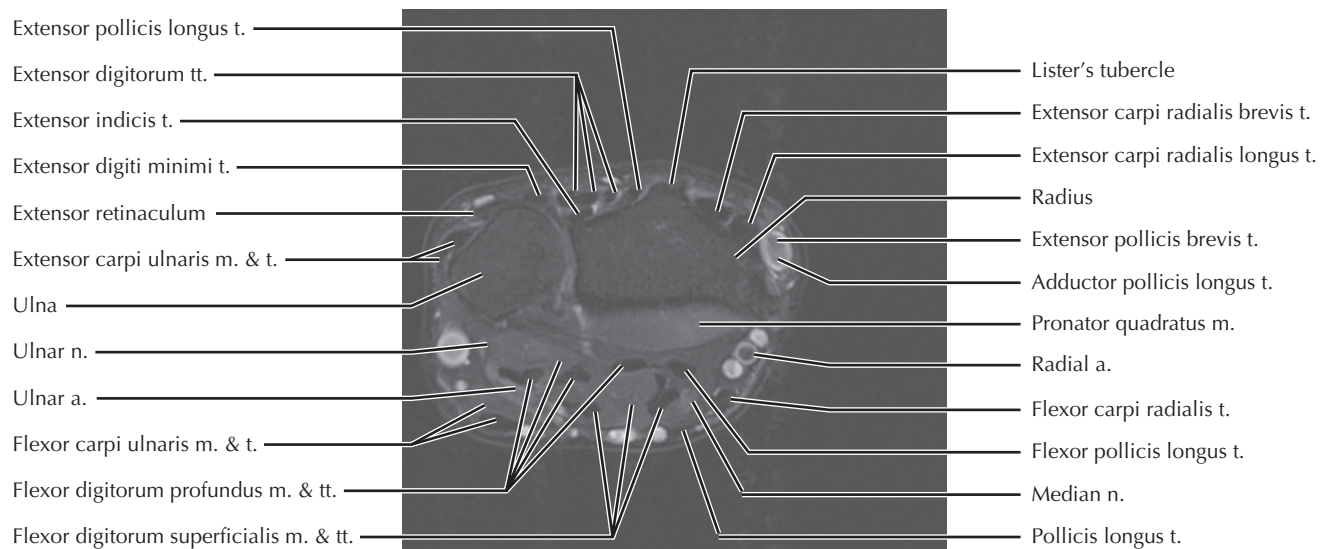
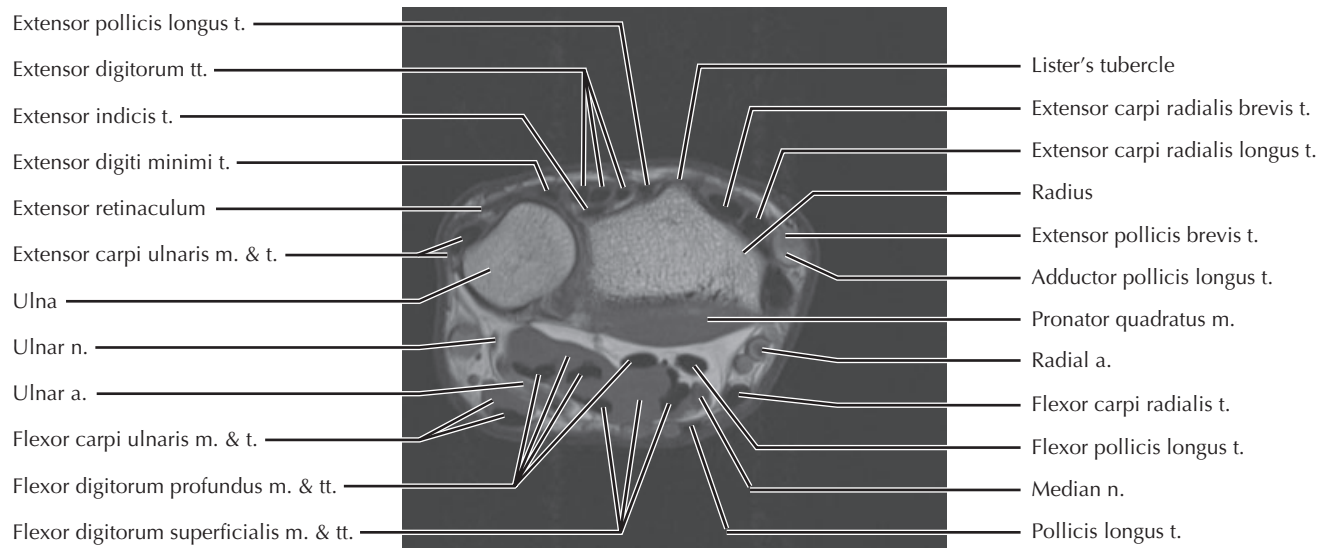
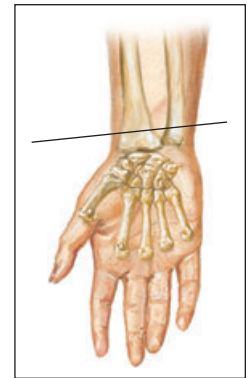
The extensor tendons to the wrist and hand are contained in six specific compartments.

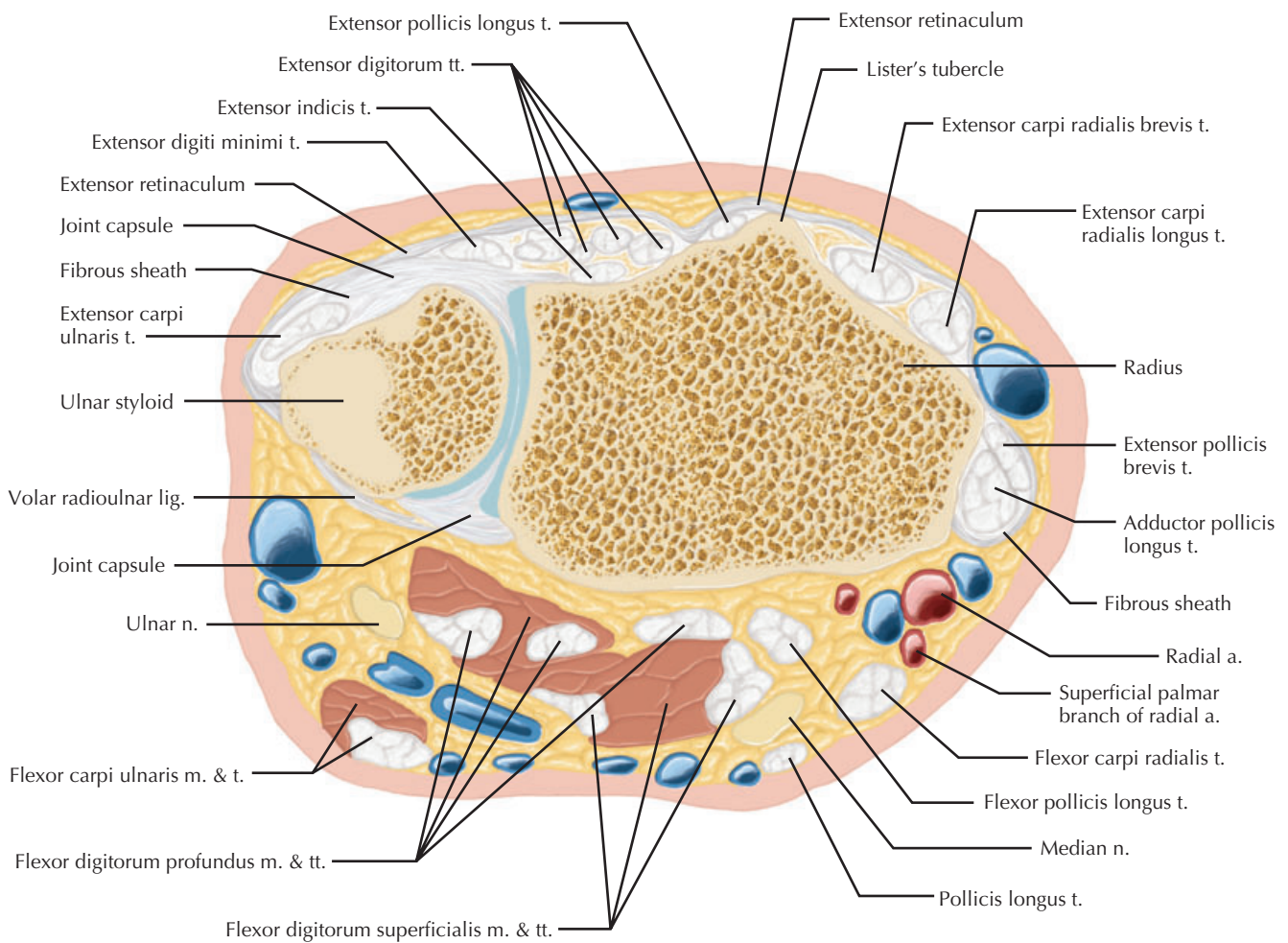
PATHOLOGIC PROCESS

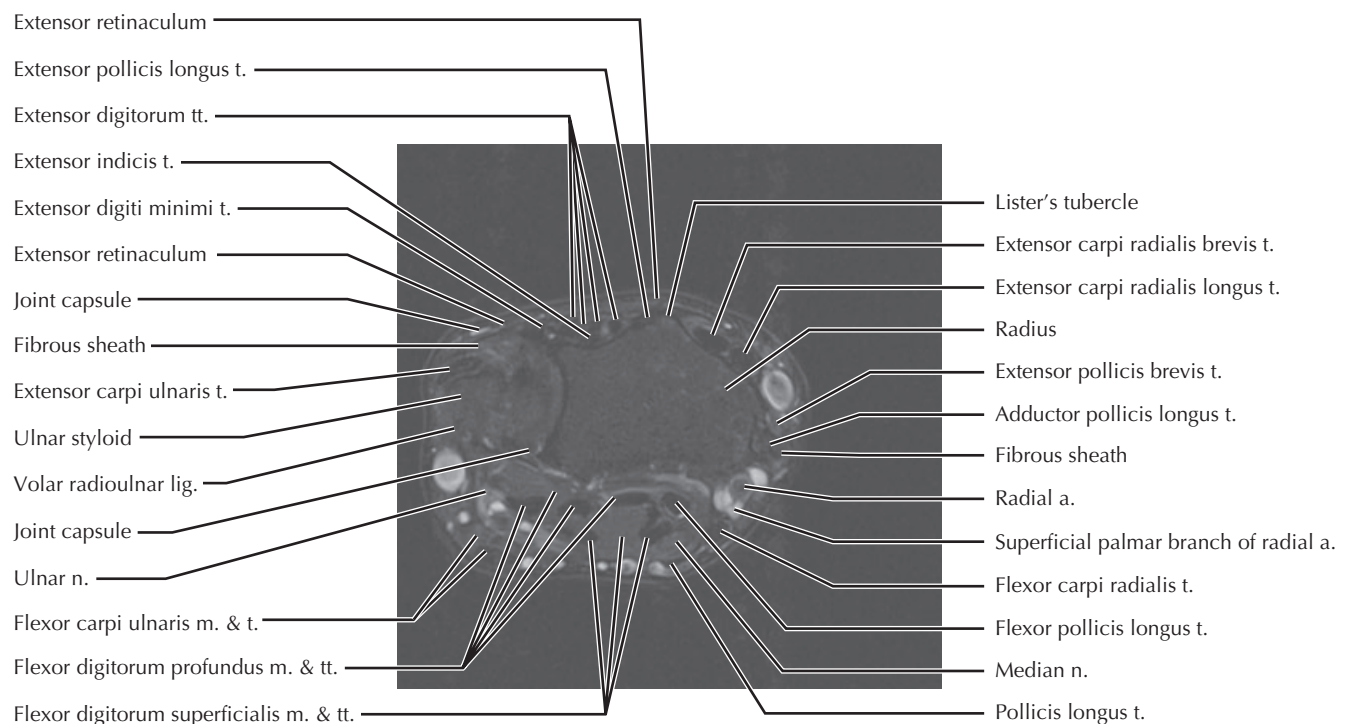
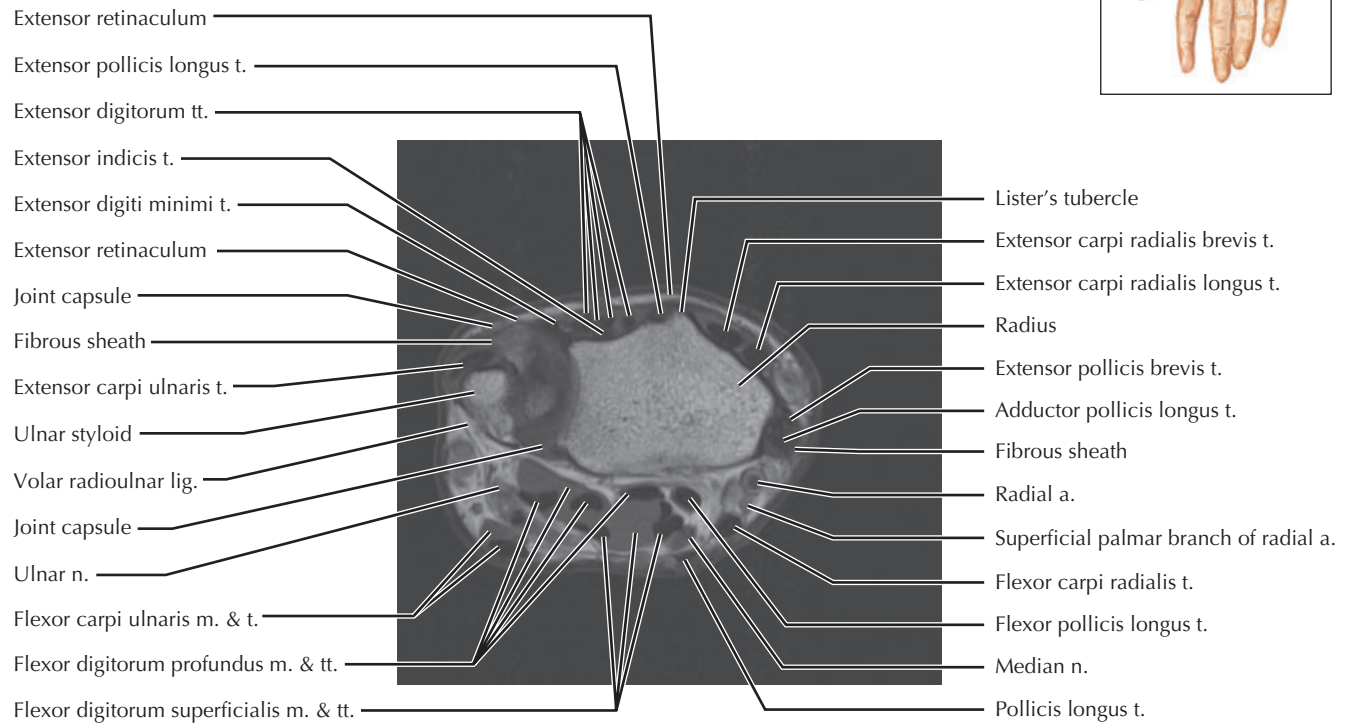
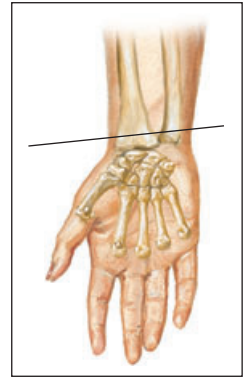
Subluxation or dislocation of the extensor carpi radialis is diagnosed when the tendon is partially or completely dislodged from its groove in the dorsal aspect of the ulna. This is best evaluated on axial images.

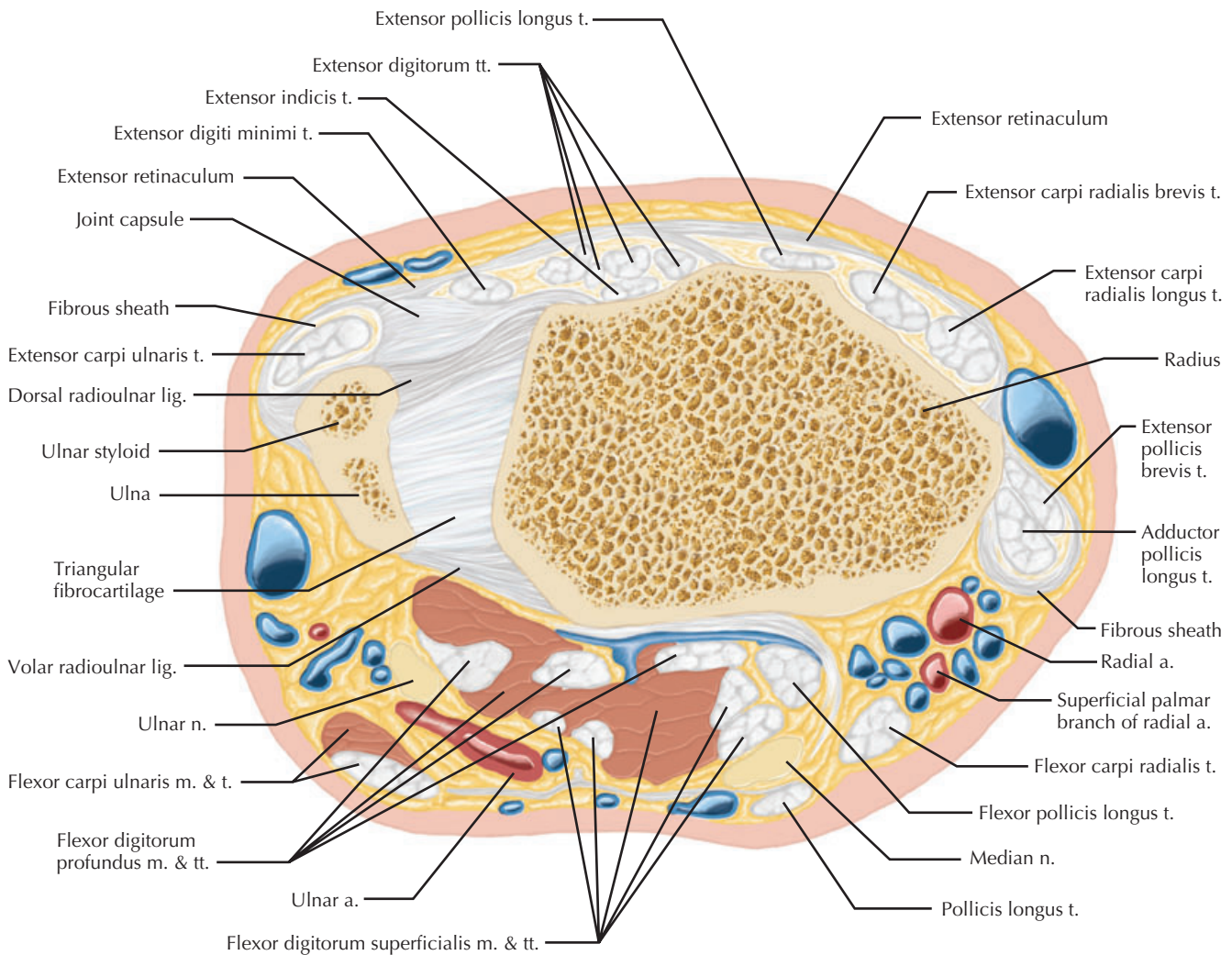
DIAGNOSTIC CONSIDERATION

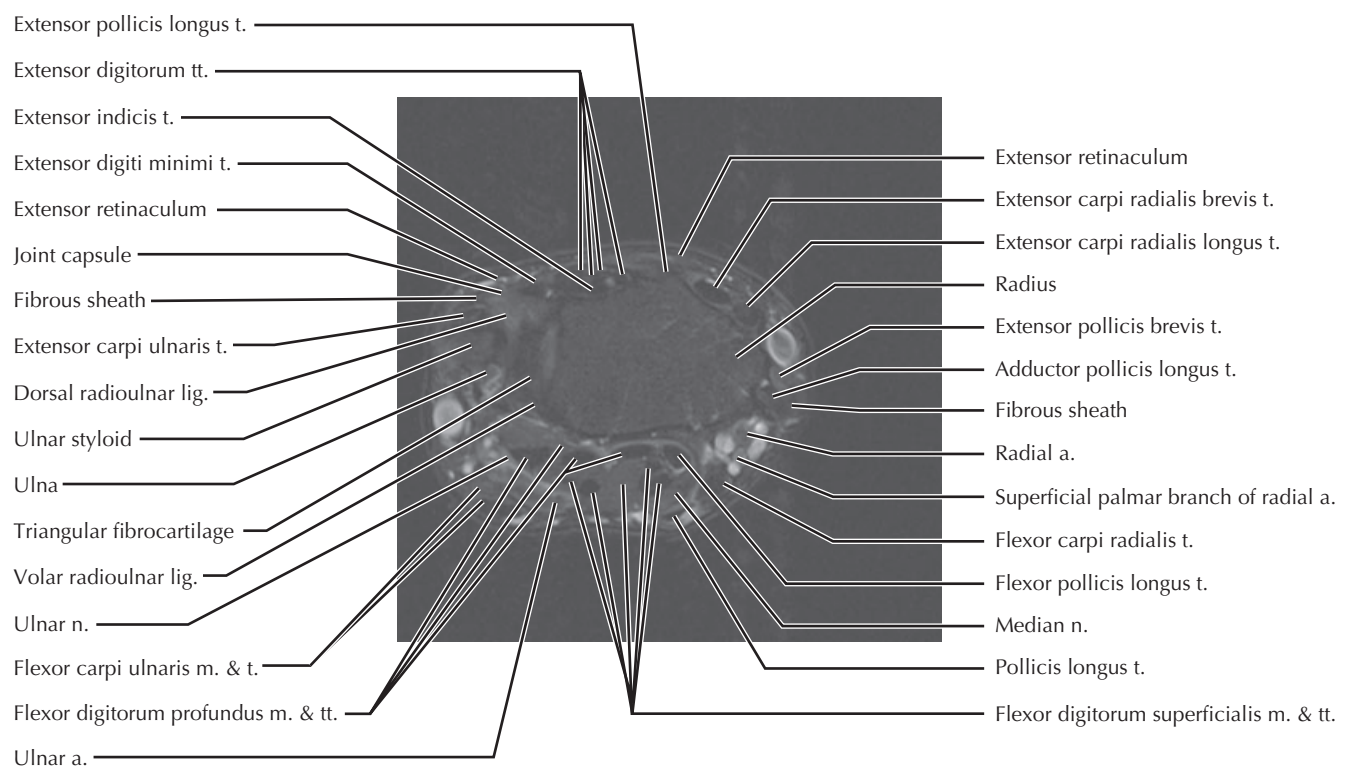
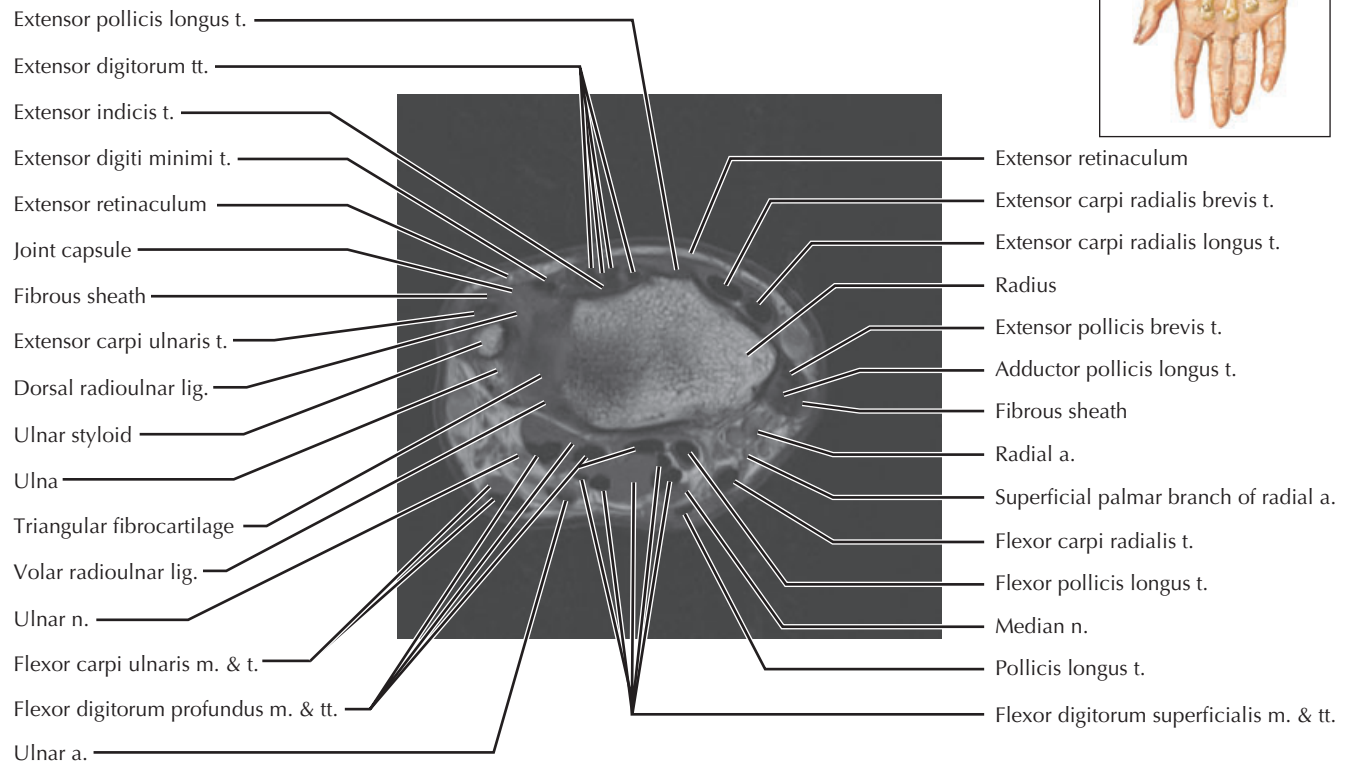
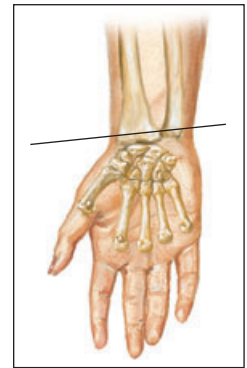
The wrist should be imaged in a neutral position midway between pronation and supination. In this position the extensor carpi ulnaris tendon lies in its groove on the distal ulna. The extensor carpi ulnaris tendon normally slides out of this position when the wrist is supinated, and the resulting configuration can be mistaken for a dislocation.

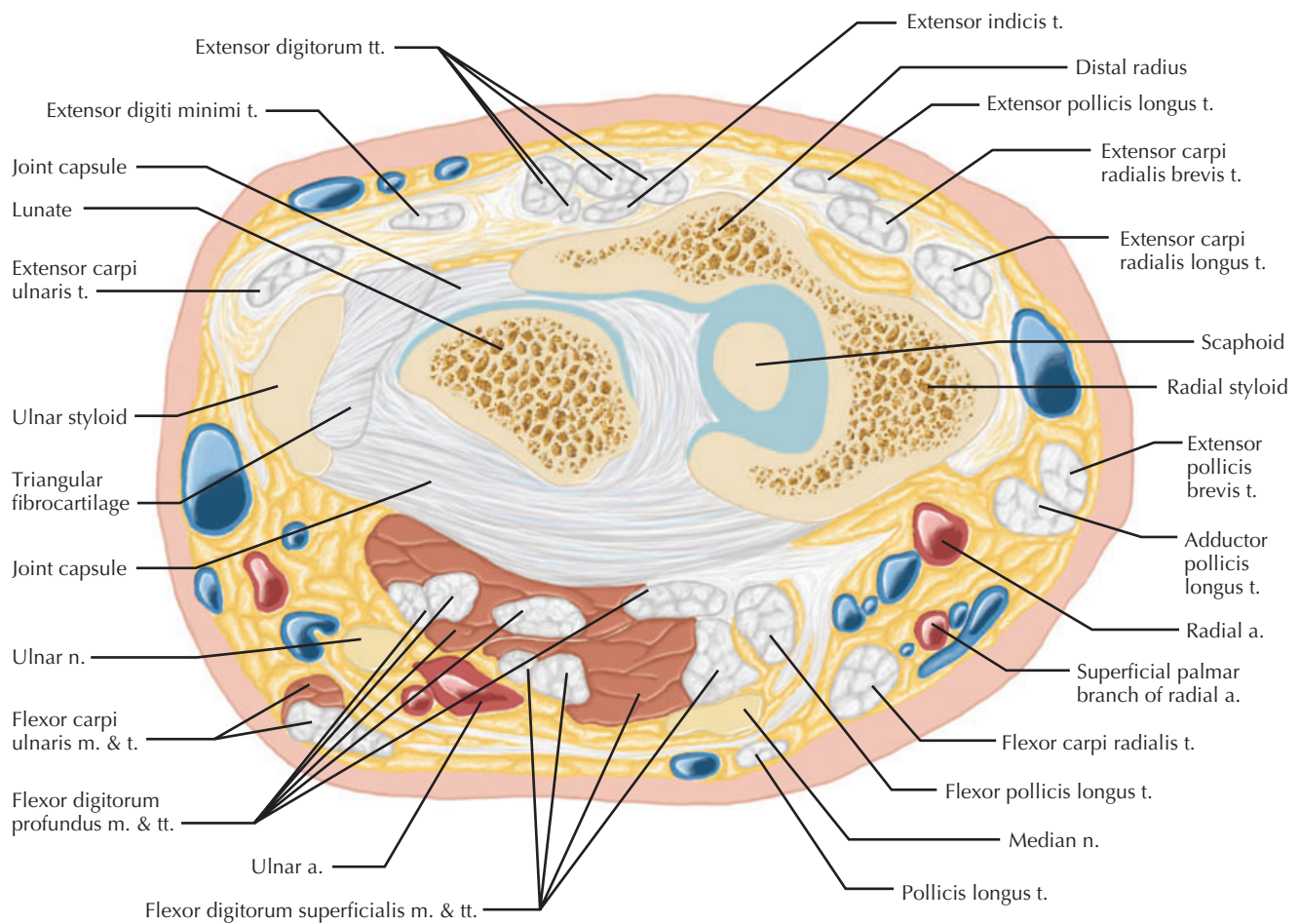


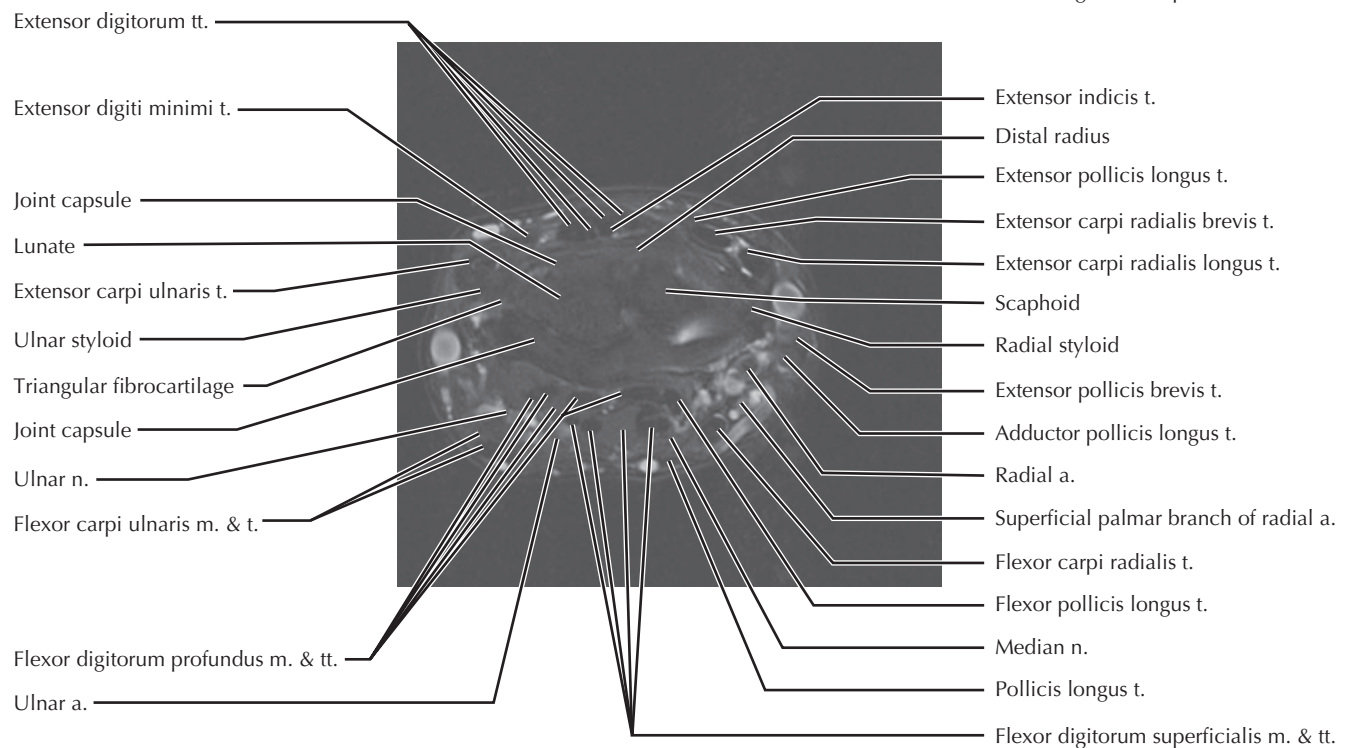
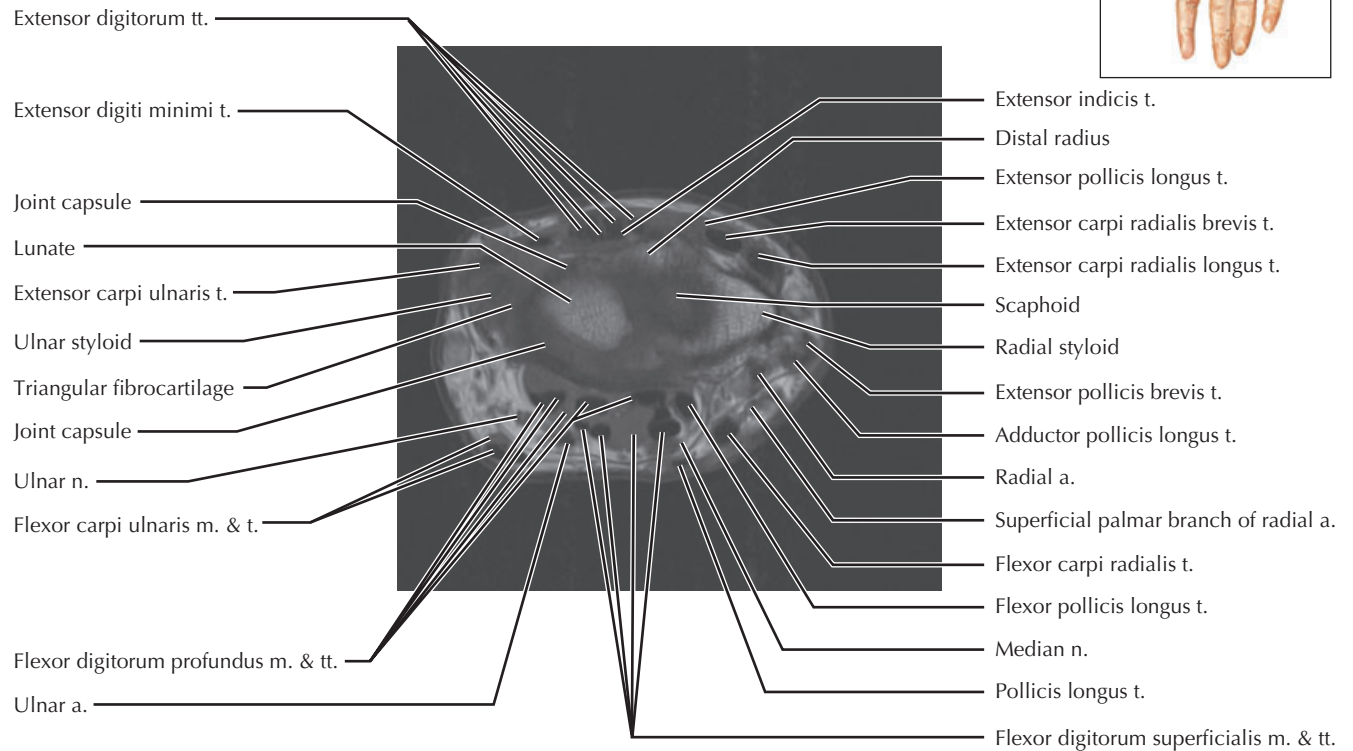
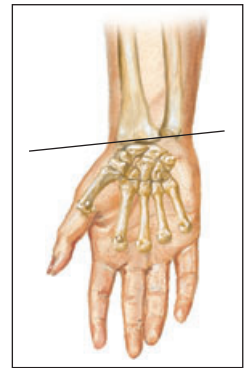


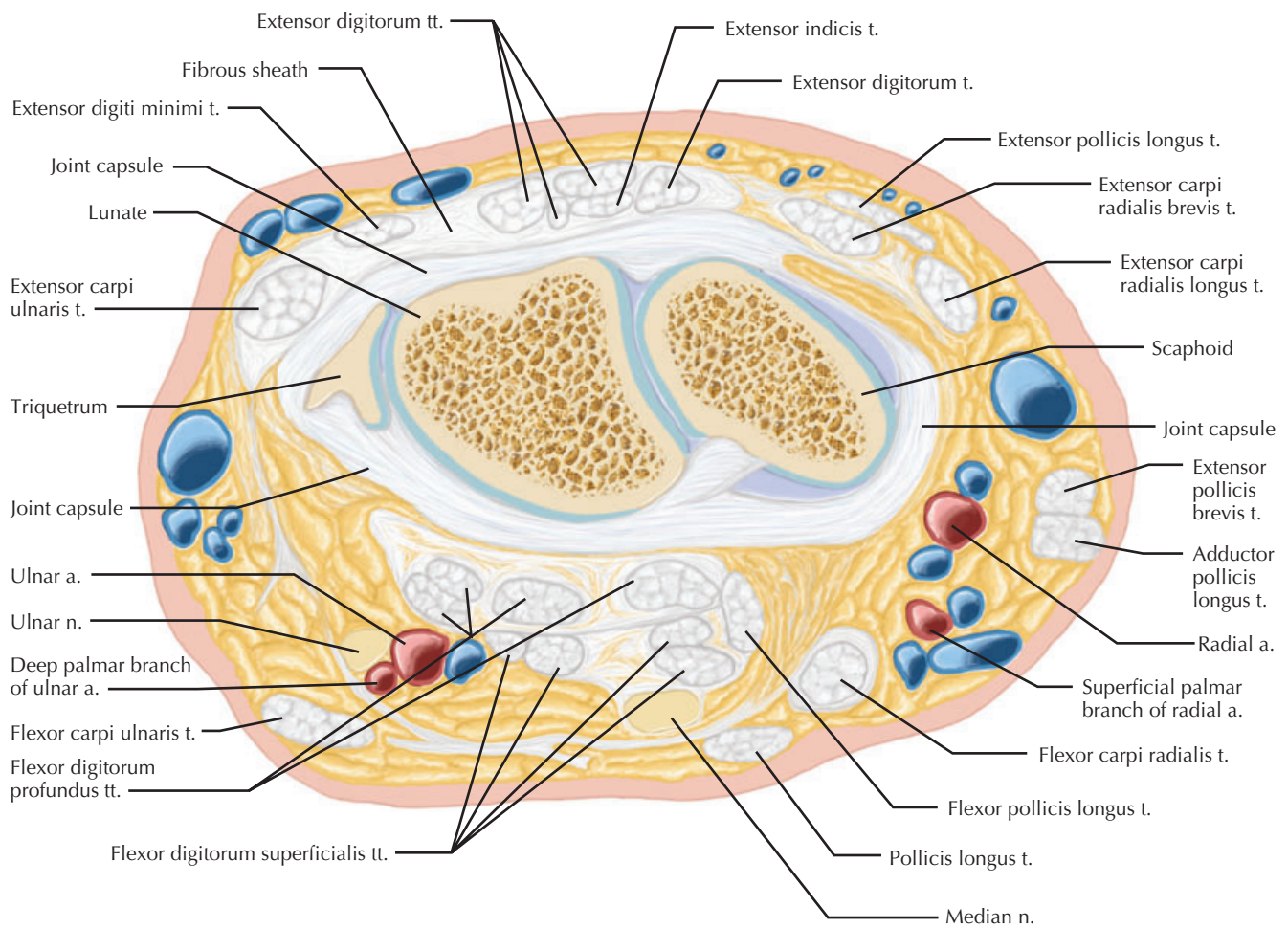


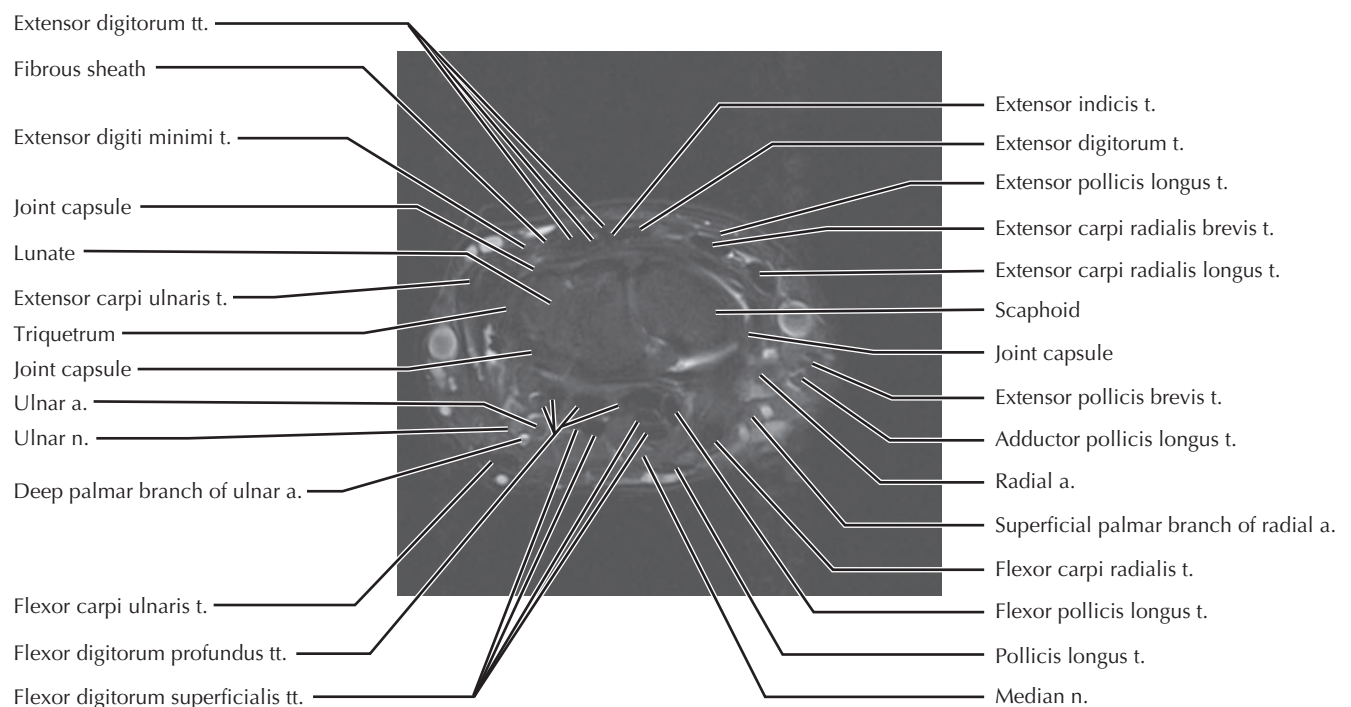
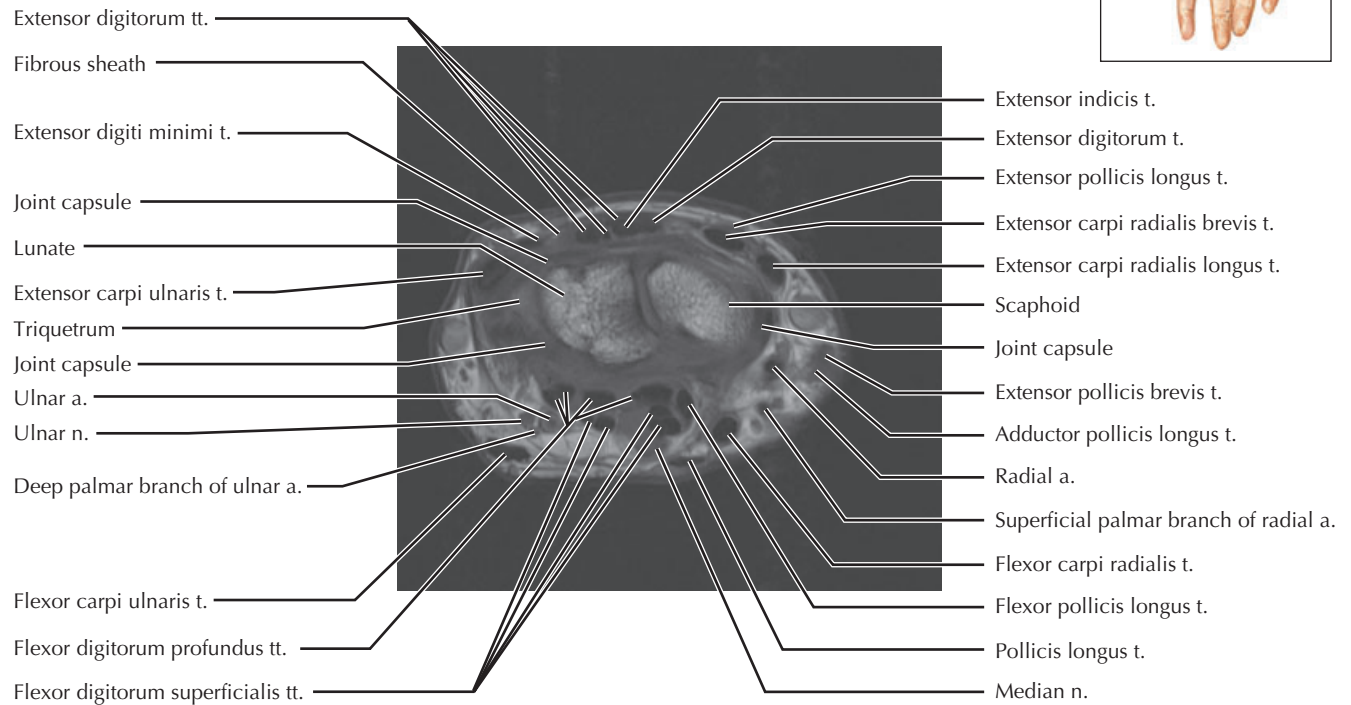
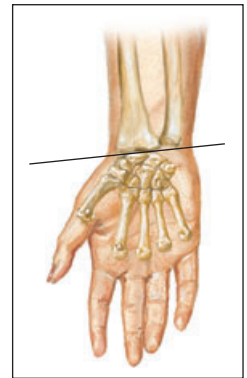


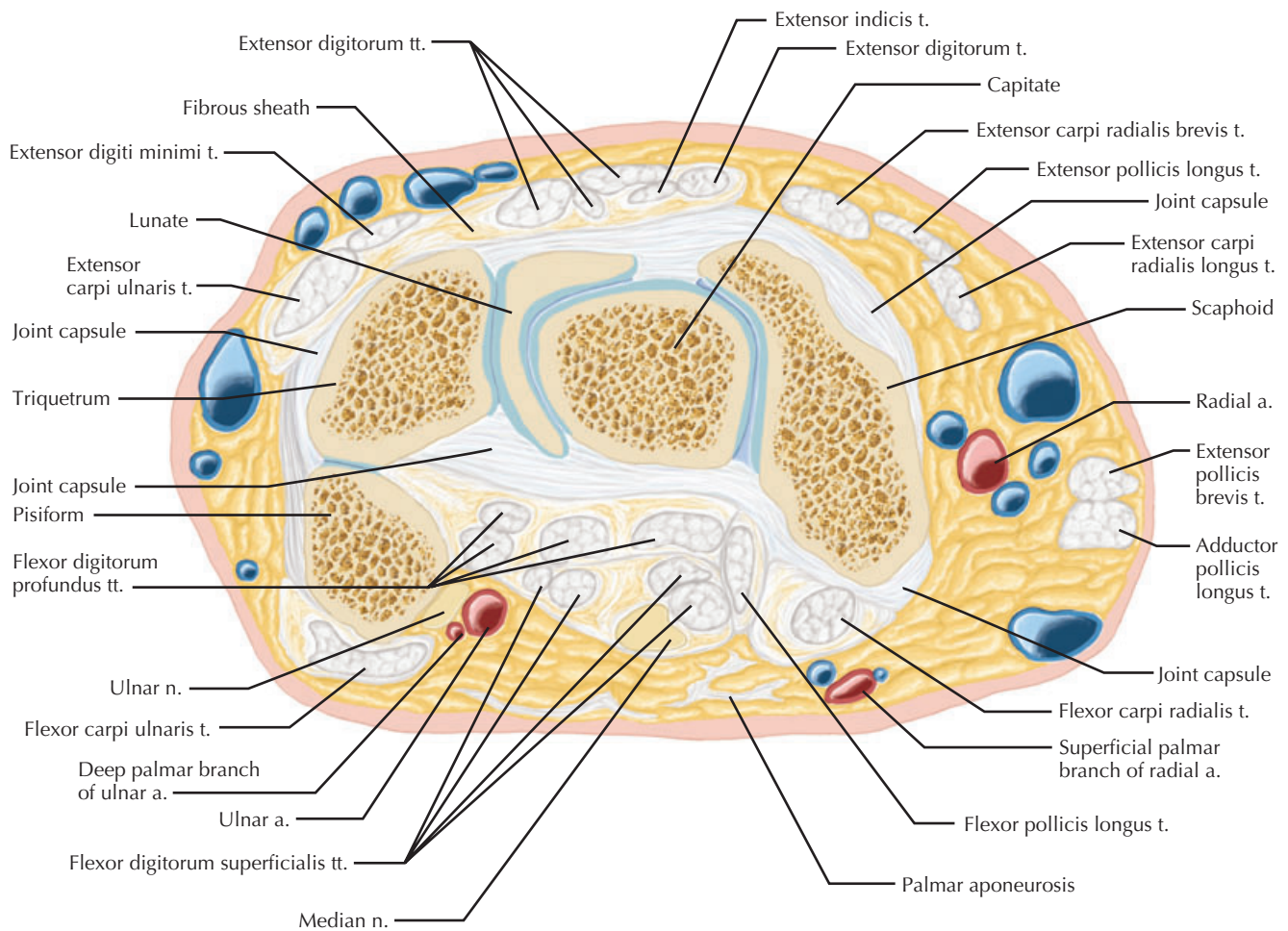


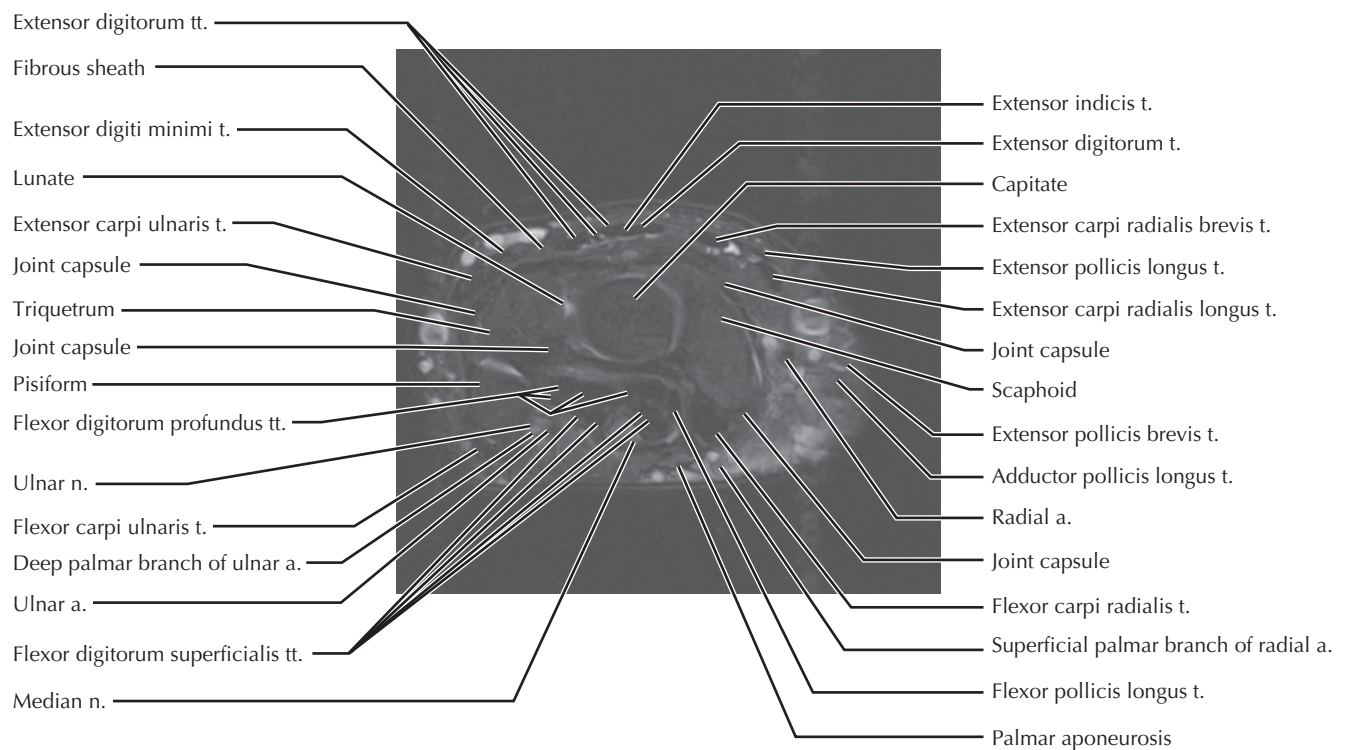
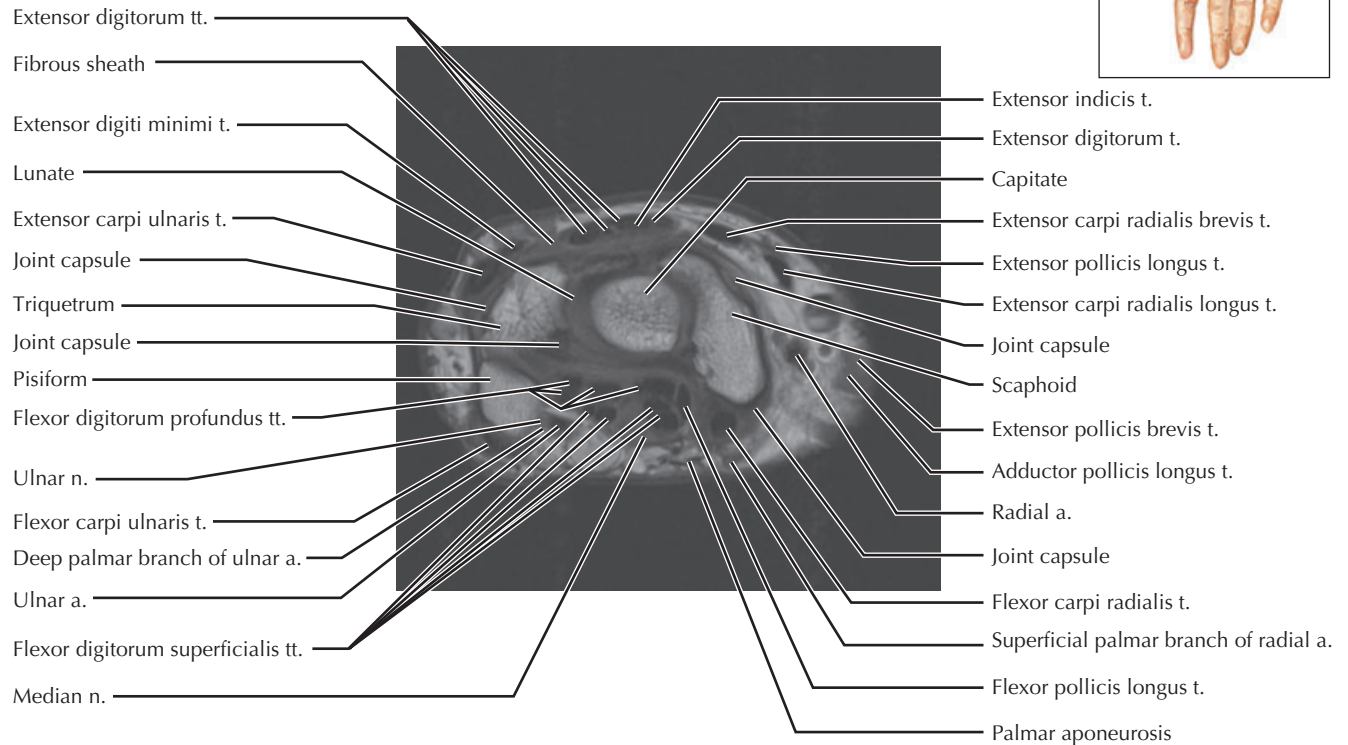
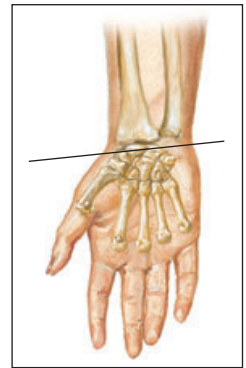


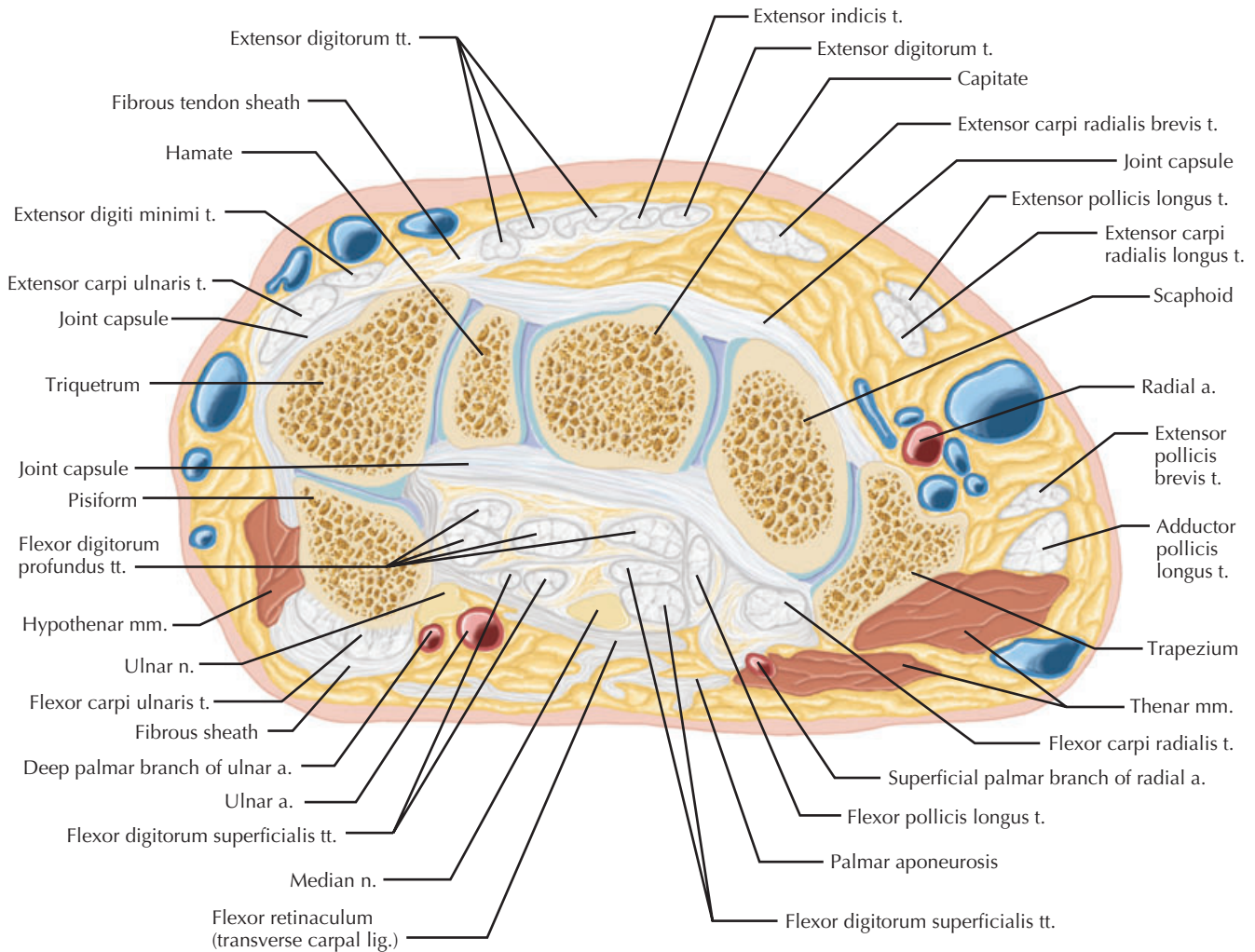






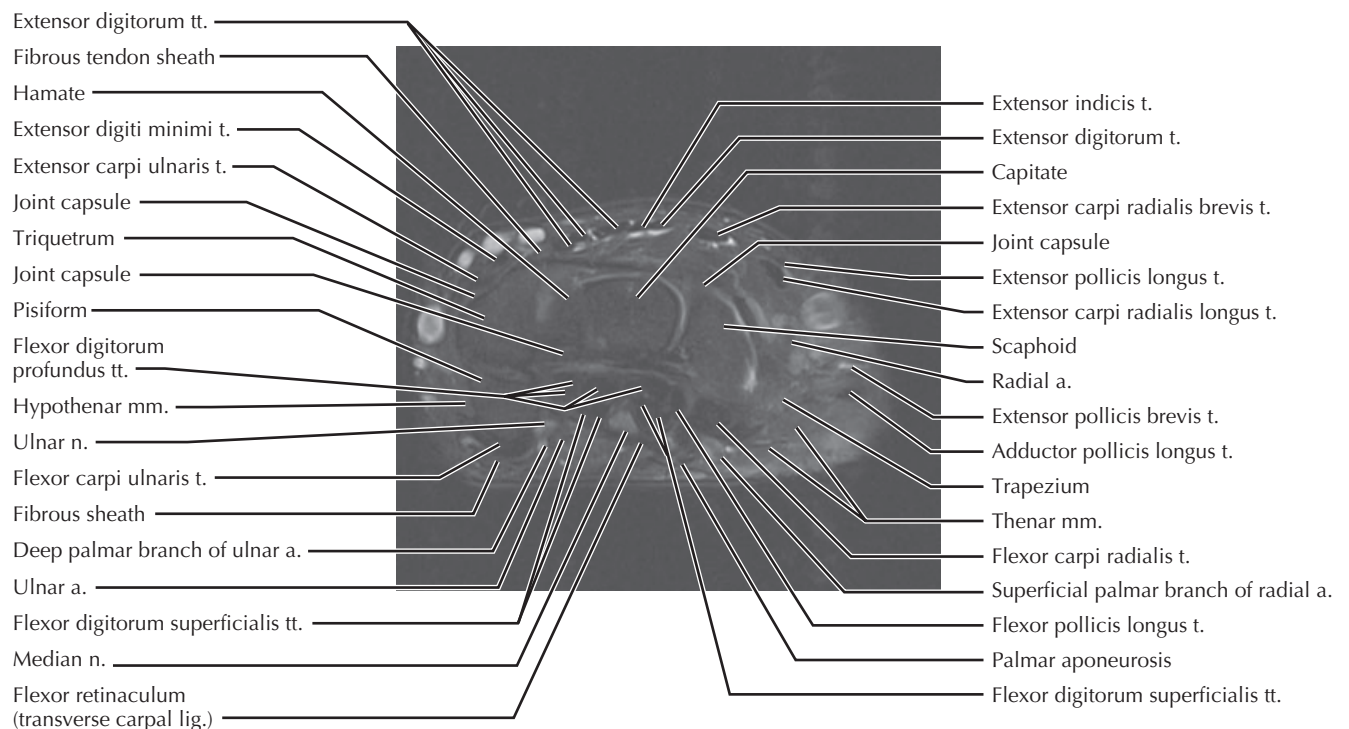
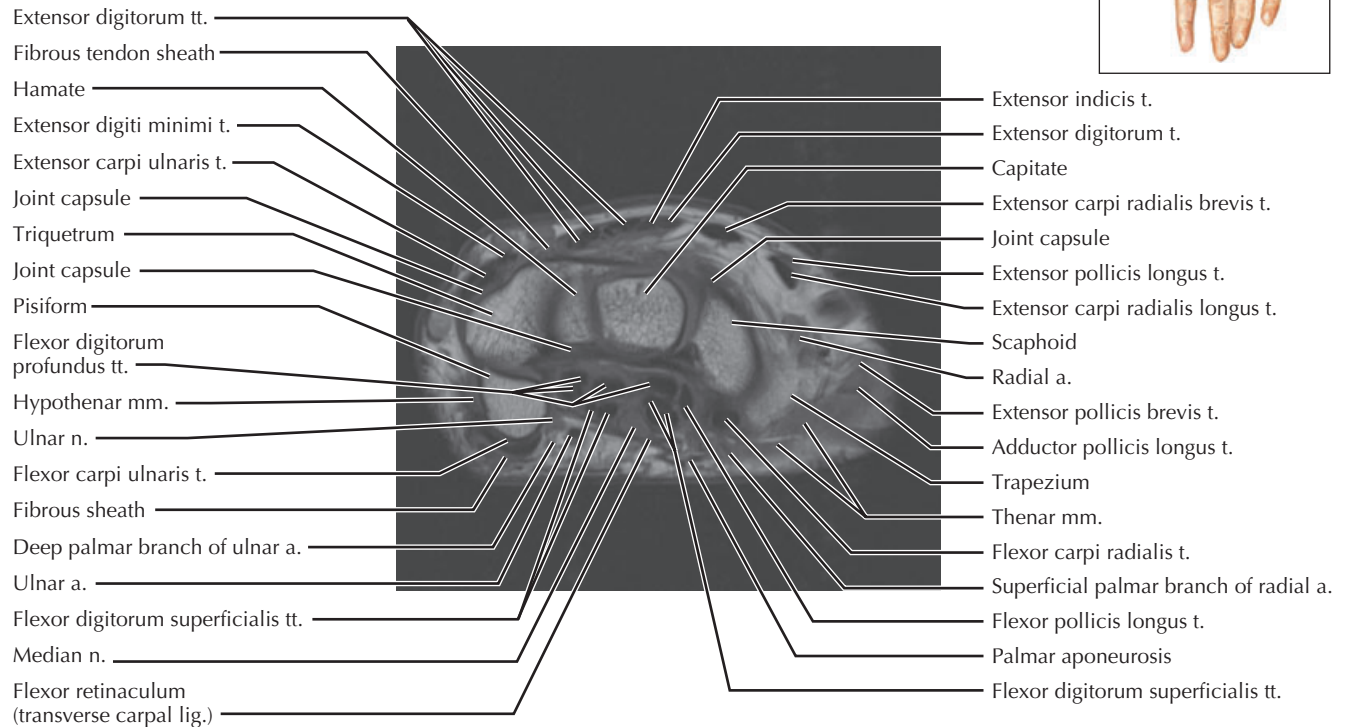
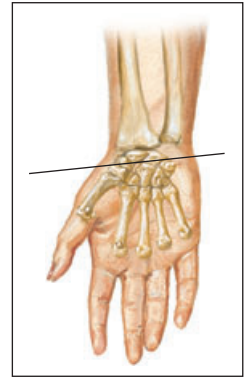


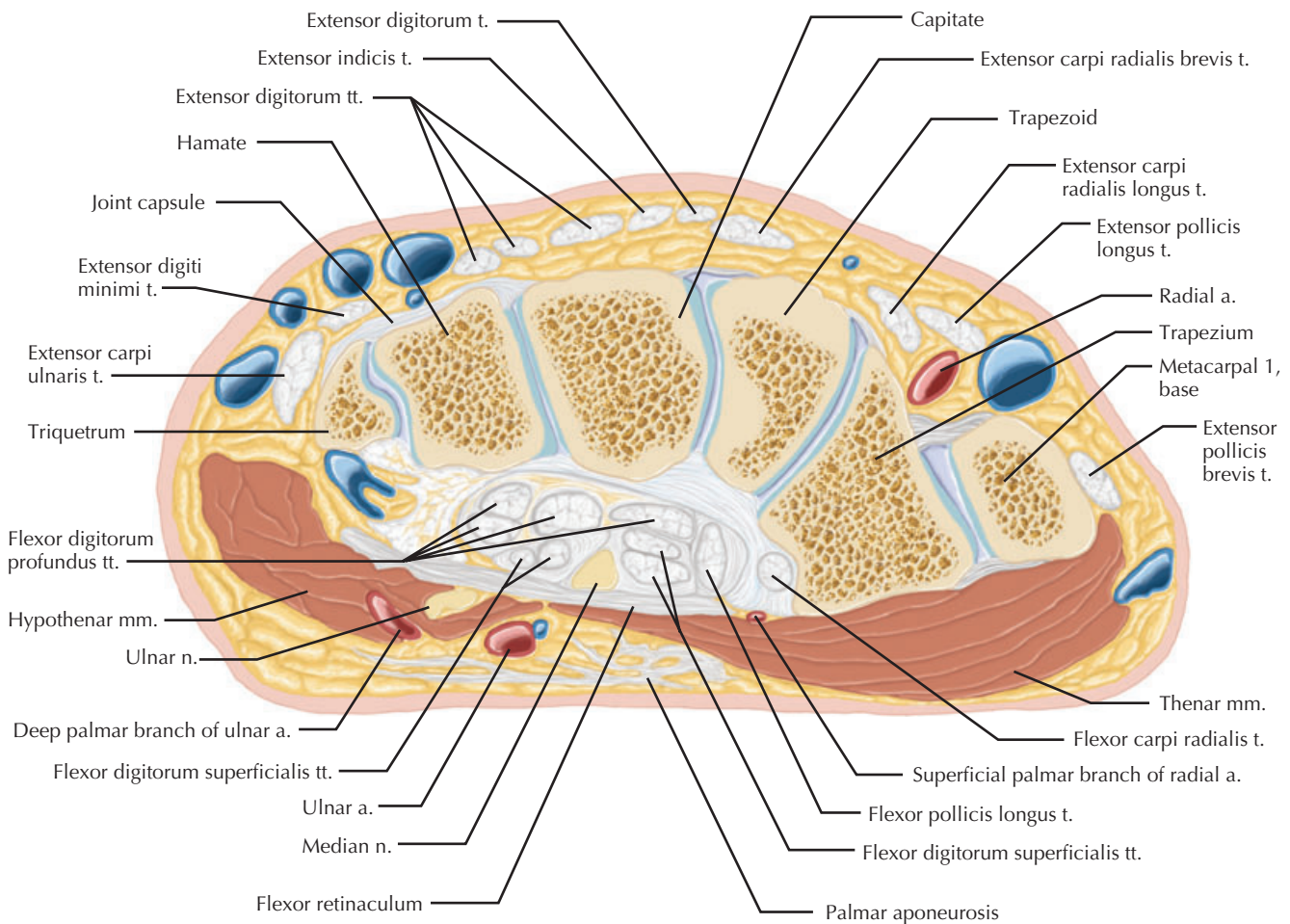




PATHOLOGIC PROCESS

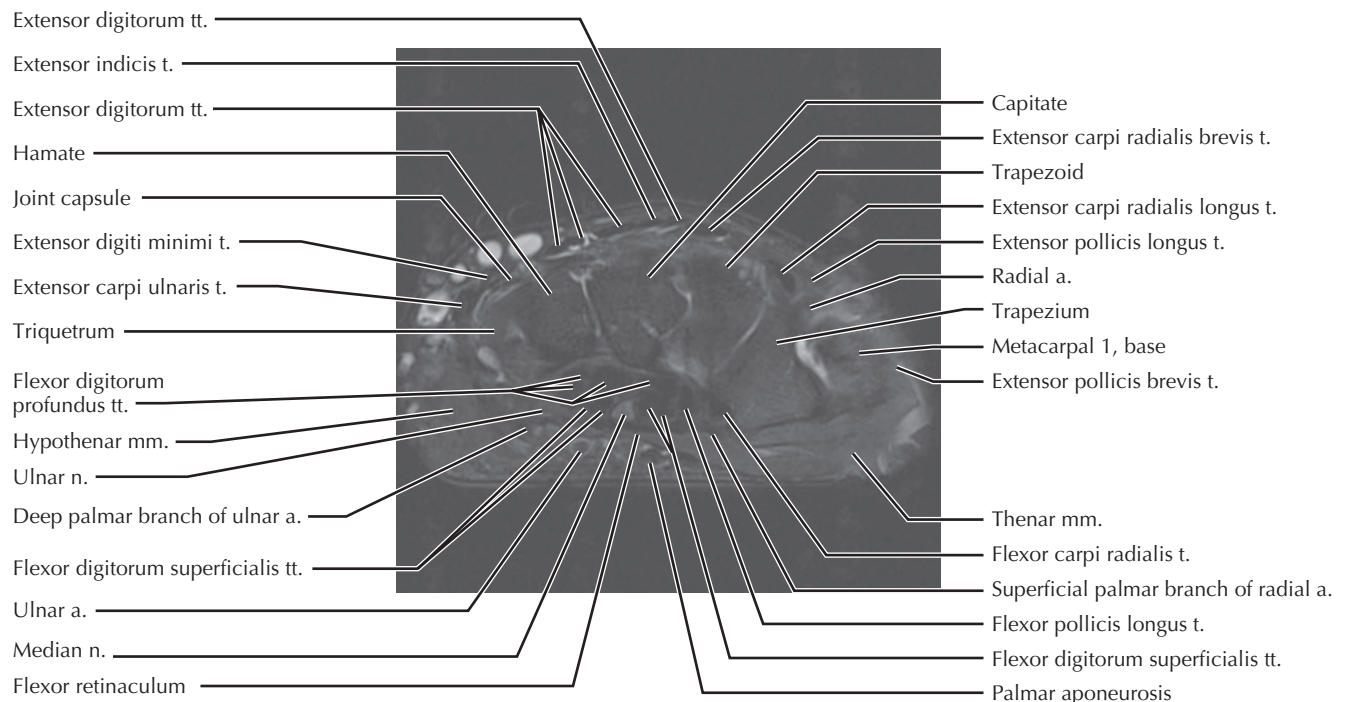
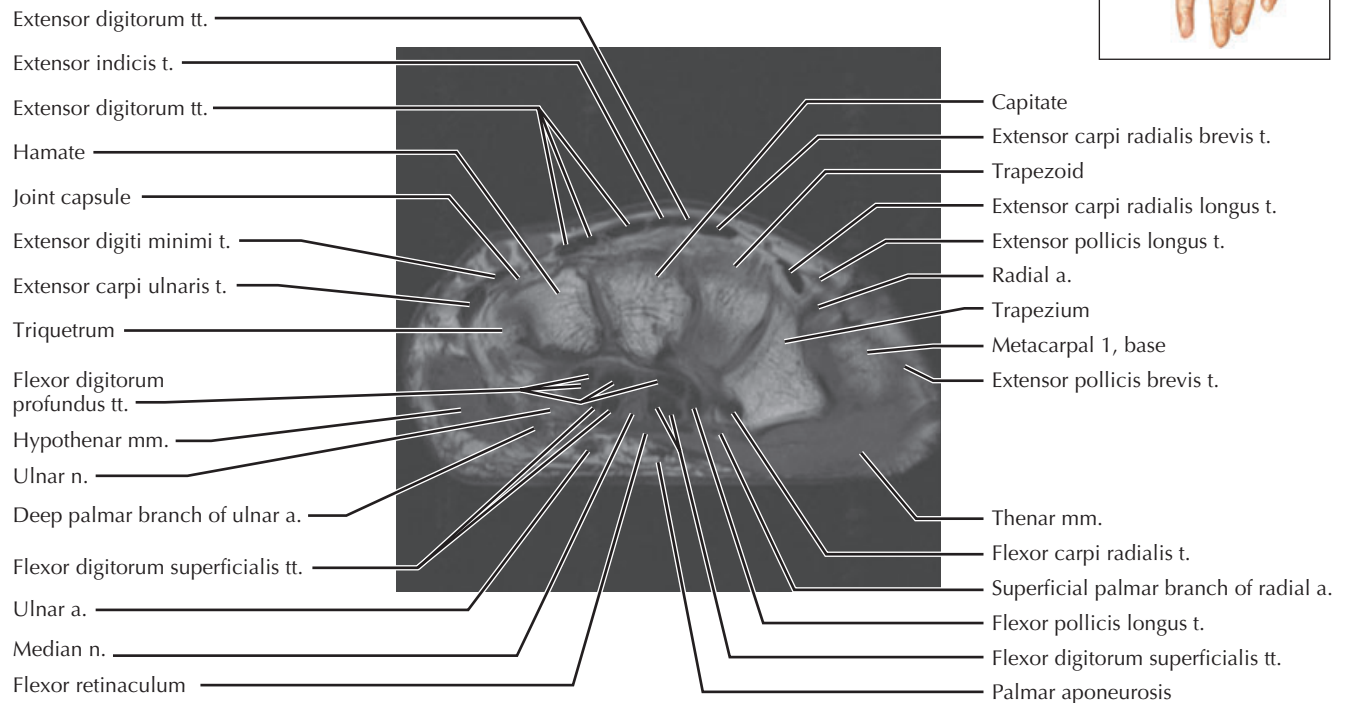
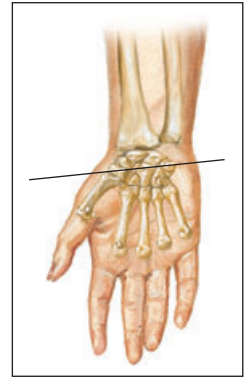
Tenosynovitis of the flexor digitorum tendons in the carpal tunnel is a common cause of carpal tunnel syndrome. A distal flexor tenosynovitis can rapidly ascend into the flexor compartment, affecting the median nerve in the carpal tunnel as well as other flexor tendons.

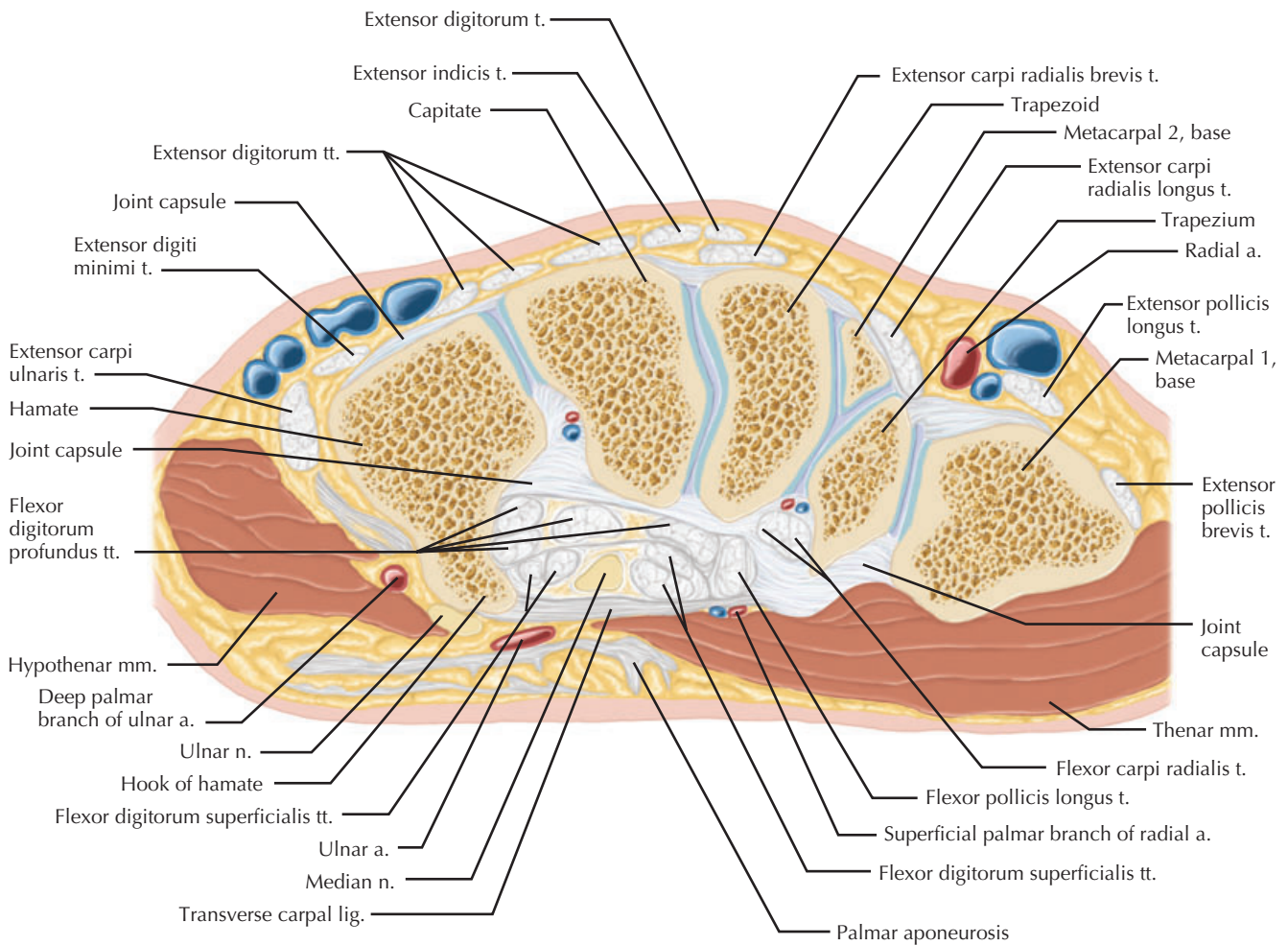




NORMAL ANATOMY

The median nerve is higher in signal intensity and typically more oval in shape than the flexor tendons in the carpal tunnel. The size of the median nerve is maintained or slightly diminished as it progresses distally through the tunnel.



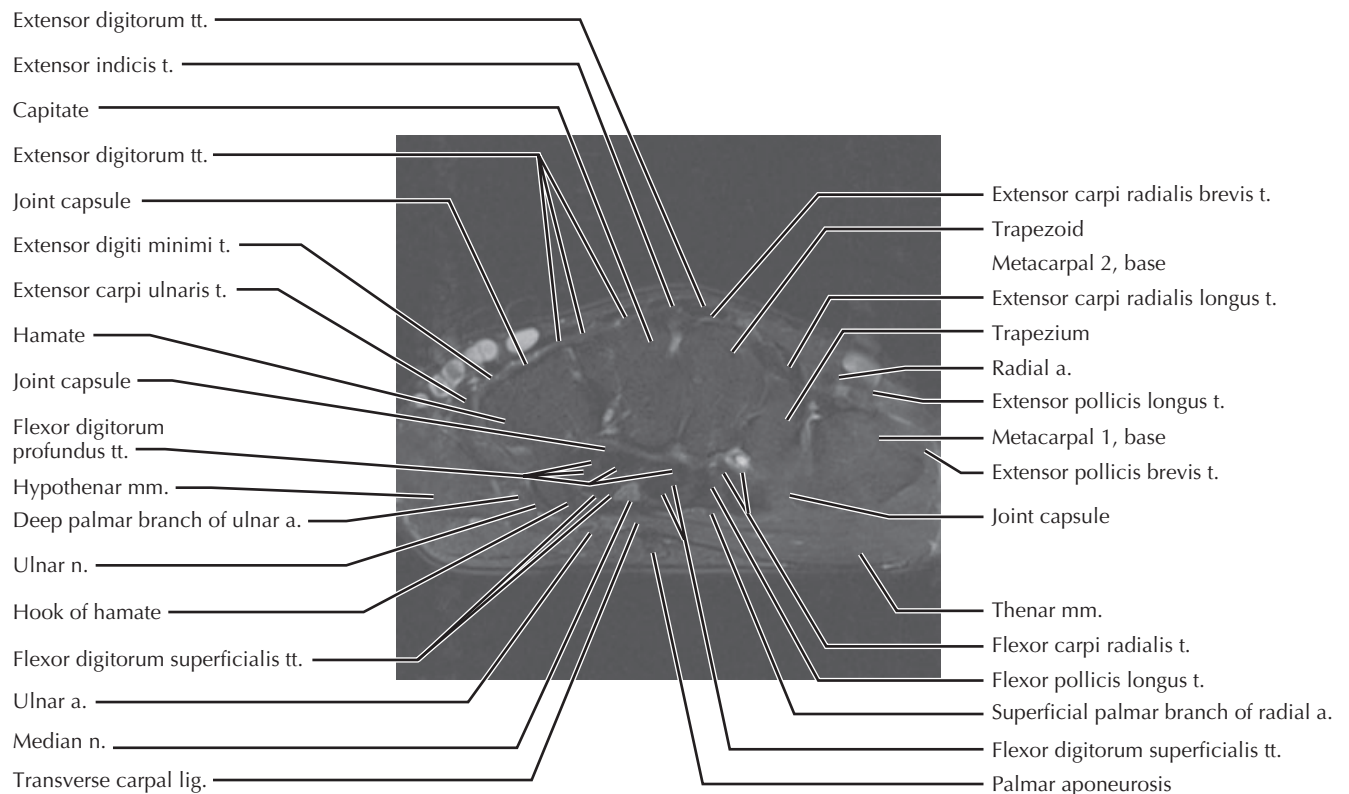
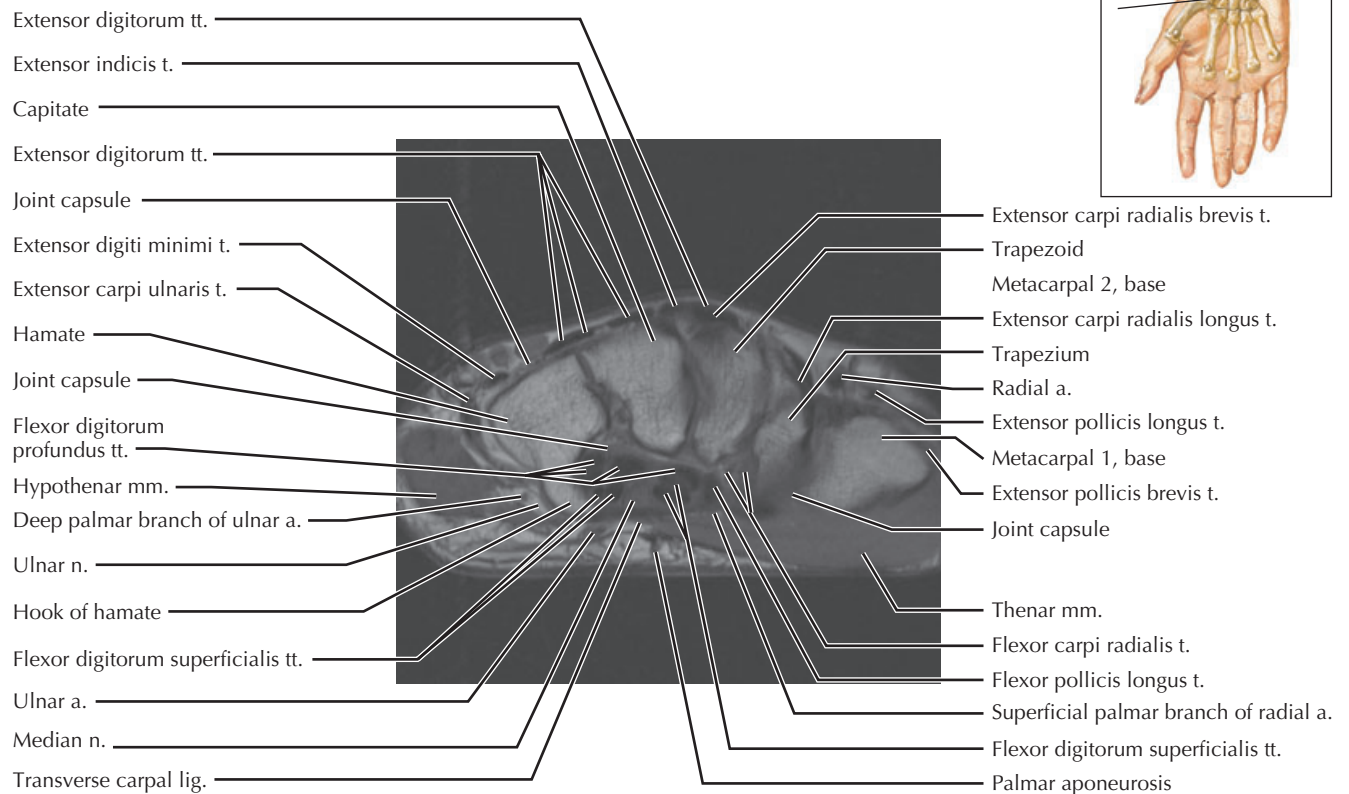
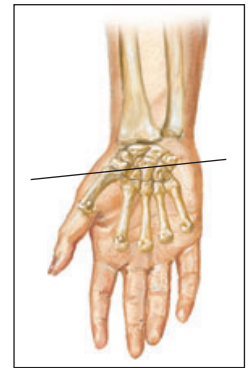


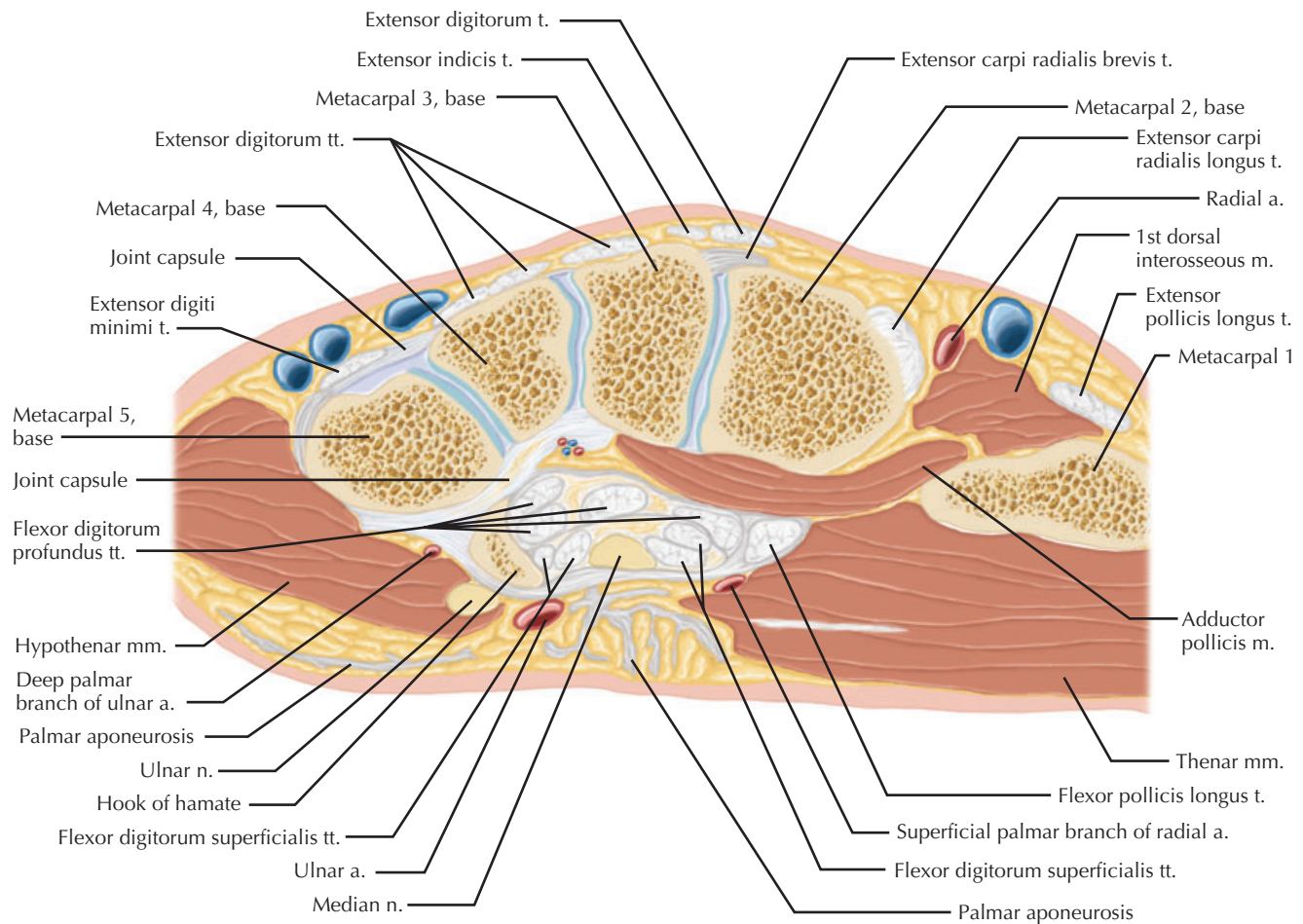
NORMAL ANATOMY

Guyon's canal is a potential space between the hook of the hamate and the pisiform. It transmits the ulnar artery and ulnar nerve.

PATHOLOGIC PROCESS

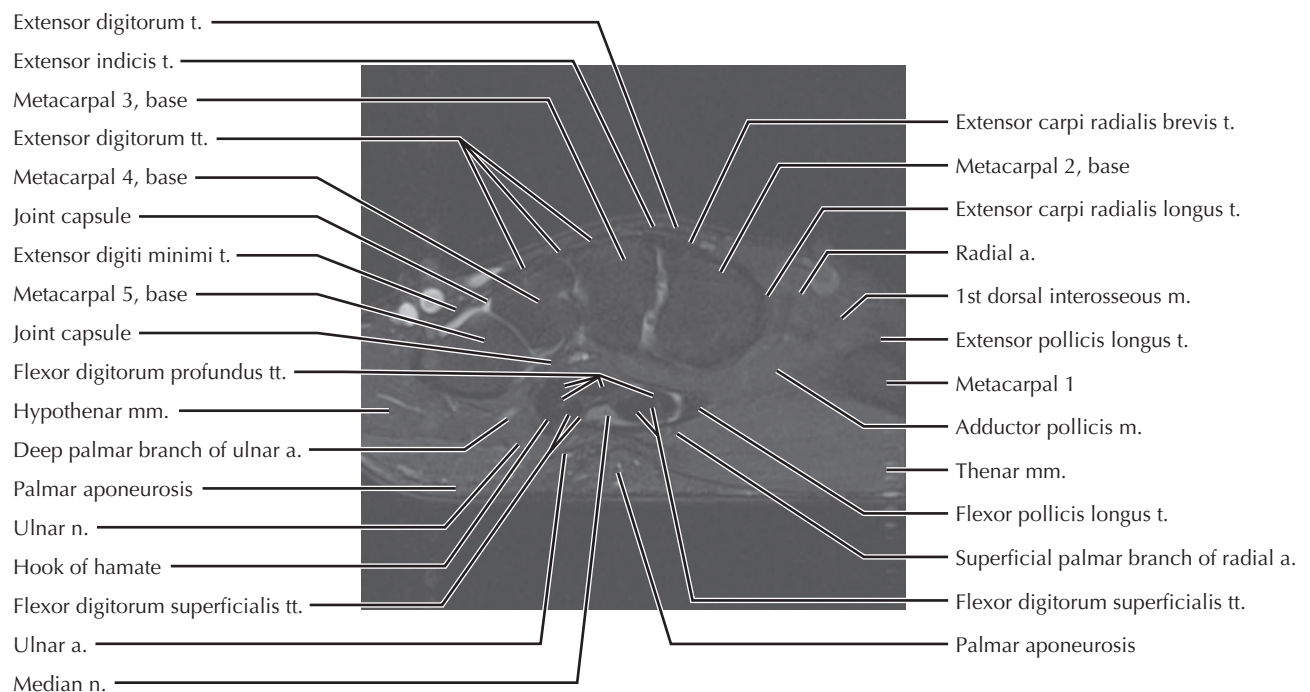
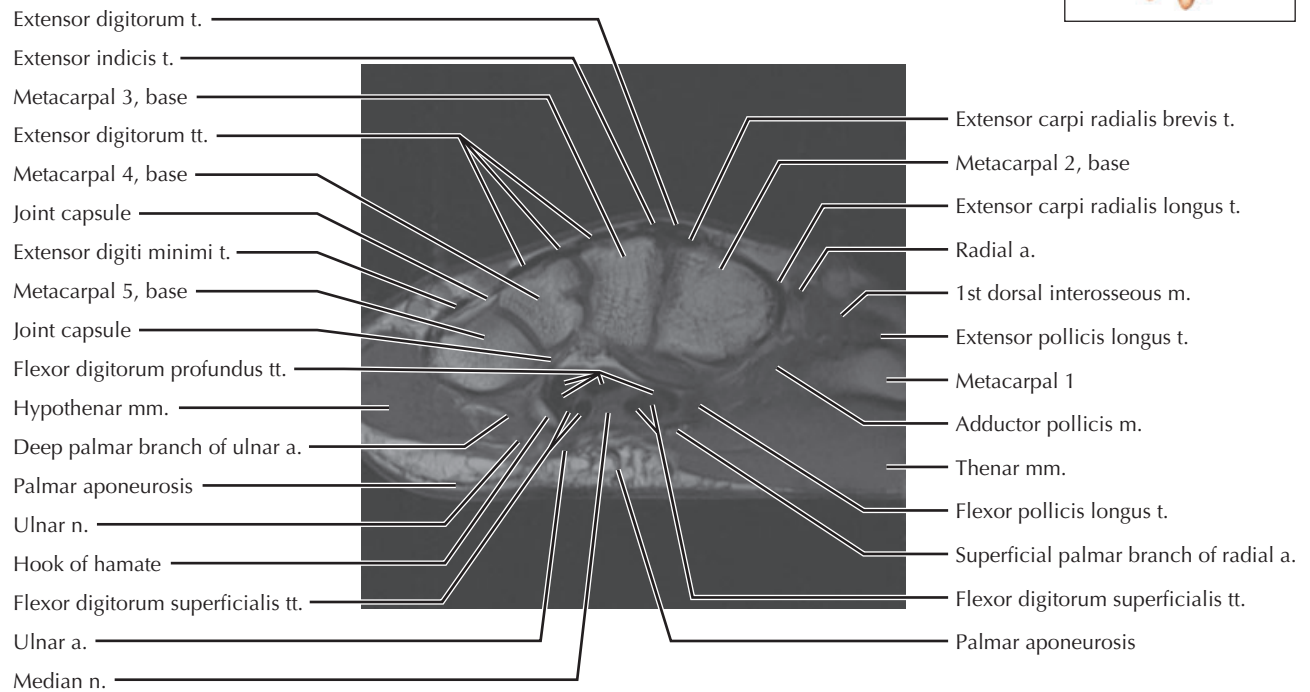
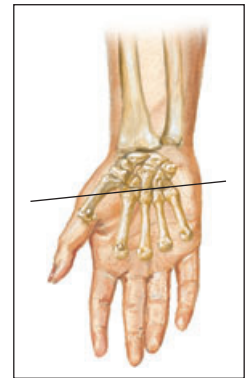
In ulnar tunnel syndrome, the ulnar nerve becomes compressed within Guyon's canal. Causes for this compression can include masses, repetitive trauma, or hook of hamate fracture.

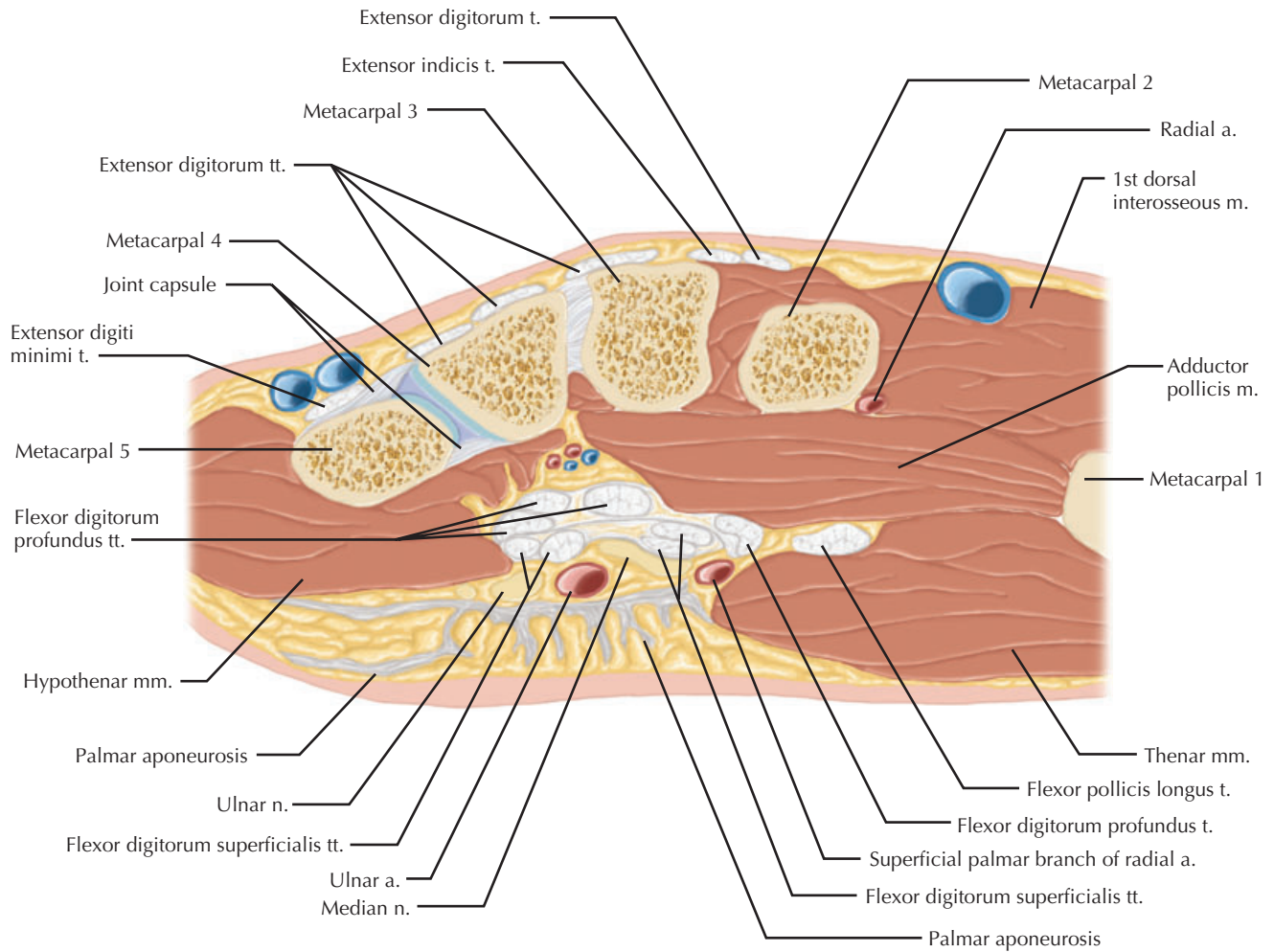


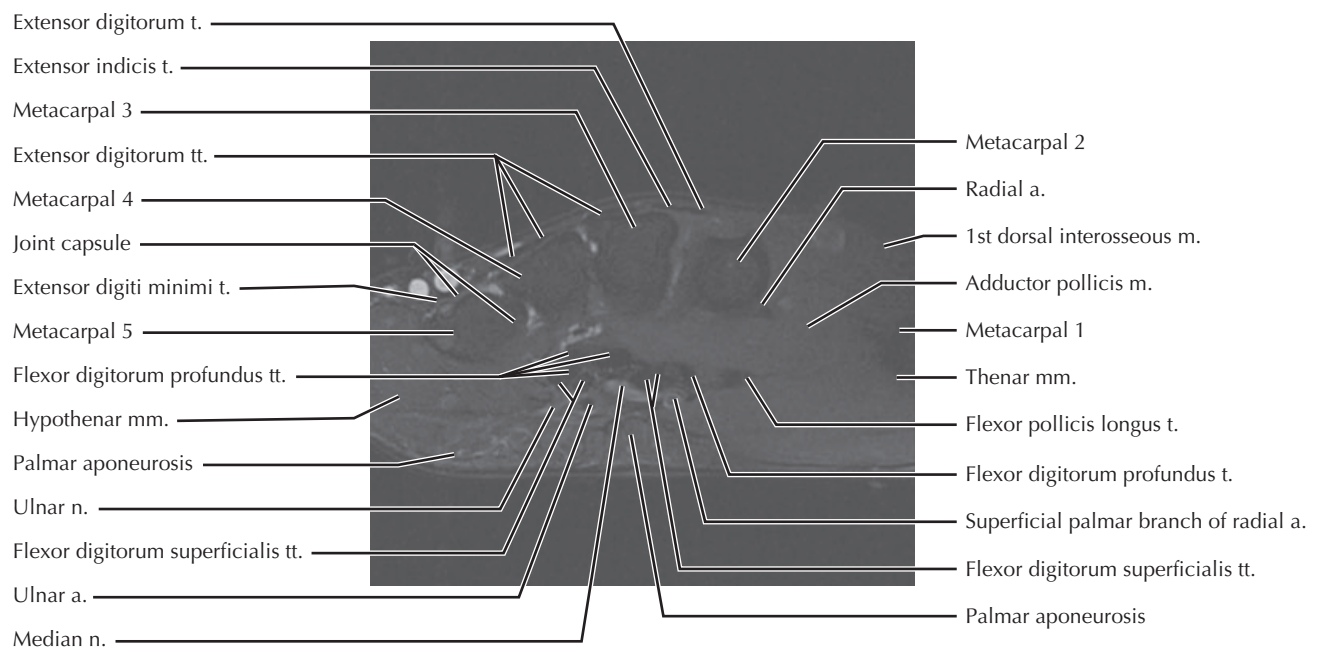
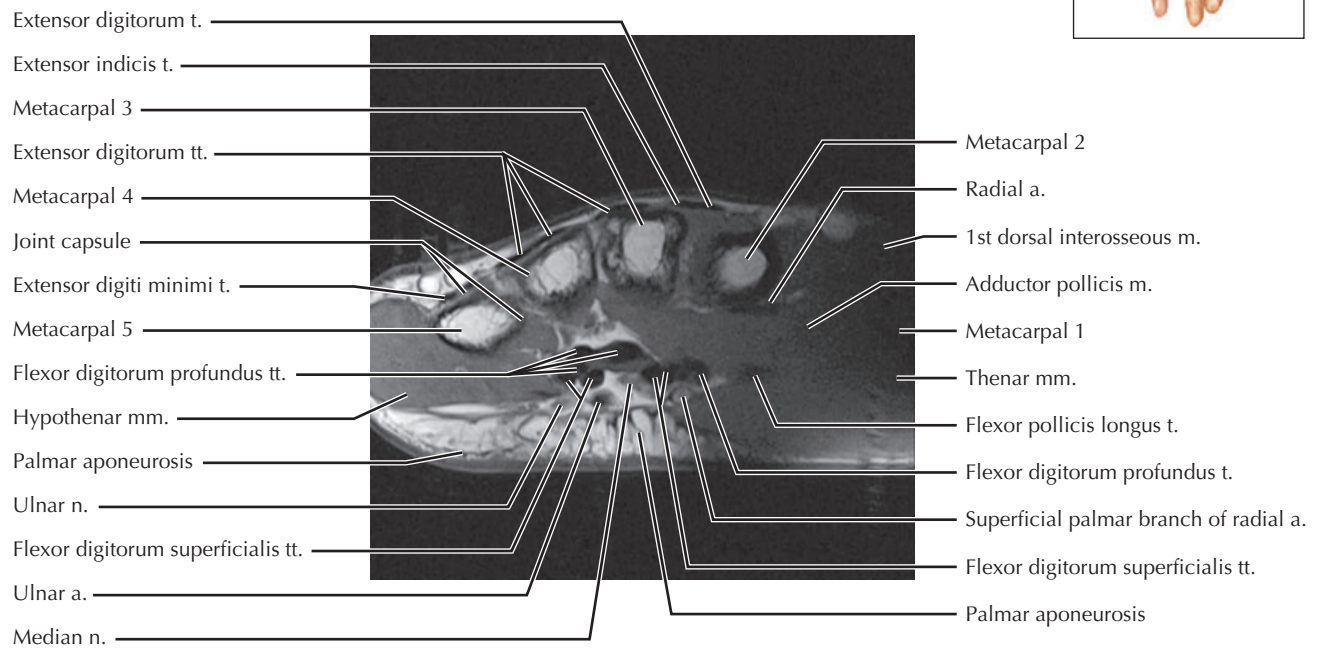
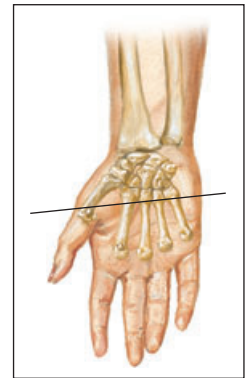


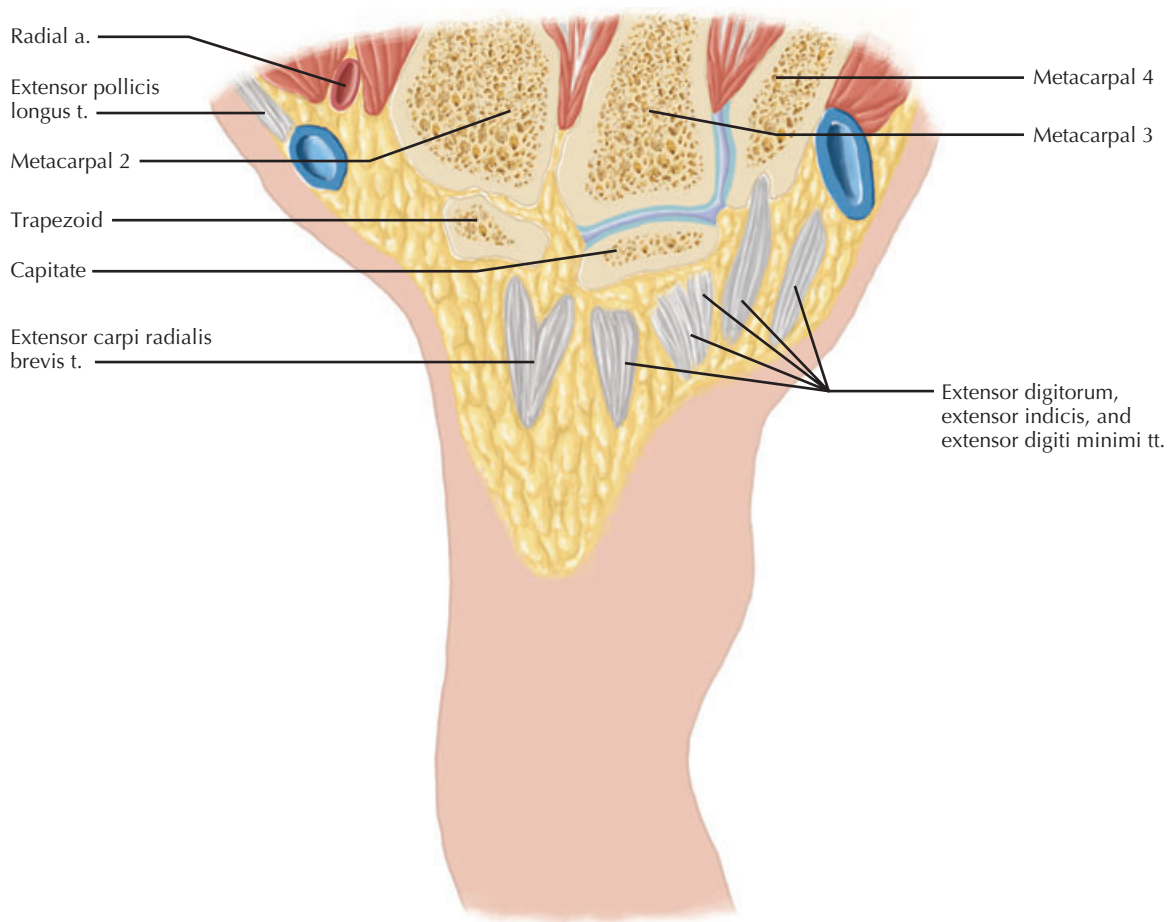
NORMAL VARIANT

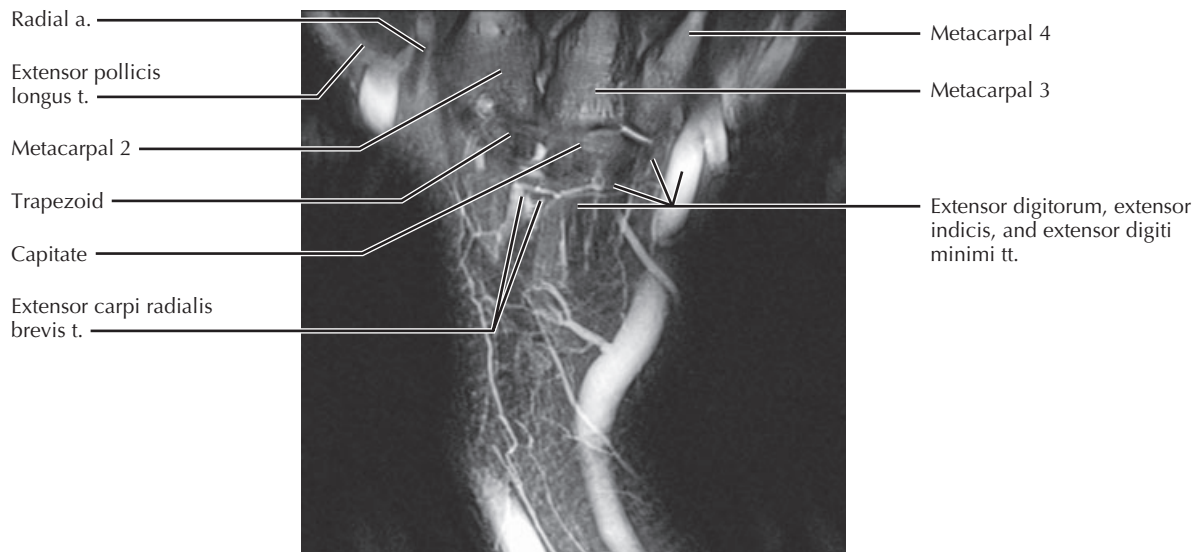
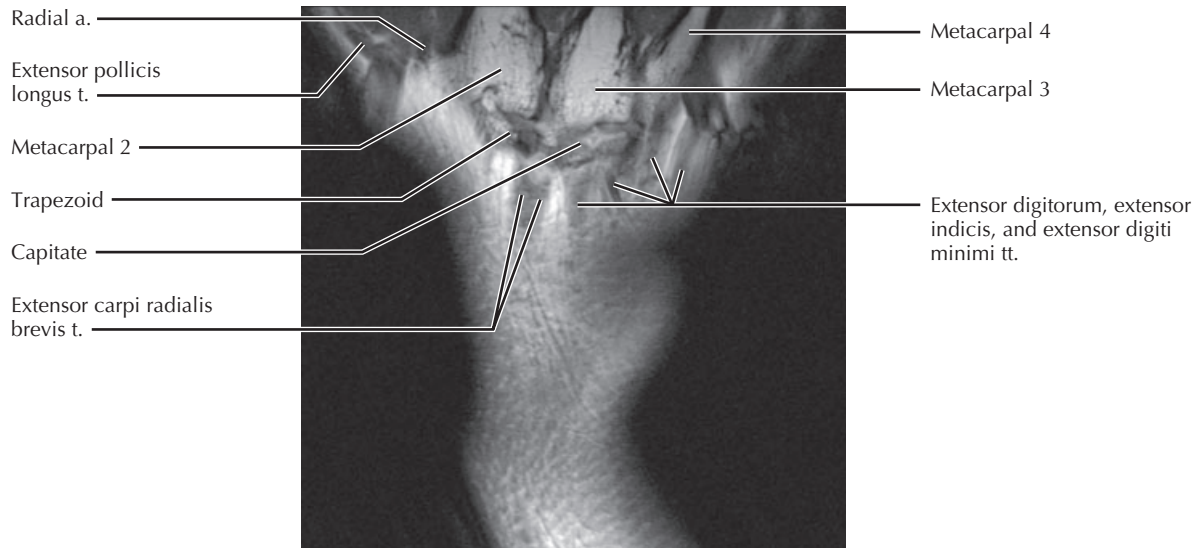
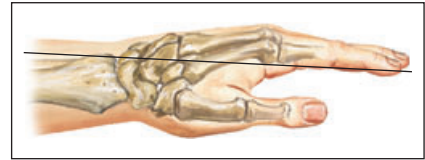
An os styloideum is an accessory ossification center that forms during embryonic development. It is located on the dorsum of the wrist at the base of the second and third metacarpals adjacent to the capitate and trapezoid bones. This may occasionally fuse with the second or third metacarpal or both. Arthrosis, irritation, and interference with movements of nearby extensor tendons sometimes occur. Ganglia, bursa, and tenosynovitis may develop.

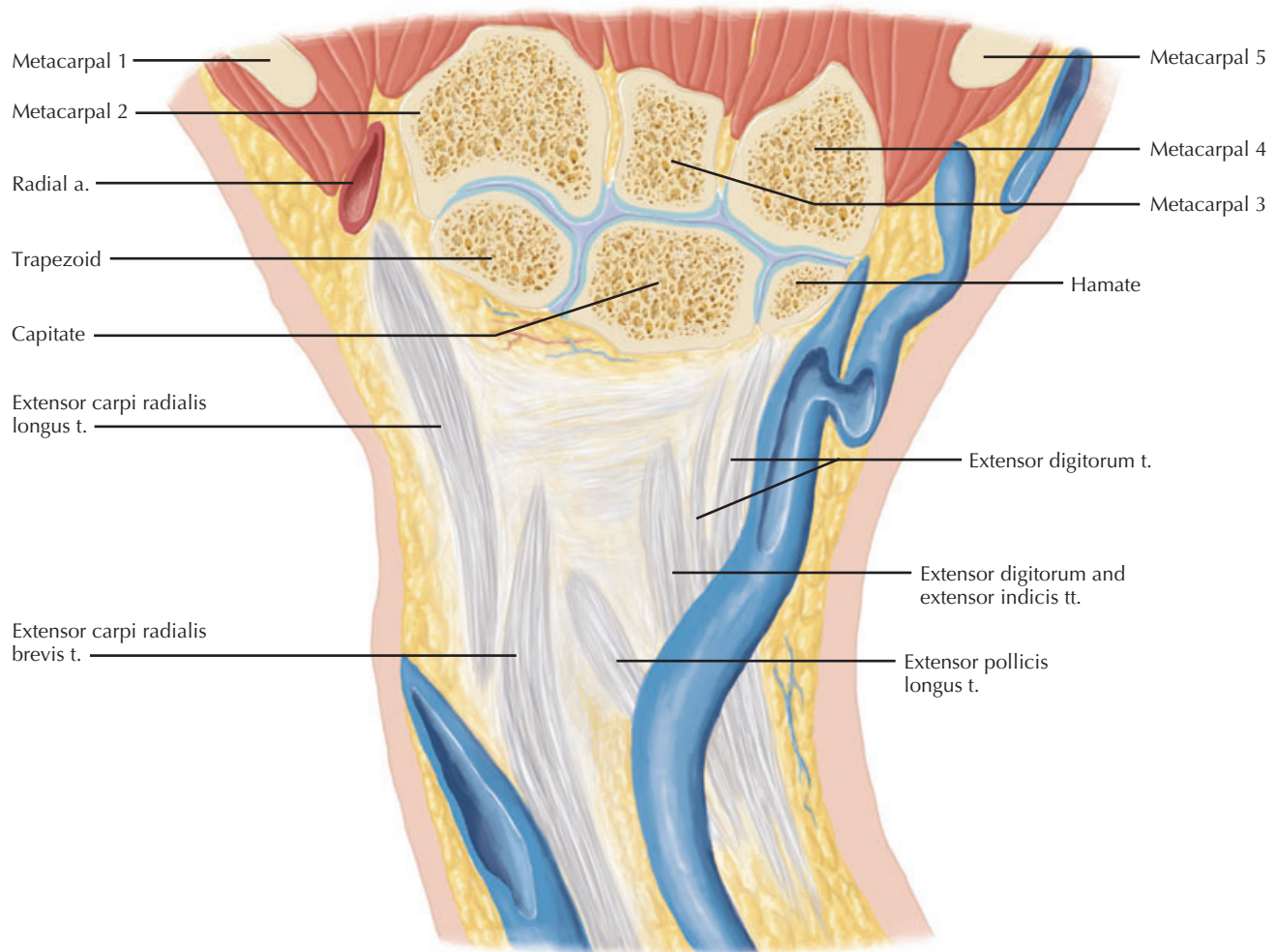






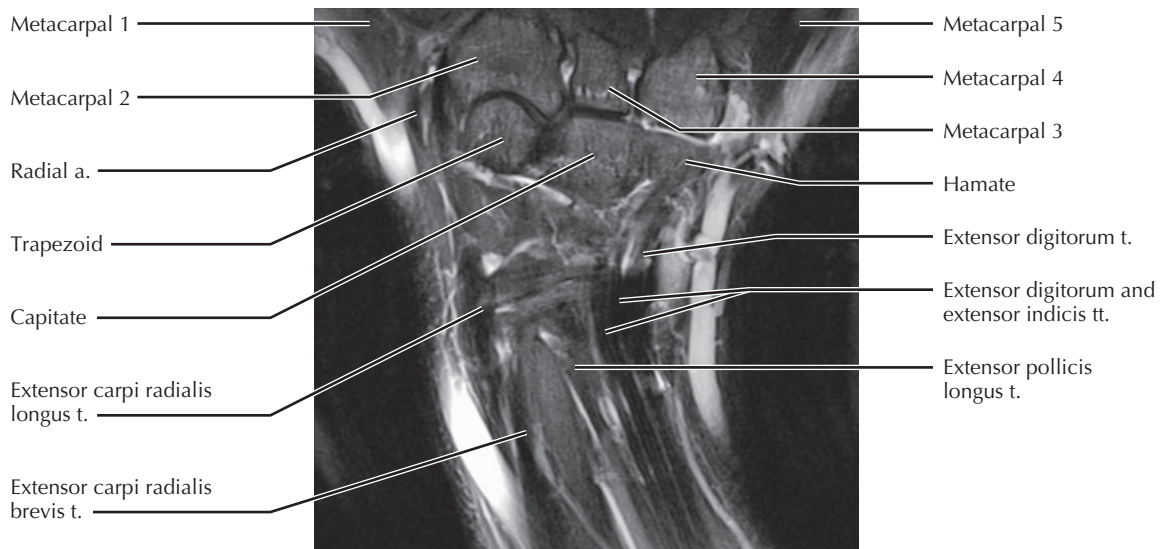
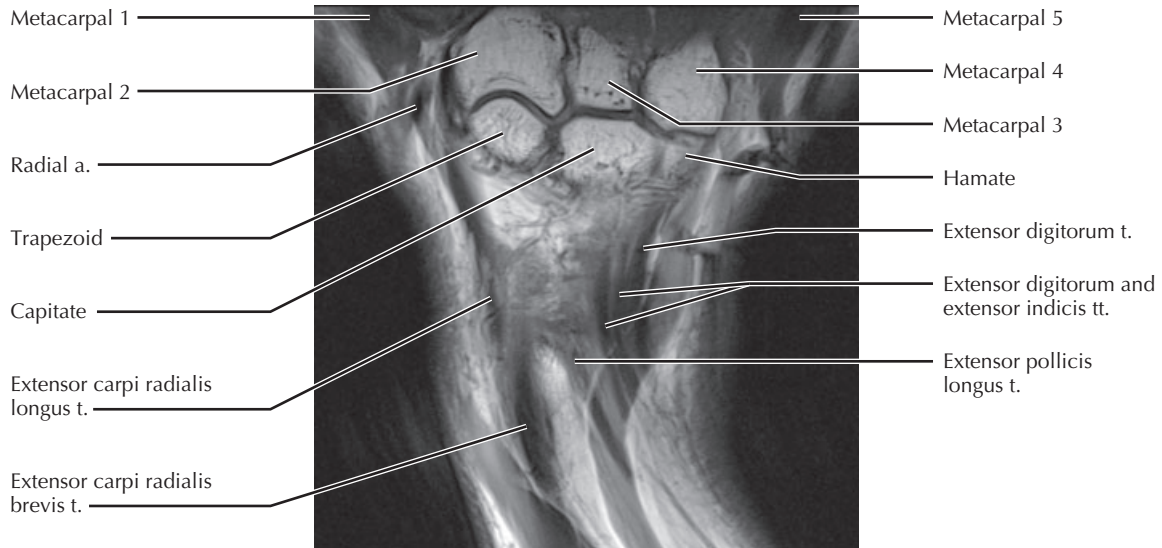
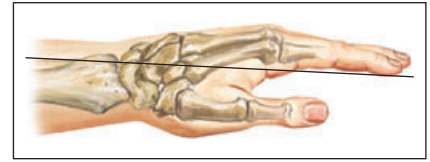


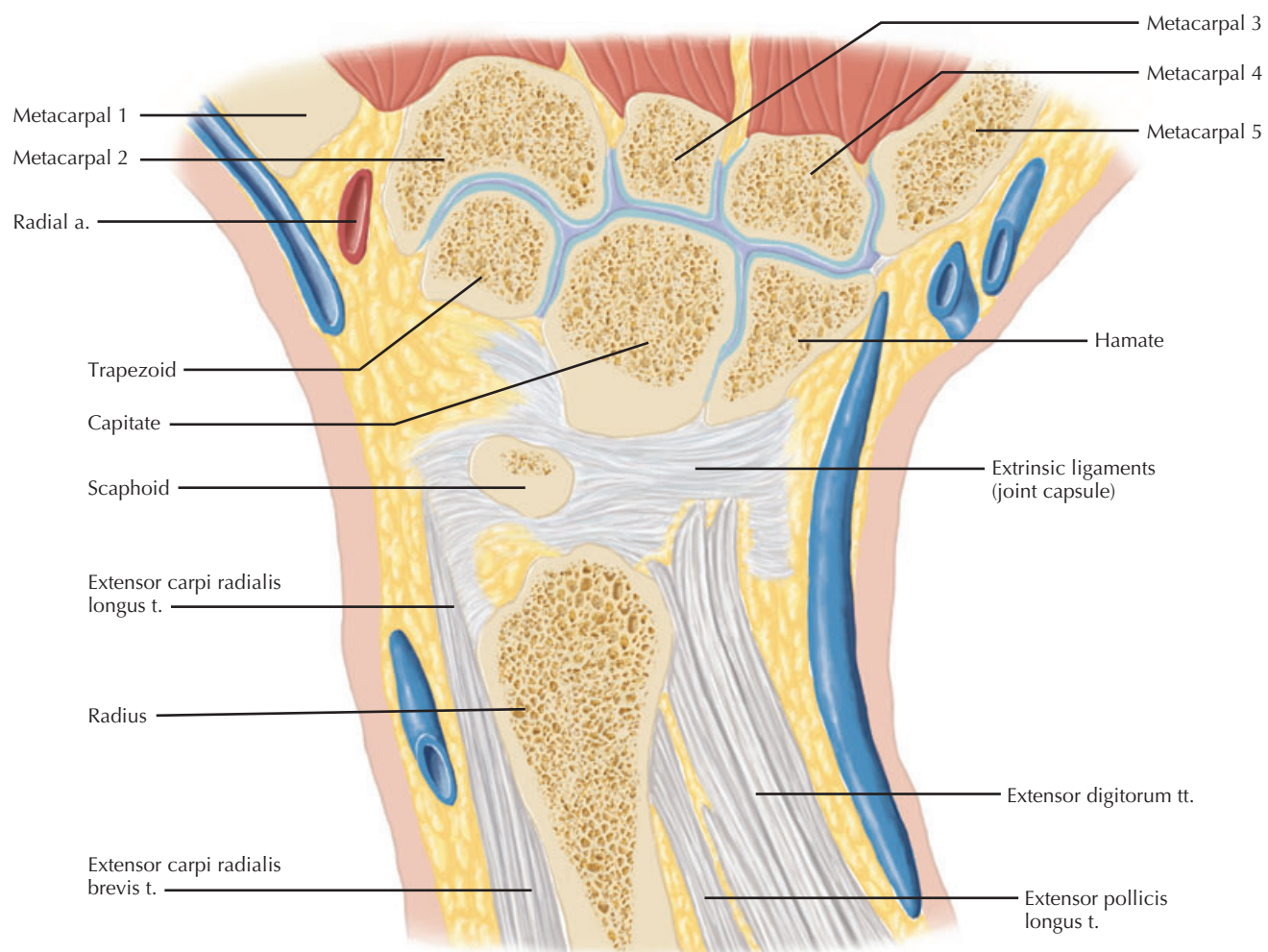


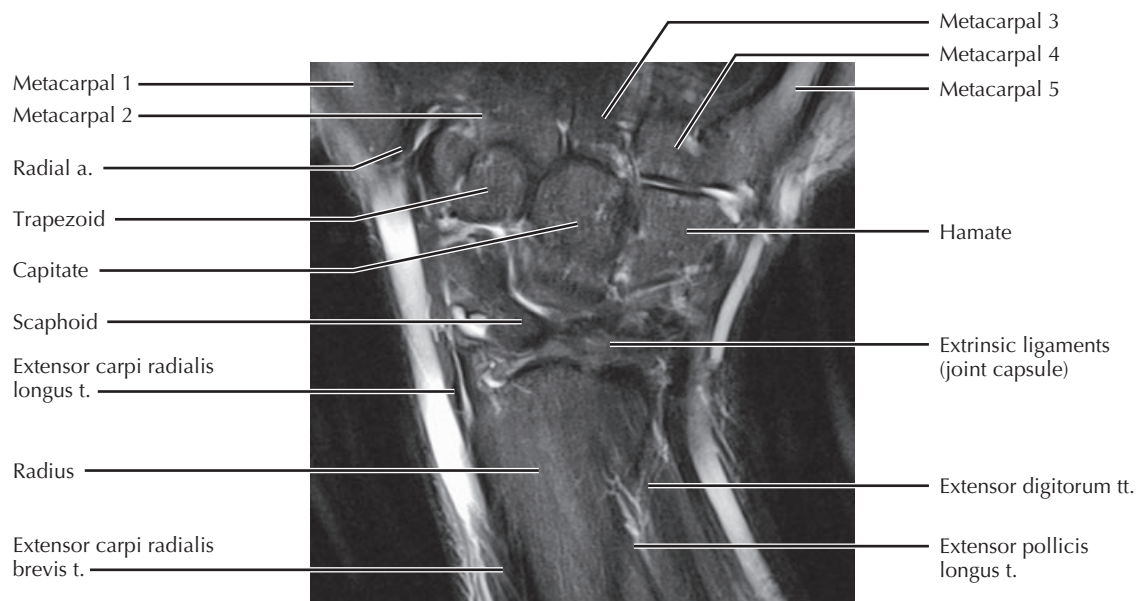
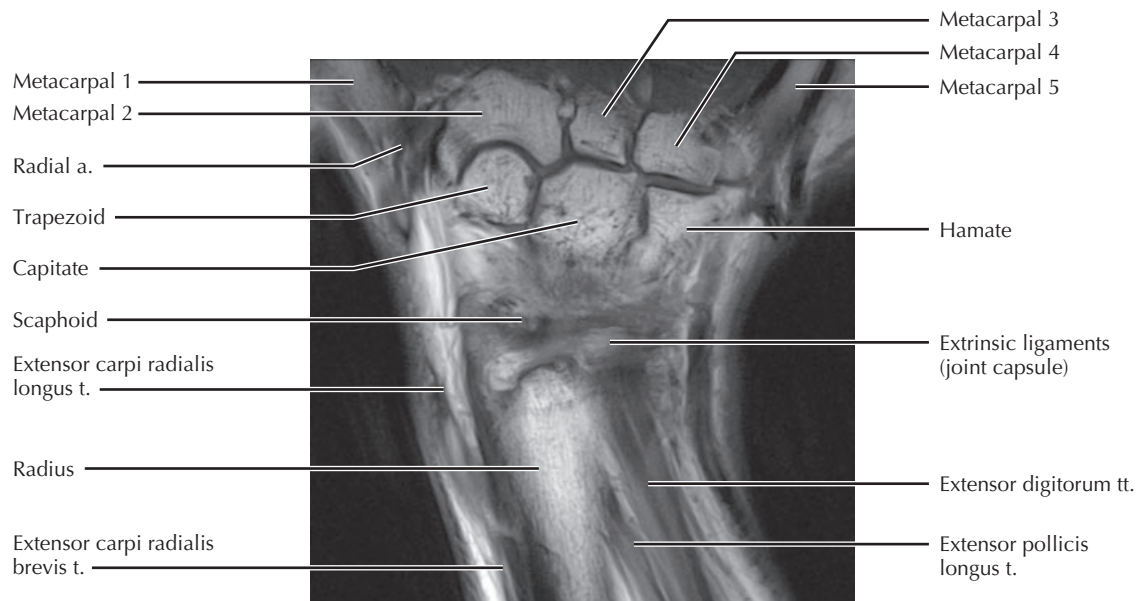
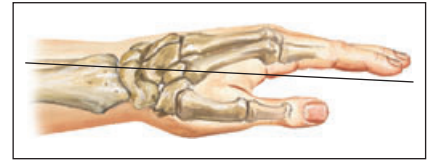


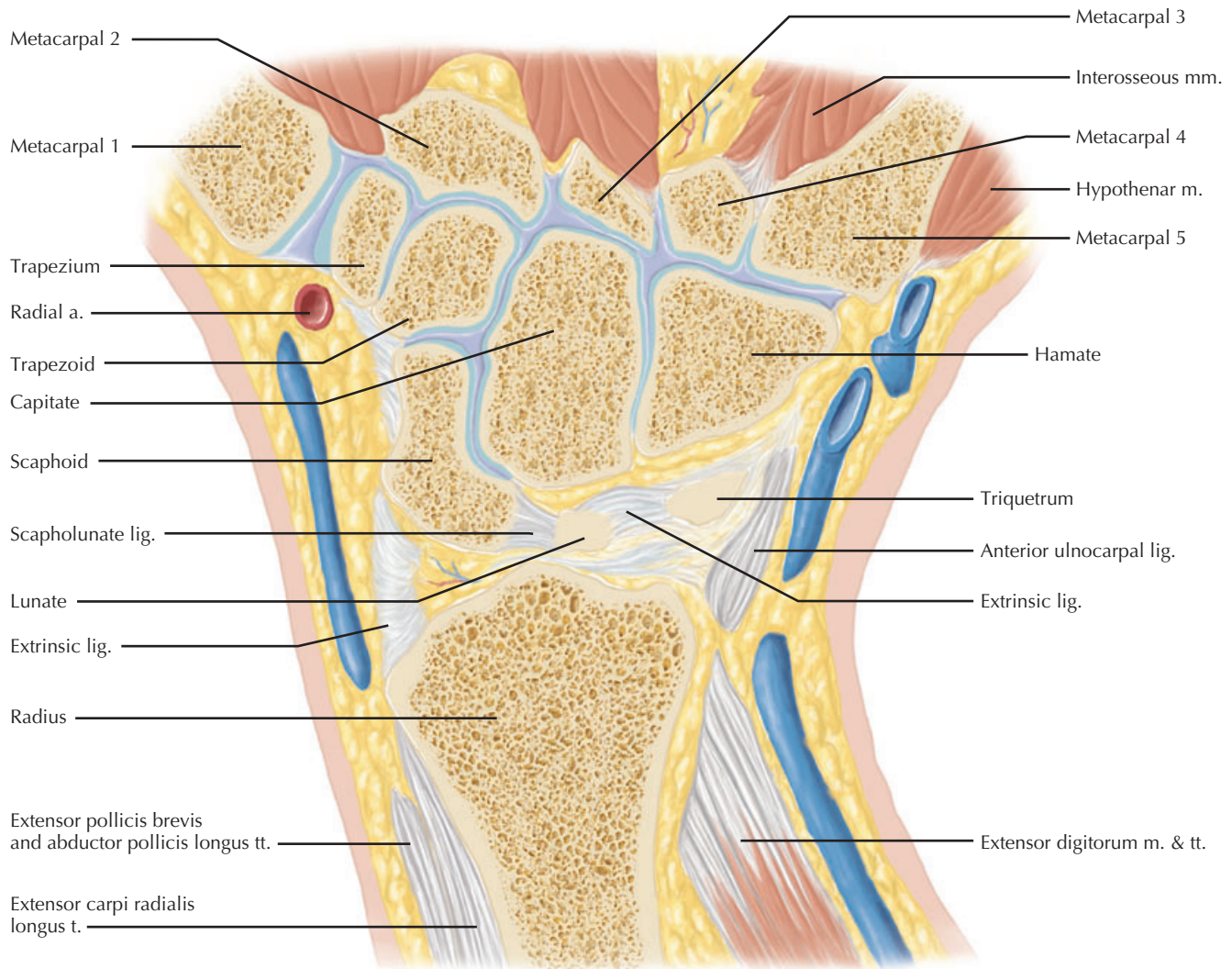
DIAGNOSTIC CONSIDERATION

The first extensor compartment crosses over the second compartment about 4 to 8 cm proximal to Lister's tubercle. Friction at this location can lead to tenosynovitis and a painful mass in the second compartment, termed *intersection syndrome*. Overuse scenarios involving repetitive screw-driver motion or thumb extension are common causes. The diagnosis is best made on coronal T2-weighted MR images of the wrist. Because the relevant anatomy is in the distal forearm, a large field of view is necessary to evaluate intersection syndrome.







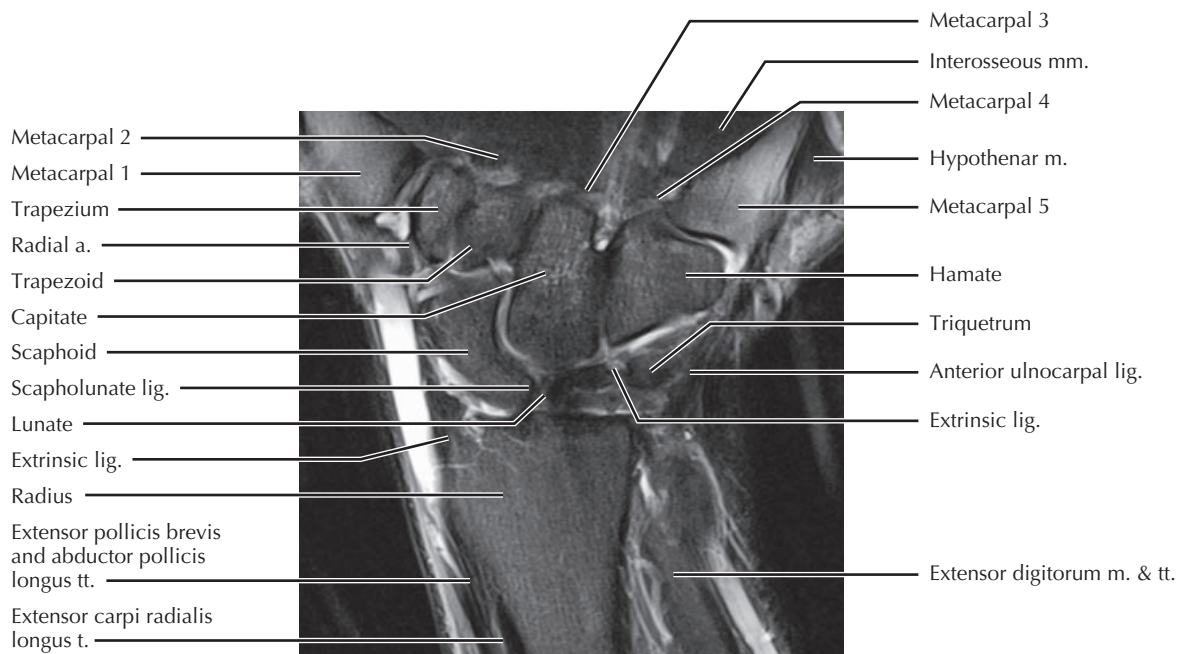
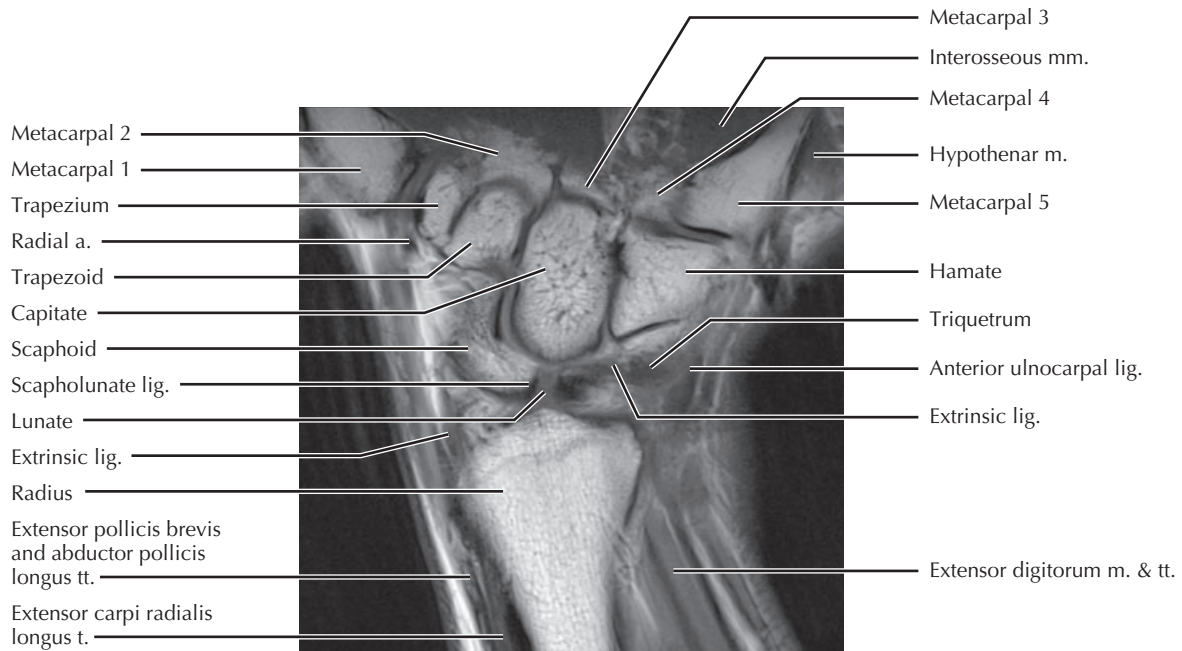
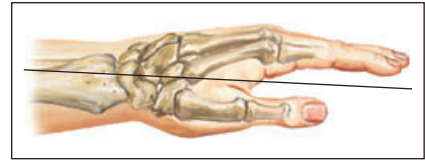


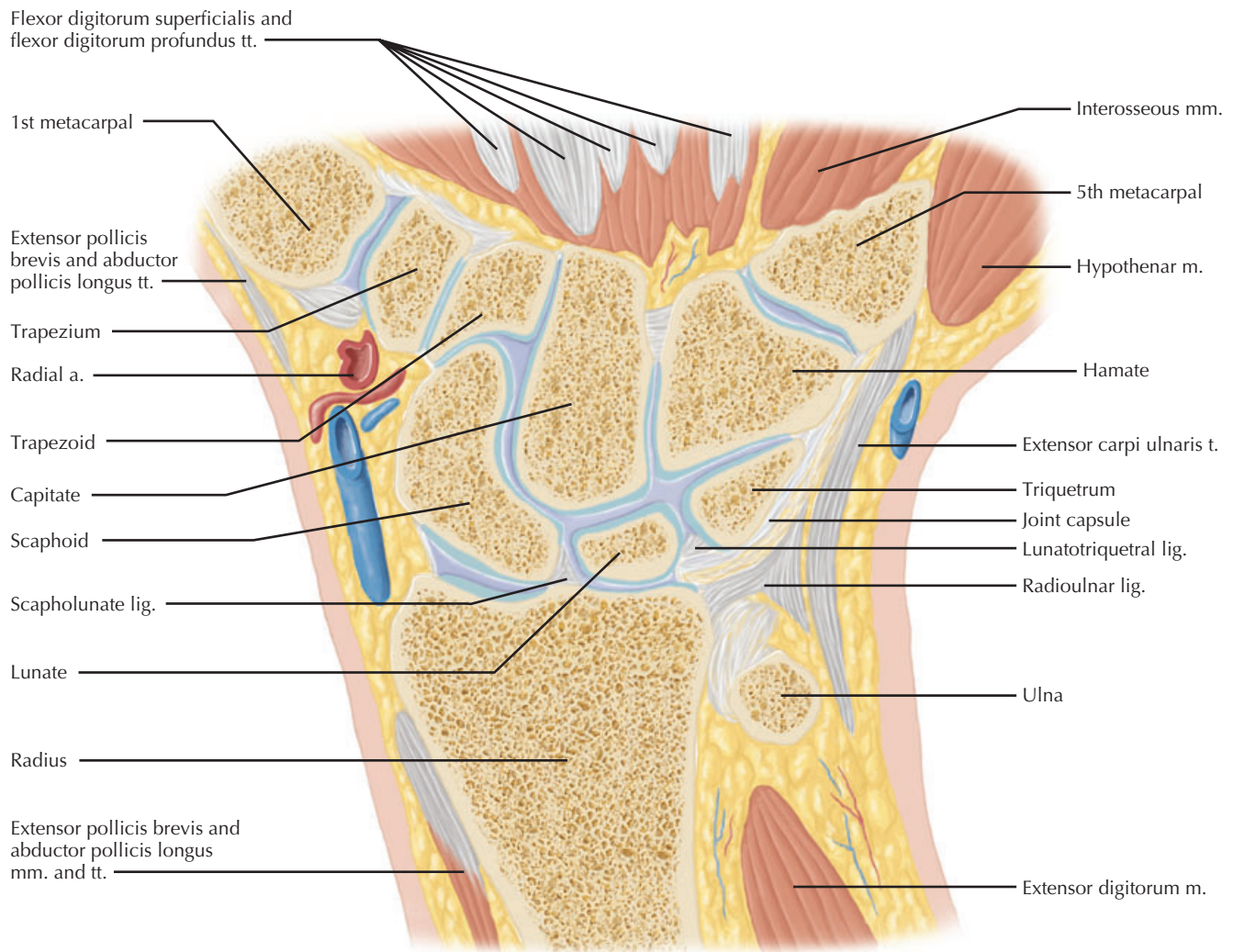
NORMAL ANATOMY

The dorsal portion of the scapholunate ligament is the strongest part. It appears band shaped on coronal view.

PATHOLOGIC PROCESS

Dorsal intercalated segmental instability (DISI) is a rotatory subluxation of the scaphoid secondary to disruption of the scapholunate ligament. It also appears as dorsal tilting of the distal lunate articular surface. The integrity of the scapholunate ligament is best assessed on coronal view.

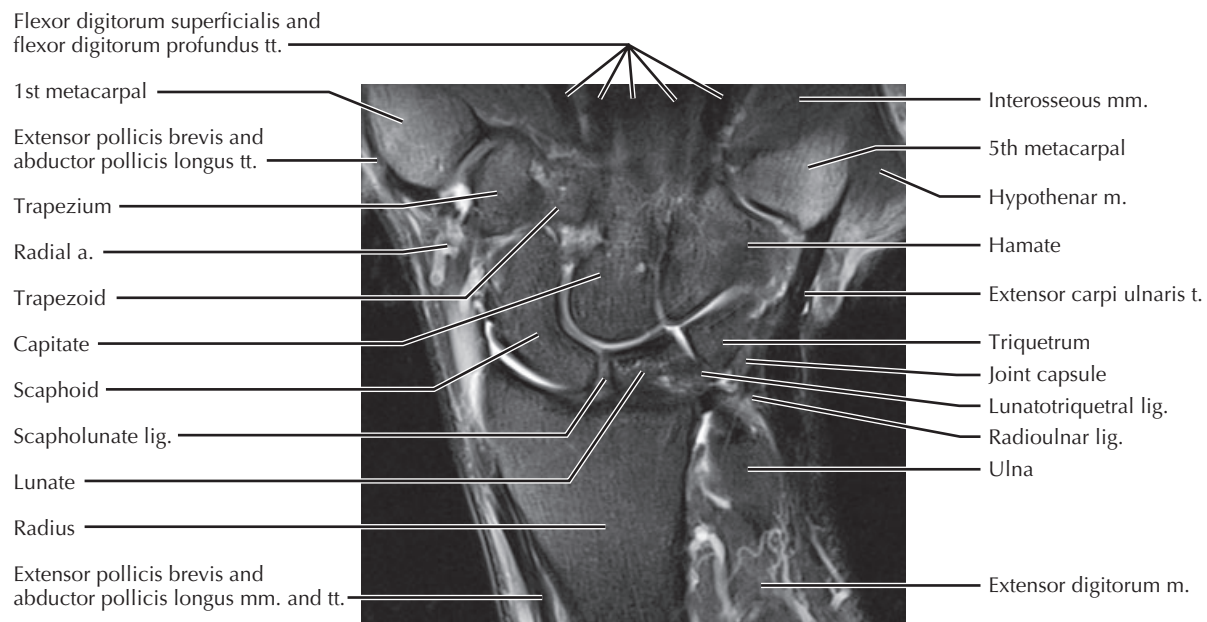
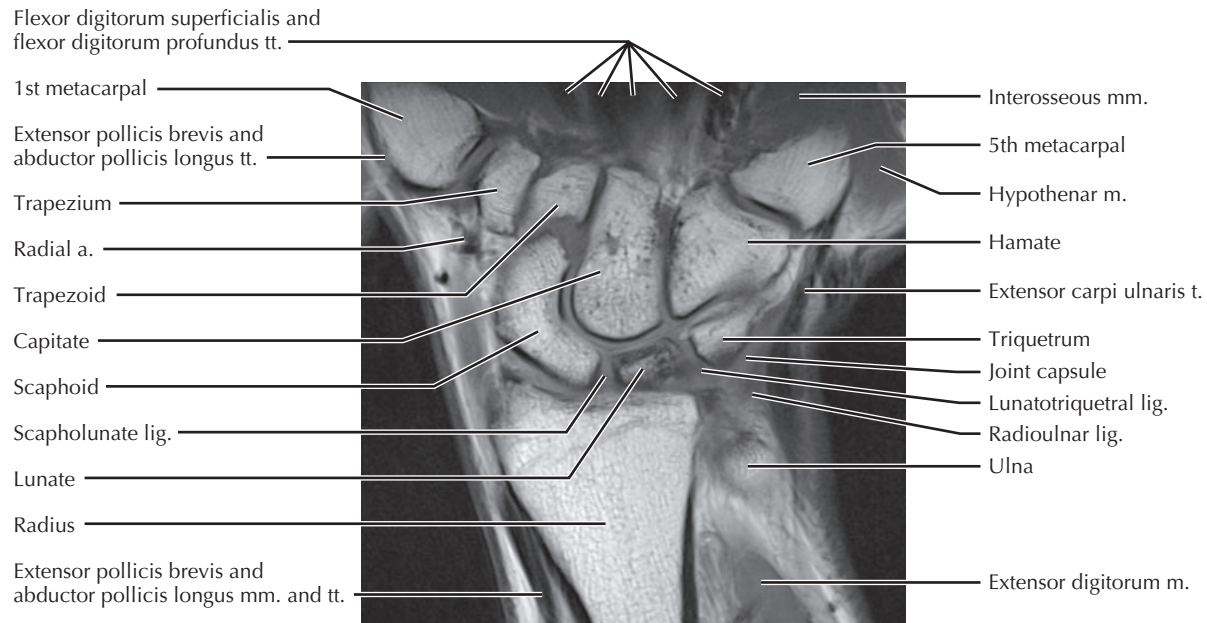
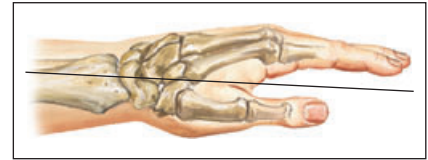


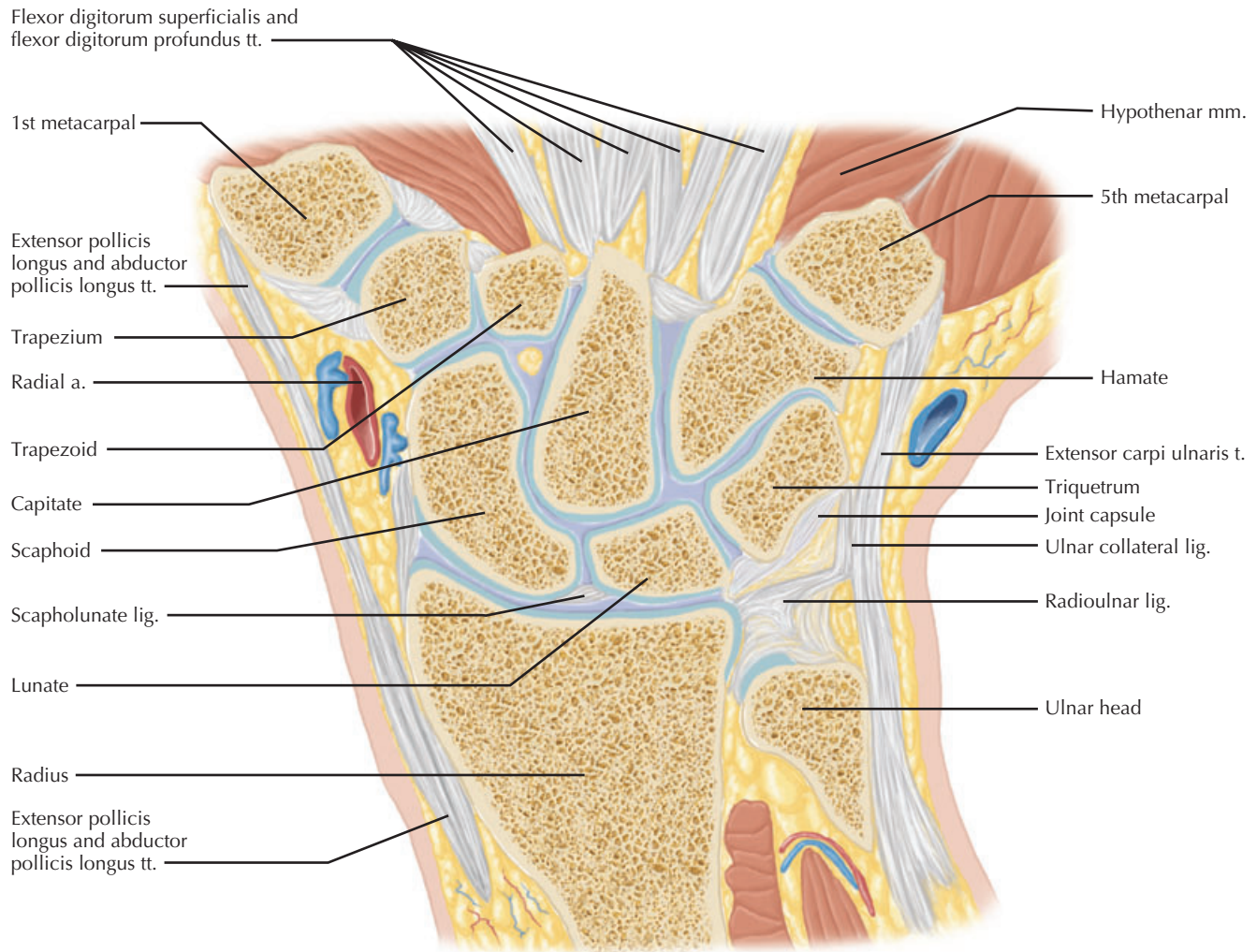


PATHOLOGIC PROCESS

The extensor carpi ulnaris tendon, which constitutes the medial border of the triangular fibrocartilage complex (TFCC), is well visualized on this image. Tenosynovitis or partial tears of the extensor carpi ulnaris often occur in association with TFCC injuries.

Scaphoid wrist fractures result in avascular necrosis (AVN) of the proximal pole. The more proximal the fracture, the greater is the chance of developing AVN. In some cases, T1-weighted MR images are better for visualizing subtle fracture lines in the scaphoid.



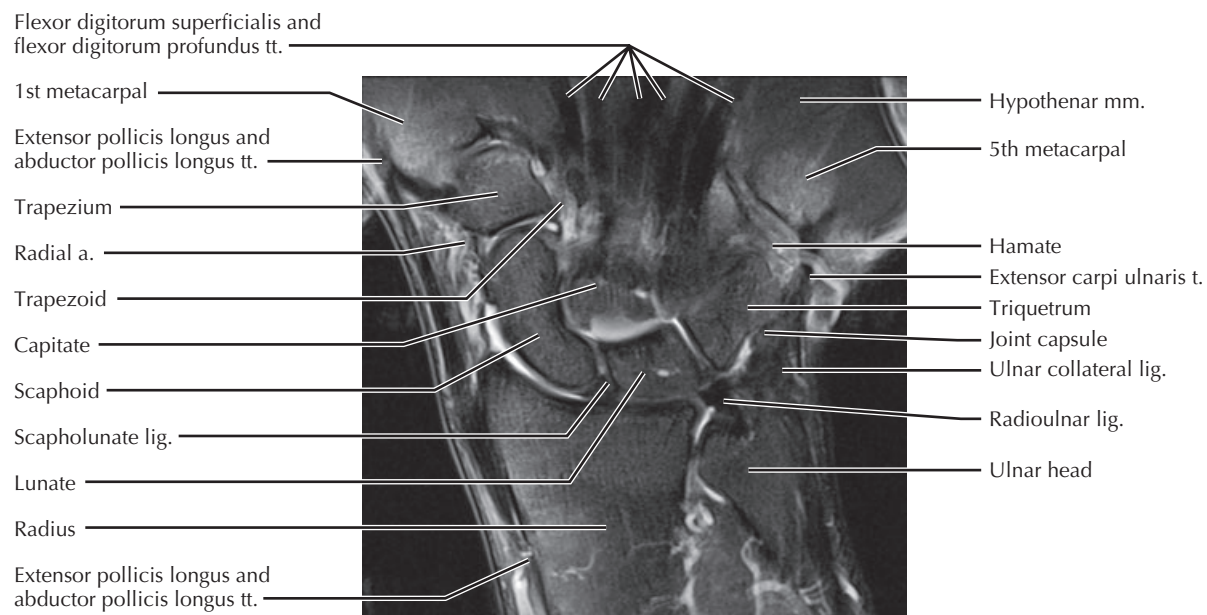
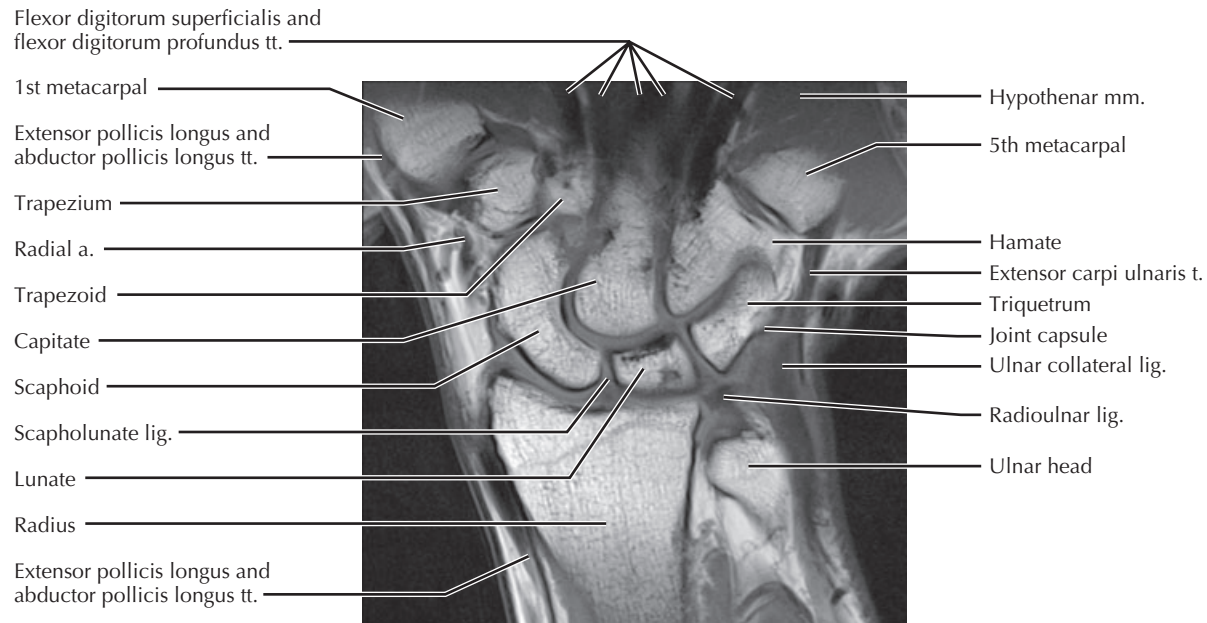
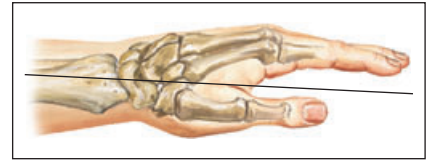


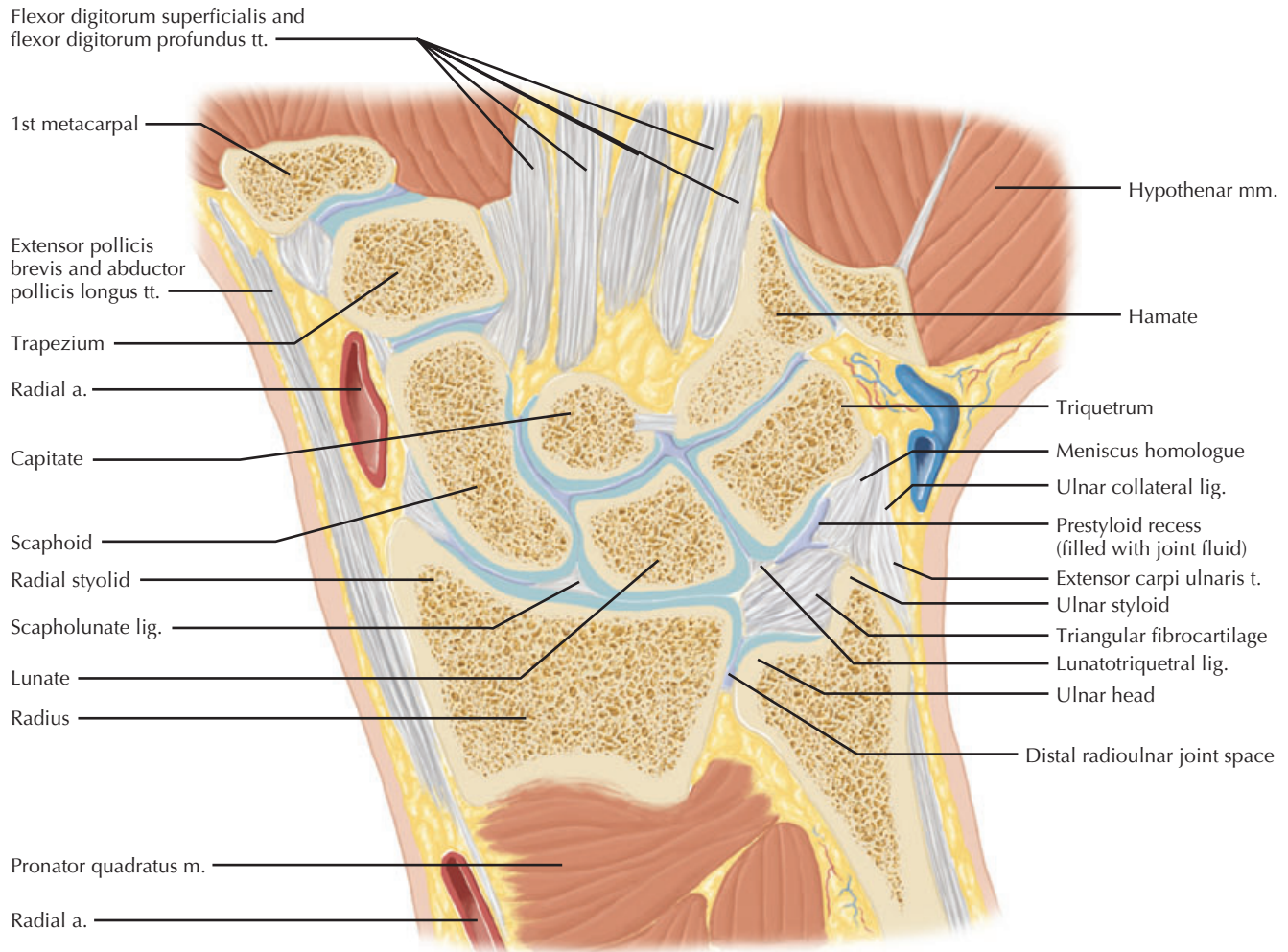
NORMAL ANATOMY

In the middle portion of the wrist, the scapholunate ligament appears triangular in shape.

PATHOLOGIC PROCESS

The lunatotriquetral ligament may attach to hyaline cartilage or cortical bone, and the volar component blends with the triangular fibrocartilage. As a result, there is a strong association between tears of the triangular fibrocartilage and tears of the lunatotriquetral ligament. Disruption of the triquetral attachment of the lunatotriquetral ligament results in the distal lunate articular surface tilting in a volar direction, called volar intercalated segmental instability (VISI).





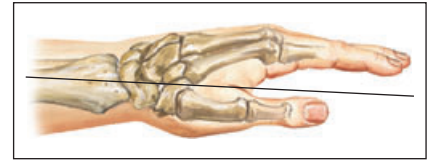
PATHOLOGIC PROCESS

De Quervain's tenosynovitis involves inflammation of the extensor pollicis brevis and abductor pollicis longus tendons. Patients present with "snuffbox" tenderness, and onset can be associated with overuse in manual laborers and new mothers. Abnormal signal around the tendons is common, with low signal on T1-weighted MR images and either low signal or high signal on T2-weighted images.

NORMAL VARIANT

A meniscus homologue is present and well visualized on this MR slice. It is absent in approximately 25% of individuals.

Negative ulnar variance, which is seen in this MR image, is an asymptomatic normal variant in which the ulna is short with respect to the radius. It is associated with an enlarged triangular fibrocartilage, which has a "block" rather than a "bowtie" shape on coronal section. This anatomy predisposes for AVN of the lunate (Kienböck's malacia).



Flexor digitorum superficialis and
flexor digitorum profundus tt.

1st metacarpal

Extensor pollicis brevis and
abductor pollicis longus tt.

Trapezium

Radial a.

Capitate

Scaphoid

Radial styloid

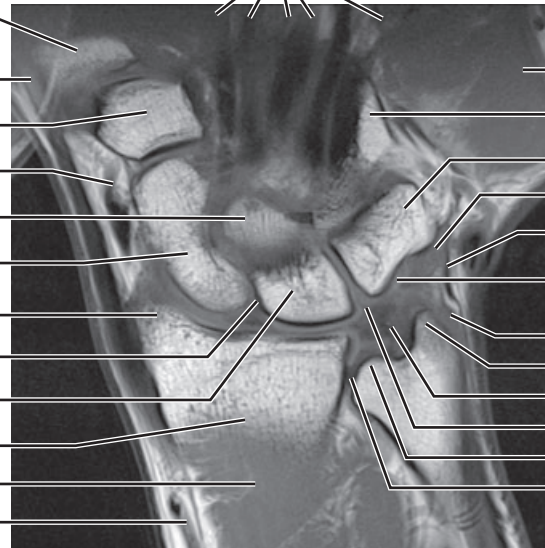
Scapholunate lig.

Lunate

Radius

Pronator quadratus m.

Radial a.



Hypothenar mm.

Hamate

Triquetrum

Meniscus homologue

Ulnar collateral lig.

Prestyloid recess
(filled with joint fluid)

Extensor carpi ulnaris t.

Ulnar styloid

Triangular fibrocartilage

Lunatotriquetral lig.

Ulnar head

Distal radioulnar joint space

Flexor digitorum superficialis and
flexor digitorum profundus tt.

1st metacarpal

Extensor pollicis brevis and
abductor pollicis longus tt.

Trapezium

Radial a.

Capitate

Scaphoid

Radial styloid

Scapholunate lig.

Lunate

Radius

Pronator quadratus m.

Radial a.



Hypothenar mm.

Hamate

Triquetrum

Meniscus homologue

Ulnar collateral lig.

Prestyloid recess
(filled with joint fluid)

Extensor carpi ulnaris t.

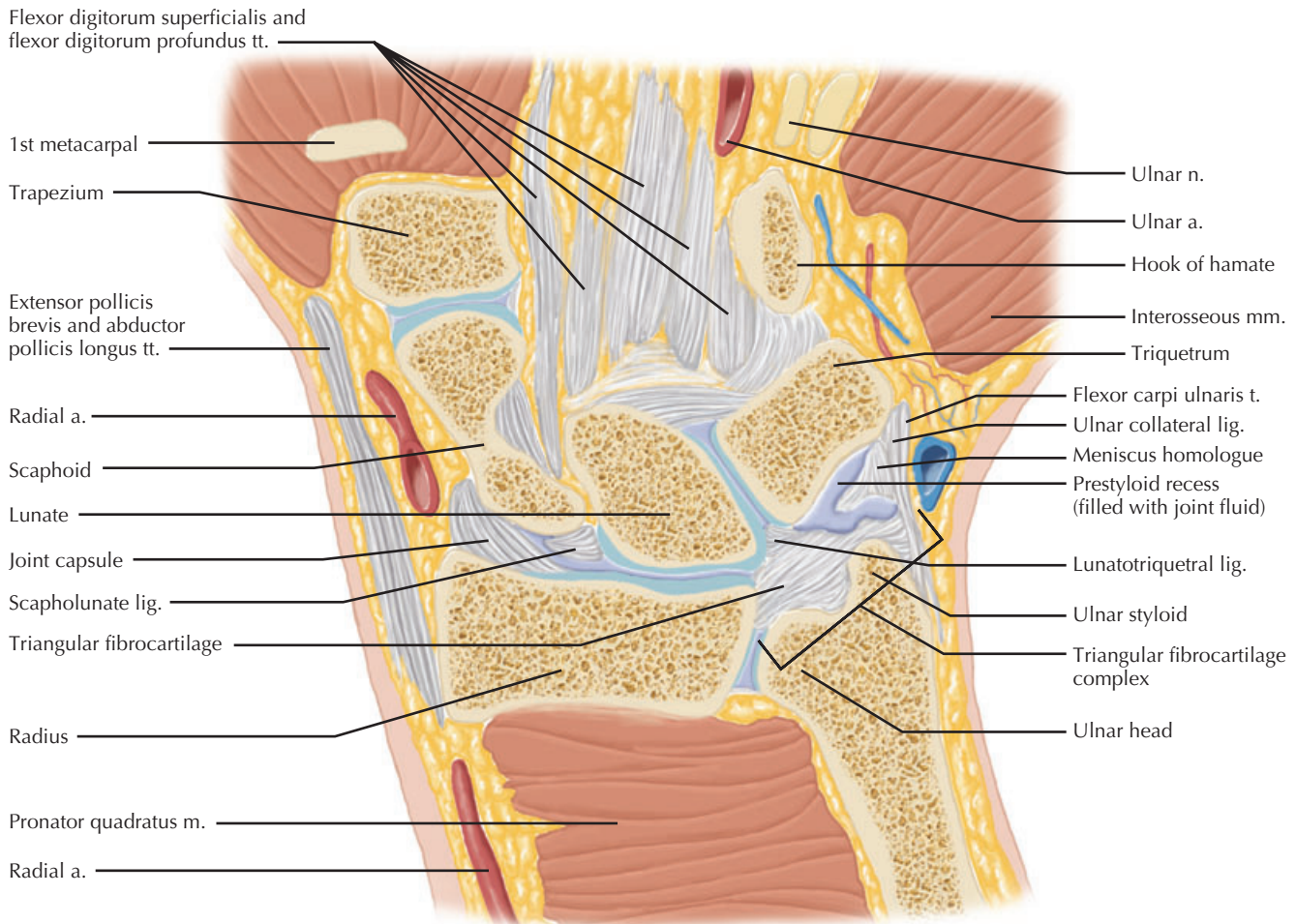
Ulnar styloid

Triangular fibrocartilage

Lunatotriquetral lig.

Ulnar head

Distal radioulnar joint space

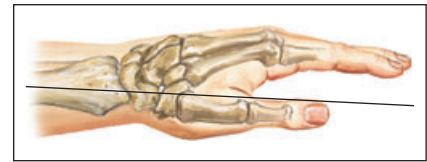


NORMAL ANATOMY

On a coronal section of the volar surface, the normal scapholunate ligament appears trapezoidal in configuration.

DIAGNOSTIC CONSIDERATION

The peripheral aspect of the ulnar side of the triangular fibrocartilage is highly vascular, allowing for good healing in the setting of injury. Although MRI has limited sensitivity for identifying tears in this location, the diagnosis is important because tears can be treated successfully with immobilization or surgery. Such injuries are best visualized on T2-weighted images.



Flexor digitorum superficialis and
flexor digitorum profundus tt.

1st metacarpal

Trapezium

Extensor pollicis brevis and
abductor pollicis longus tt.

Radial a.

Scaphoid

Lunate

Joint capsule

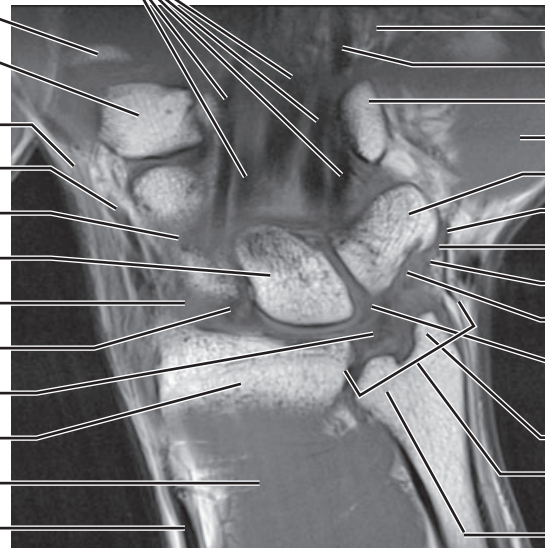
Scapholunate lig.

Triangular fibrocartilage

Radius

Pronator quadratus m.

Radial a.



Ulnar n.

Ulnar a.

Hook of hamate

Interosseous mm.

Triquetrum

Flexor carpi ulnaris t.

Ulnar collateral lig.

Meniscus homologue

Prestyloid recess
(filled with joint fluid)

Lunatotriquetral lig.

Ulnar styloid

Triangular fibrocartilage
complex

Ulnar head

Flexor digitorum superficialis and
flexor digitorum profundus tt.

1st metacarpal

Trapezium

Extensor pollicis brevis and
abductor pollicis longus tt.

Radial a.

Scaphoid

Lunate

Joint capsule

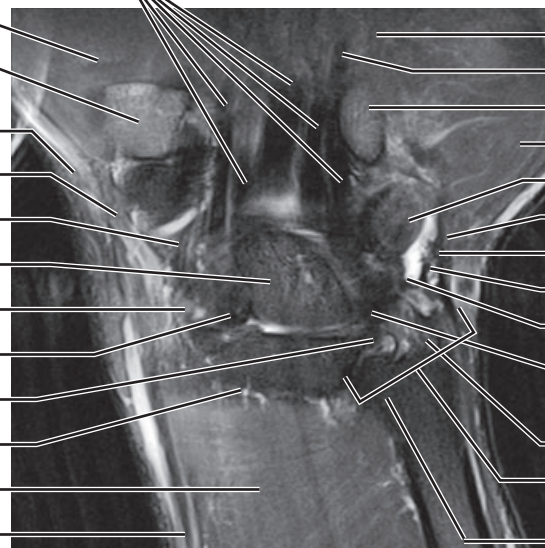
Scapholunate lig.

Triangular fibrocartilage

Radius

Pronator quadratus m.

Radial a.



Ulnar n.

Ulnar a.

Hook of hamate

Interosseous mm.

Triquetrum

Flexor carpi ulnaris t.

Ulnar collateral lig.

Meniscus homologue

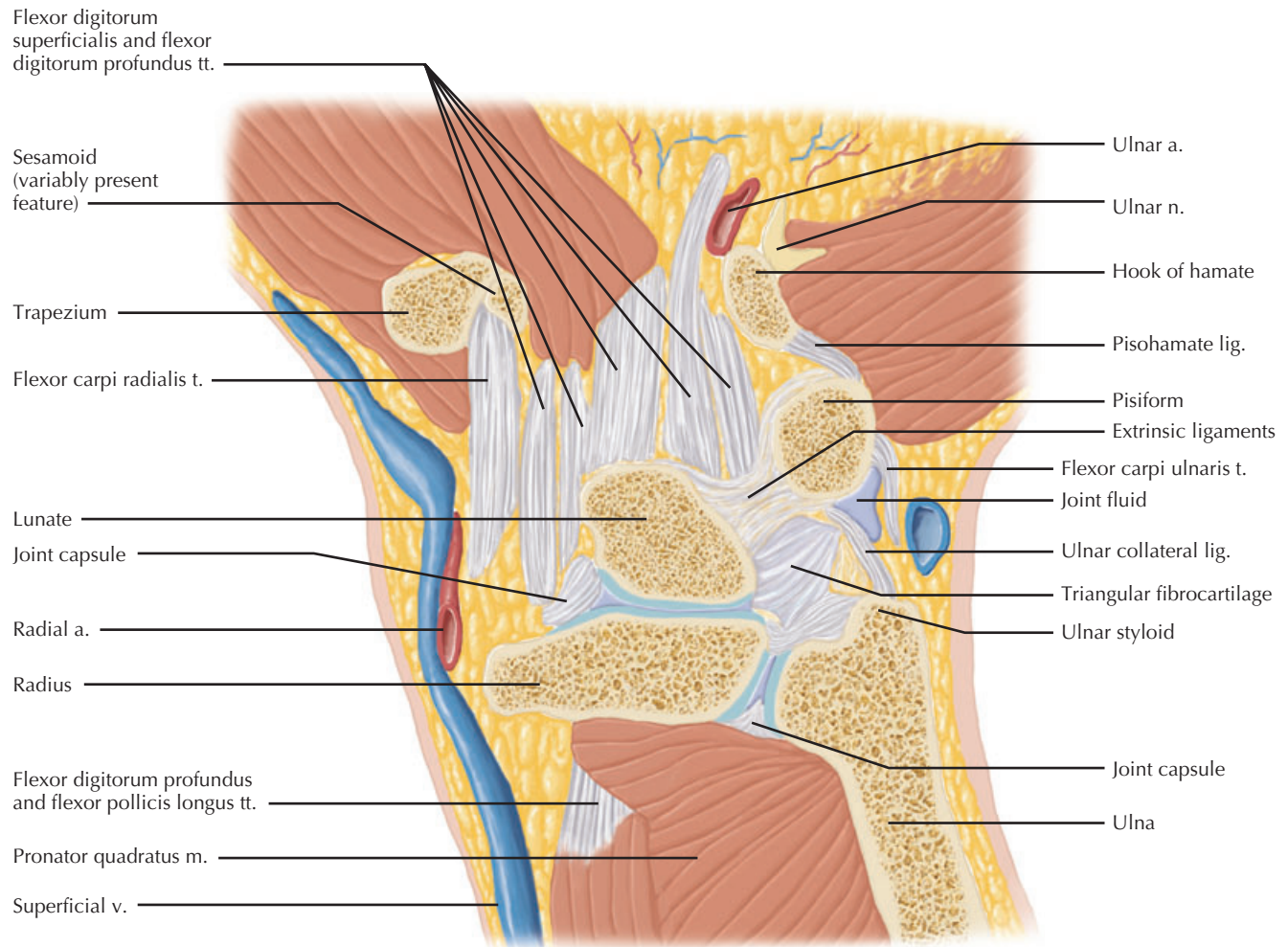
Prestyloid recess
(filled with joint fluid)

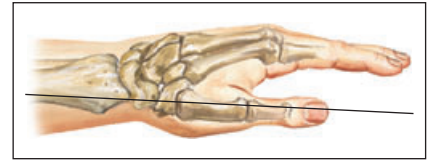
Lunatotriquetral lig.

Ulnar styloid

Triangular fibrocartilage
complex

Ulnar head





Flexor digitorum superficialis
and flexor digitorum profundus tt.

Sesamoid (variably
present feature)

Trapezium

Flexor carpi radialis t.

Lunate

Joint capsule

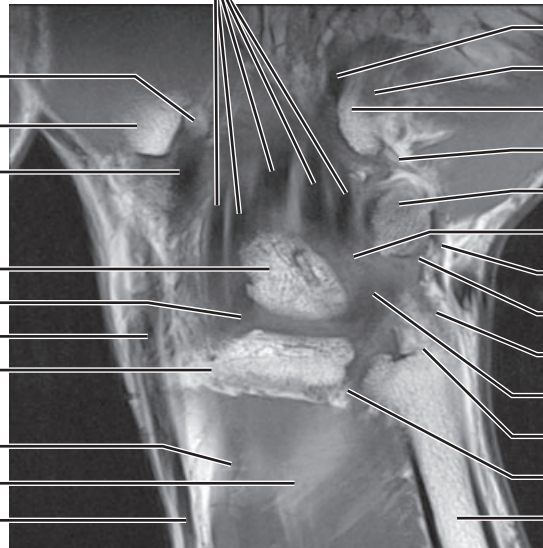
Radial a.

Radius

Flexor digitorum profundus
and flexor pollicis longus tt.

Pronator quadratus m.

Superficial v.



Ulnar a.

Ulnar n.

Hook of hamate

Pisohamate lig.

Pisiform

Extrinsic ligaments

Flexor carpi ulnaris t.

Joint fluid

Ulnar collateral lig.

Triangular fibrocartilage

Ulnar styloid

Joint capsule

Ulna

Flexor digitorum superficialis
and flexor digitorum profundus tt.

Sesamoid (variably
present feature)

Trapezium

Flexor carpi radialis t.

Lunate

Joint capsule

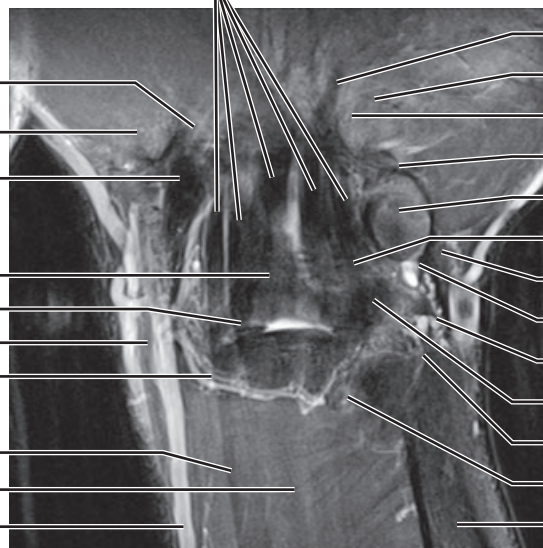
Radial a.

Radius

Flexor digitorum profundus
and flexor pollicis longus tt.

Pronator quadratus m.

Superficial v.



Ulnar a.

Ulnar n.

Hook of hamate

Pisohamate lig.

Pisiform

Extrinsic ligaments

Flexor carpi ulnaris t.

Joint fluid

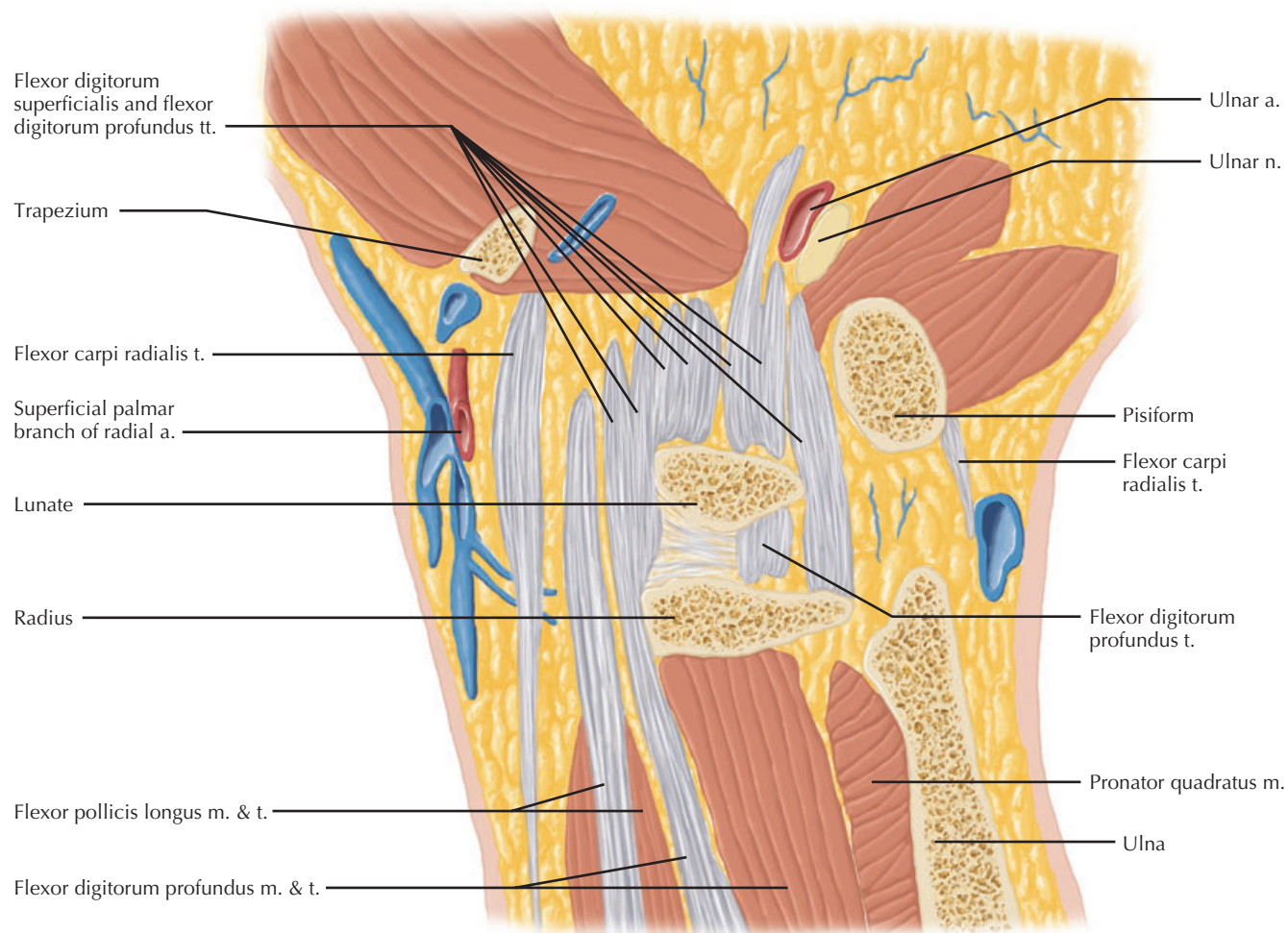
Ulnar collateral lig.

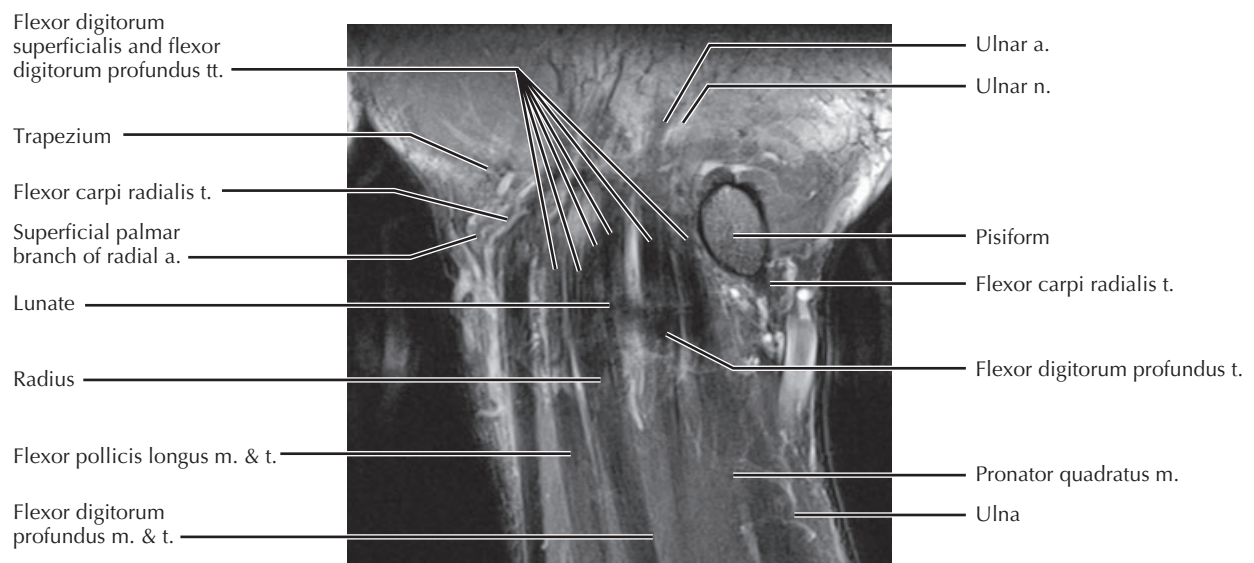
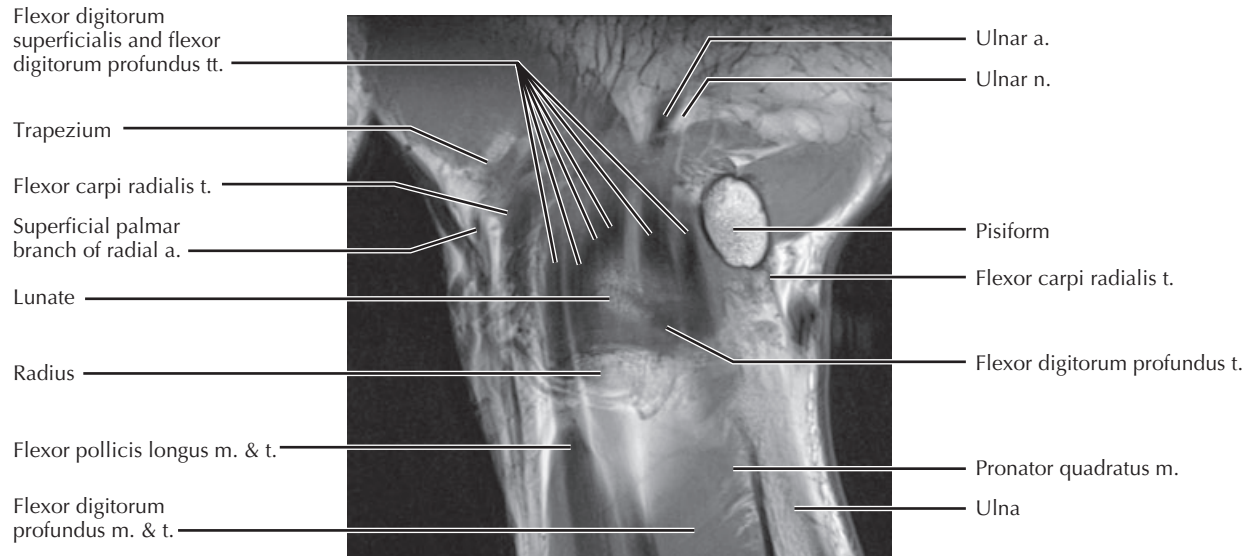
Triangular fibrocartilage

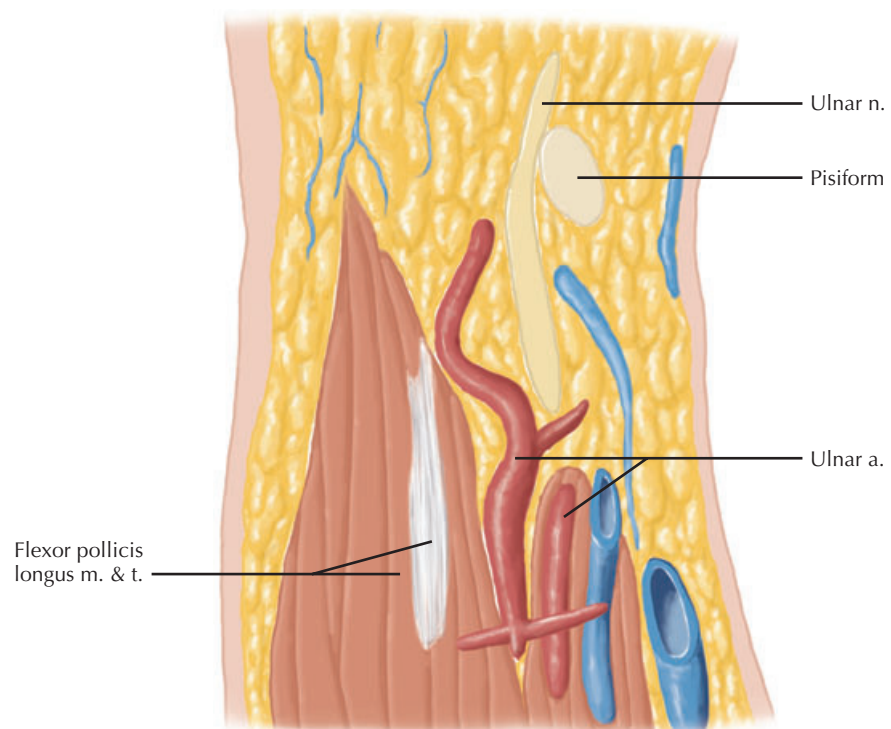
Ulnar styloid

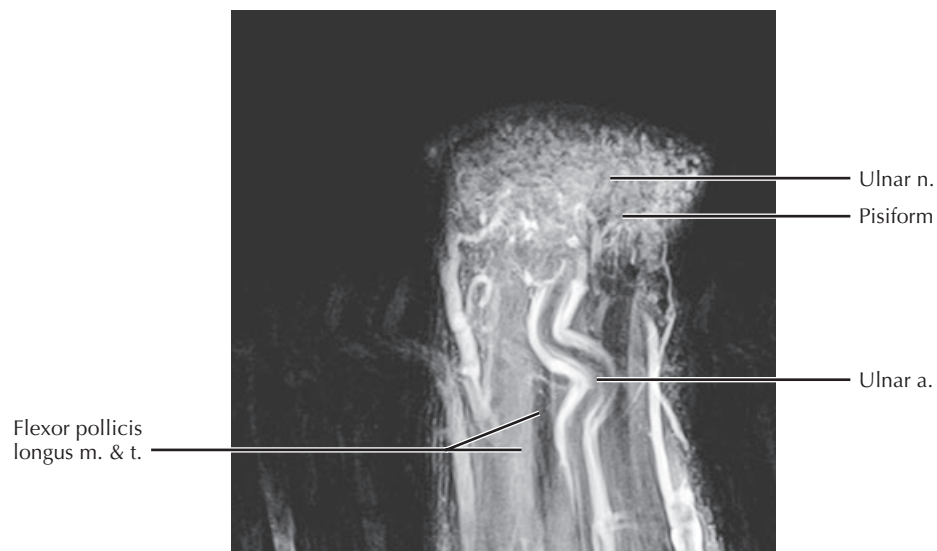
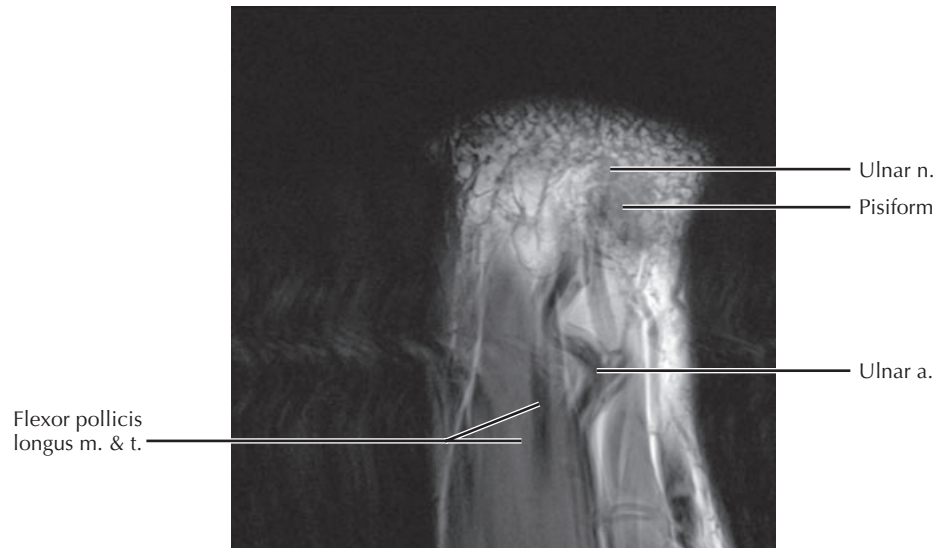
Joint capsule

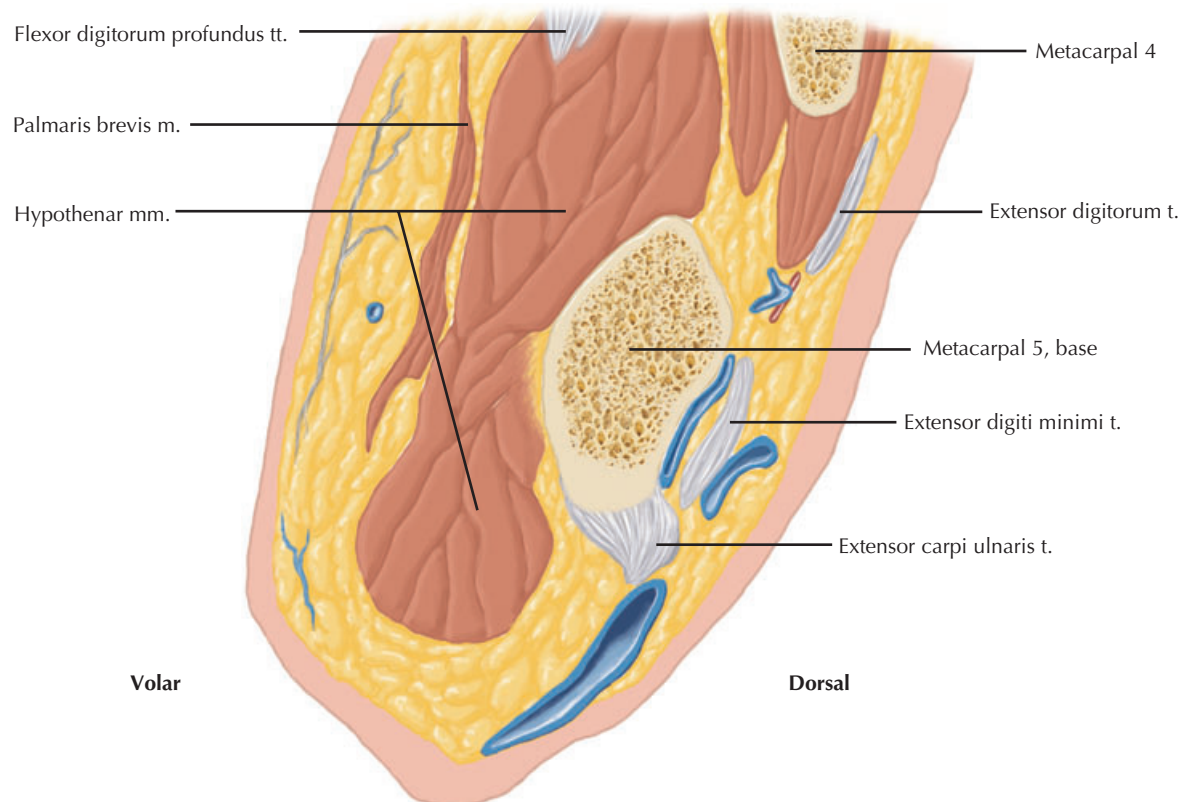
Ulna

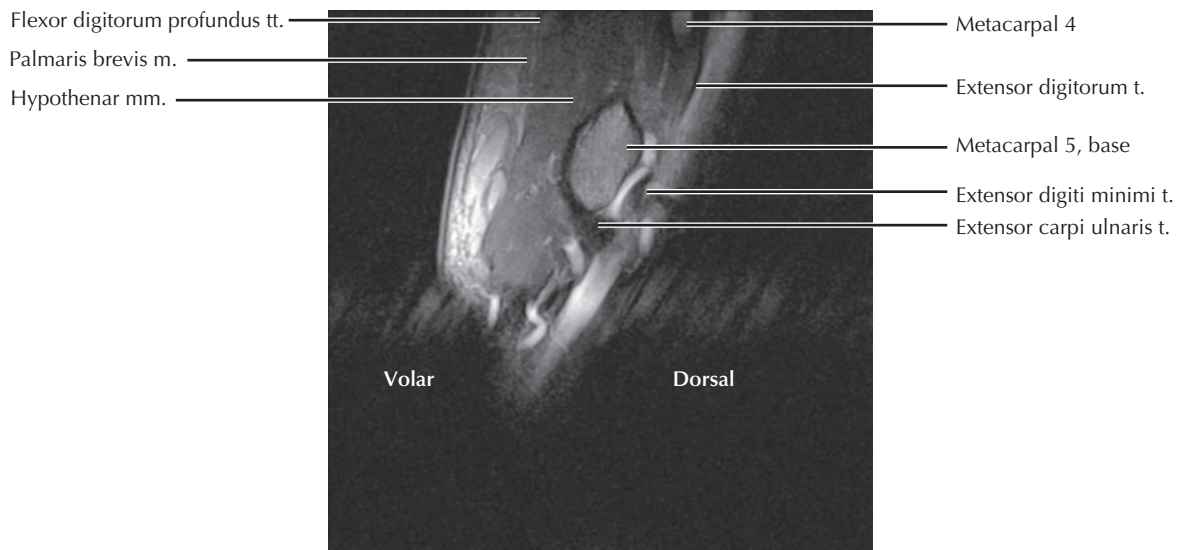
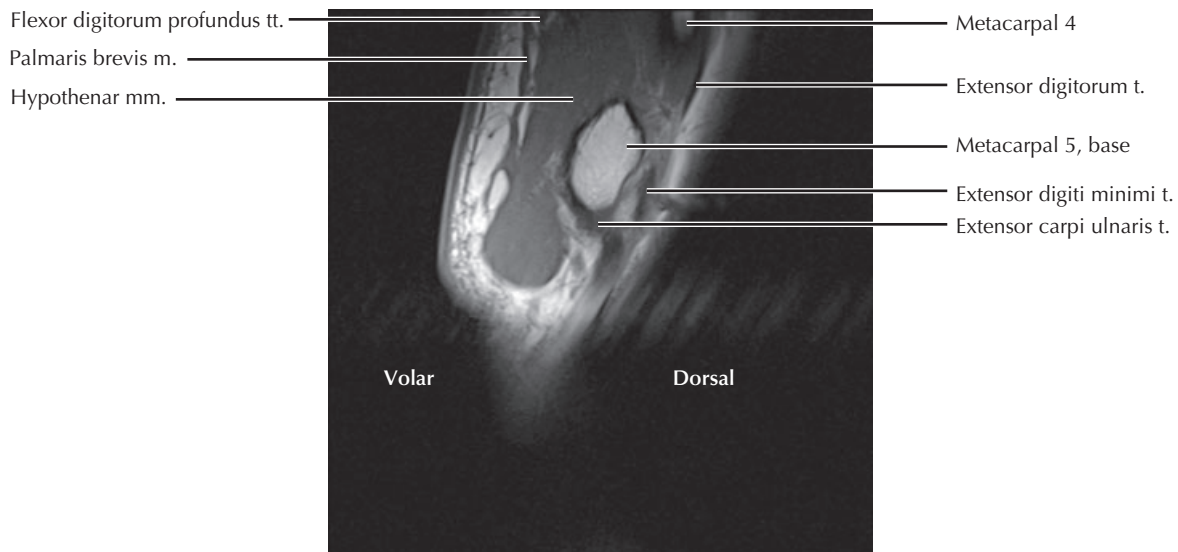
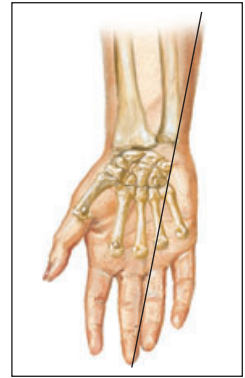


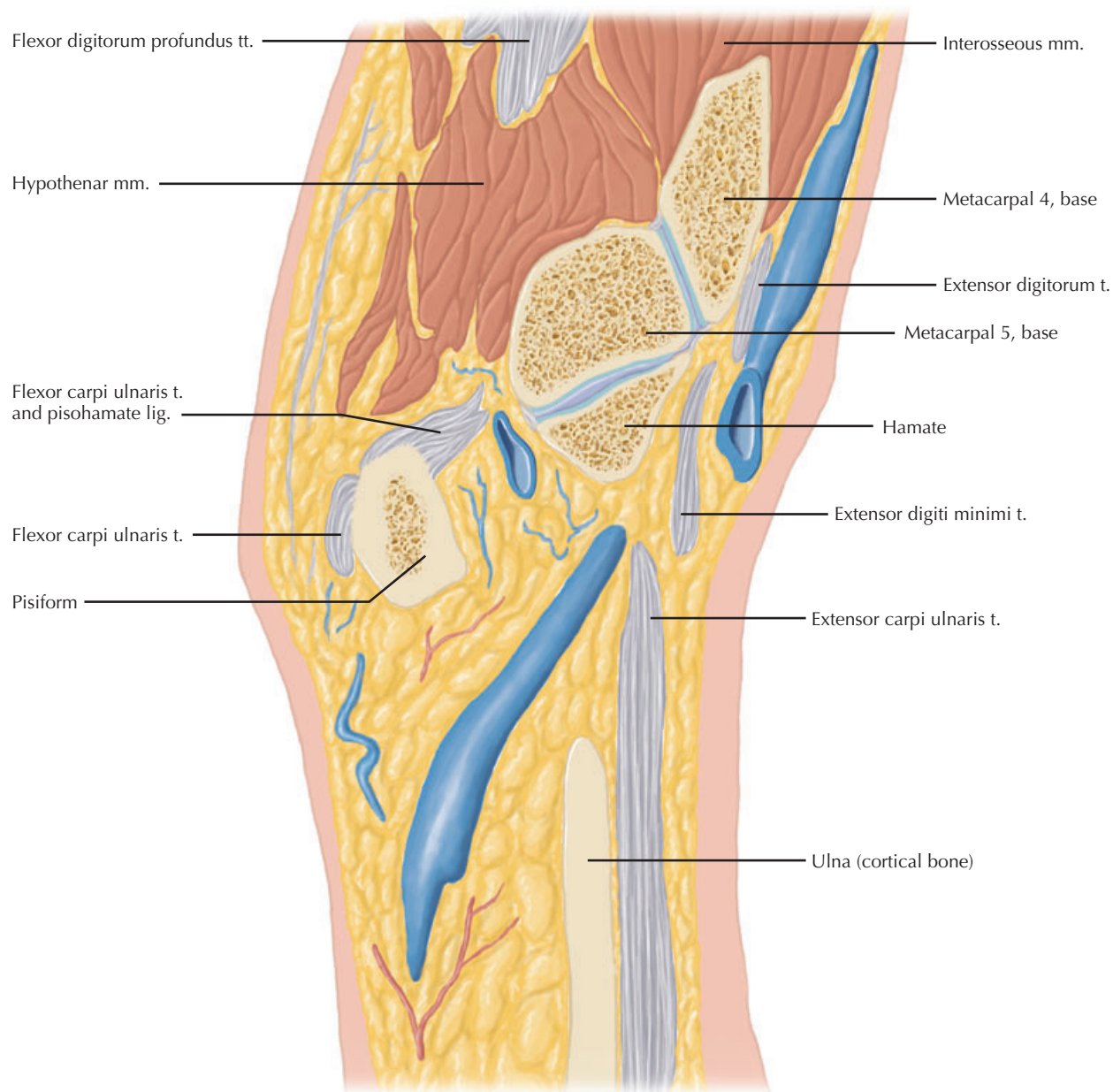


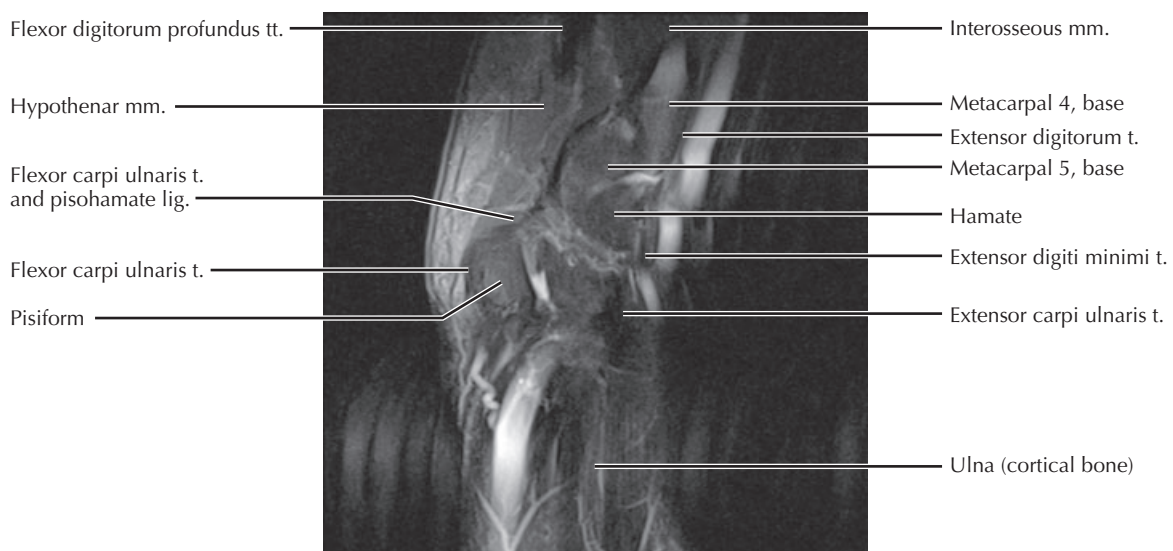
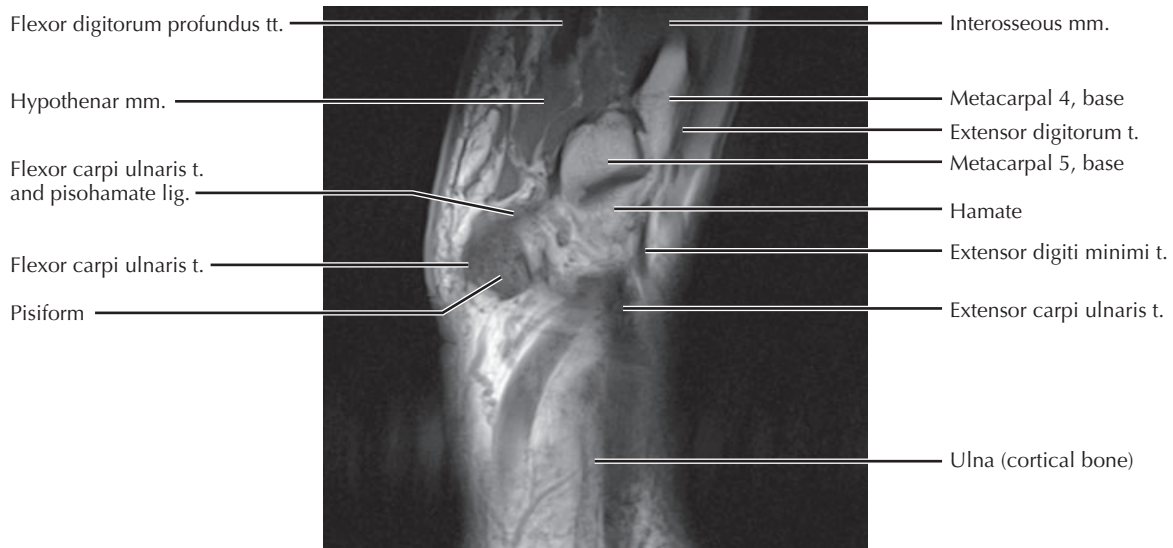
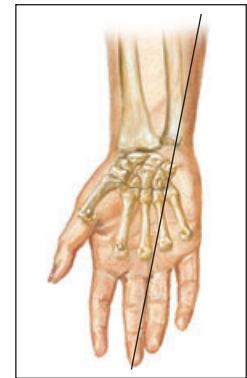


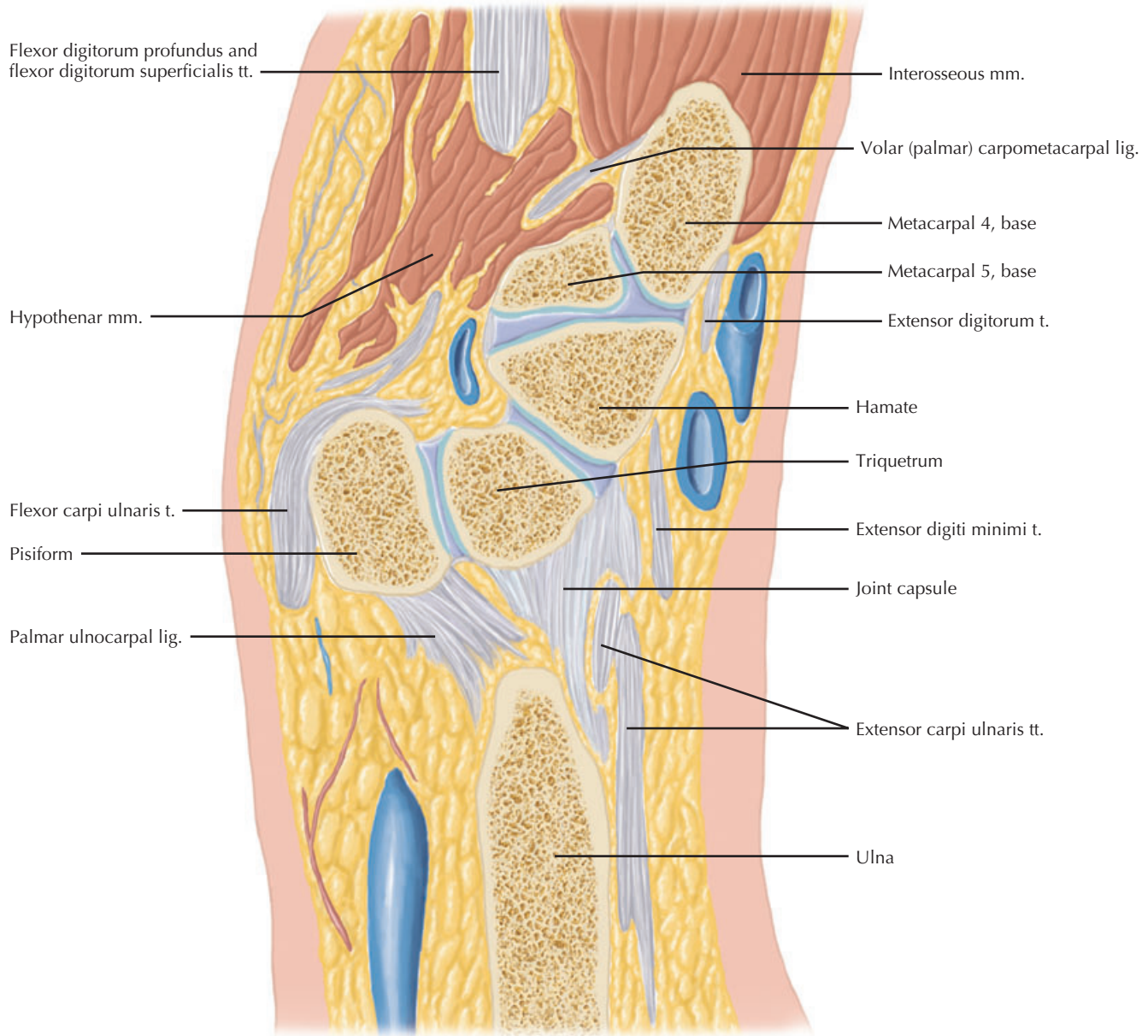






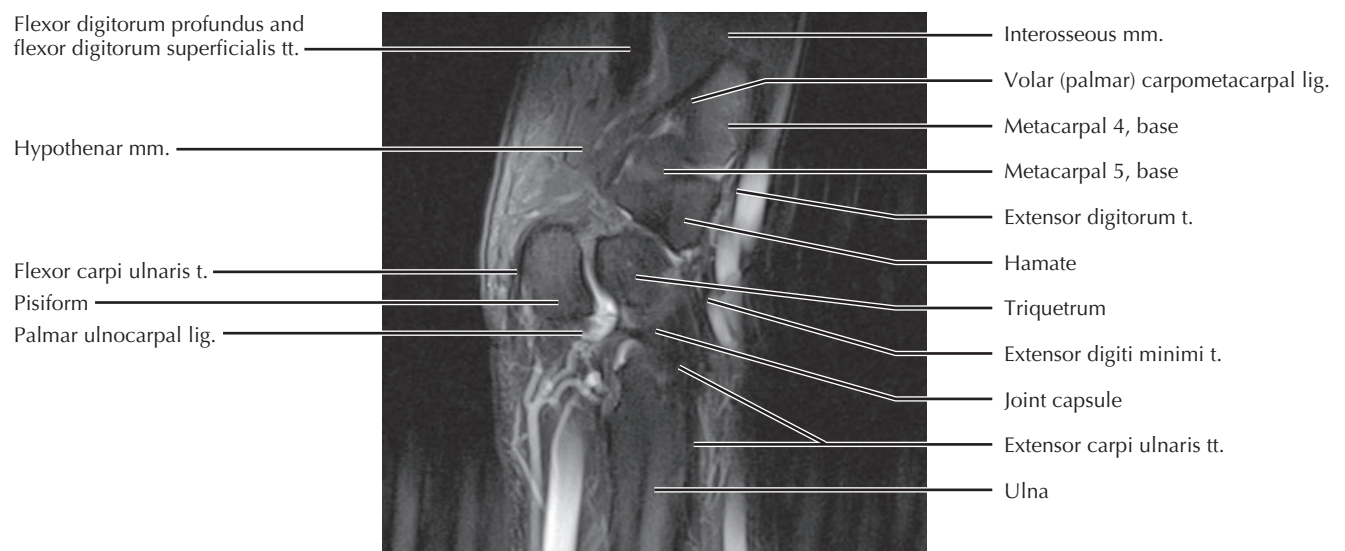
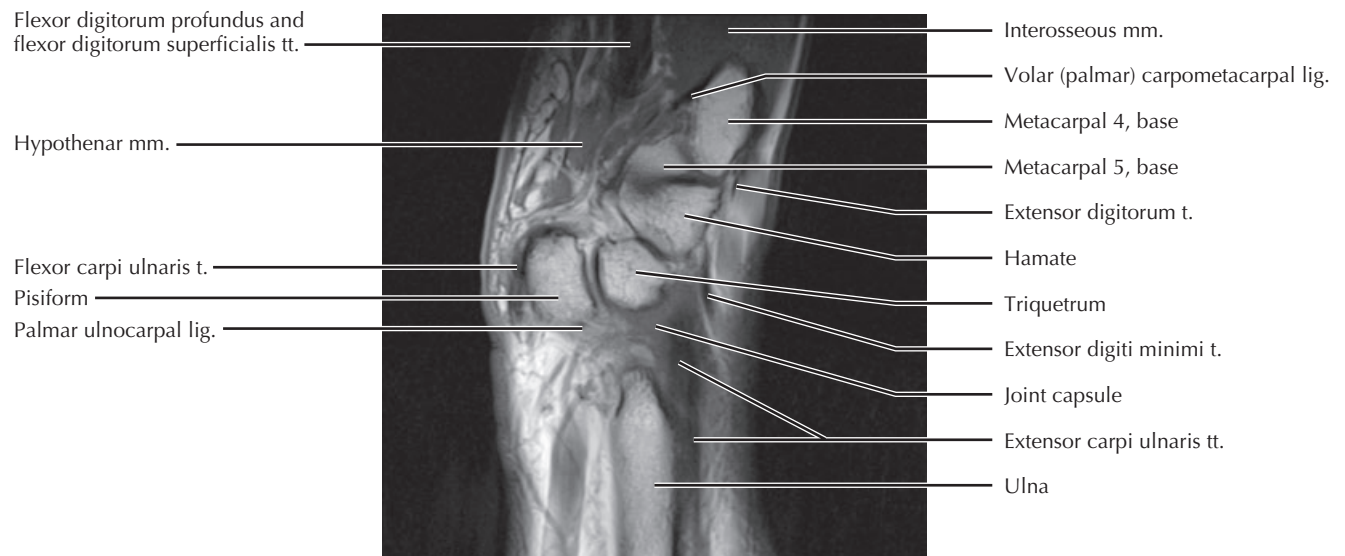
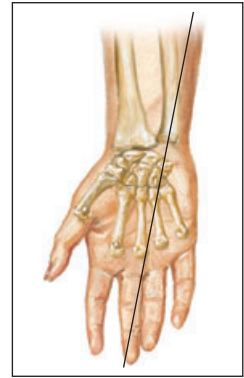


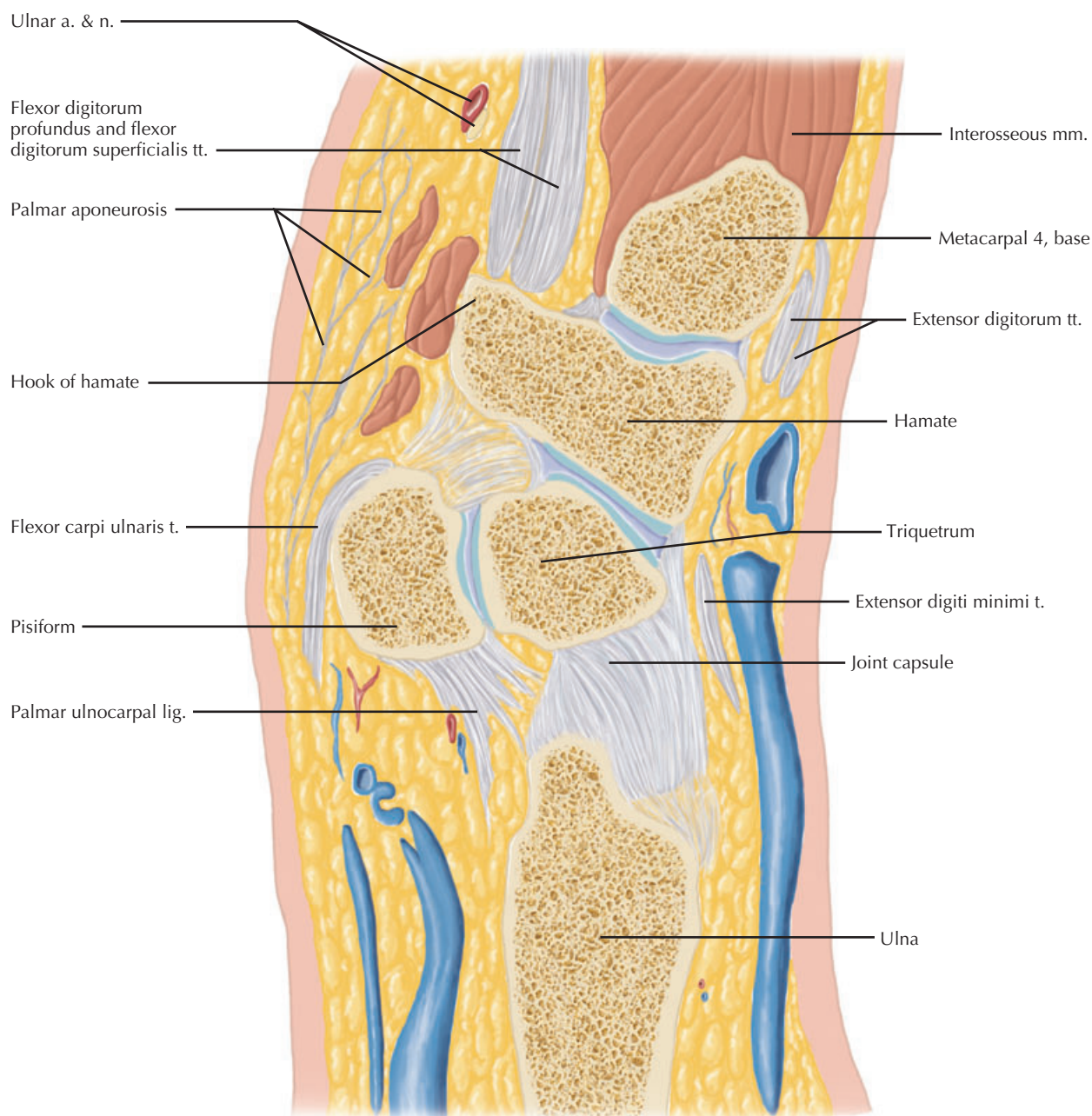




DIAGNOSTIC CONSIDERATION

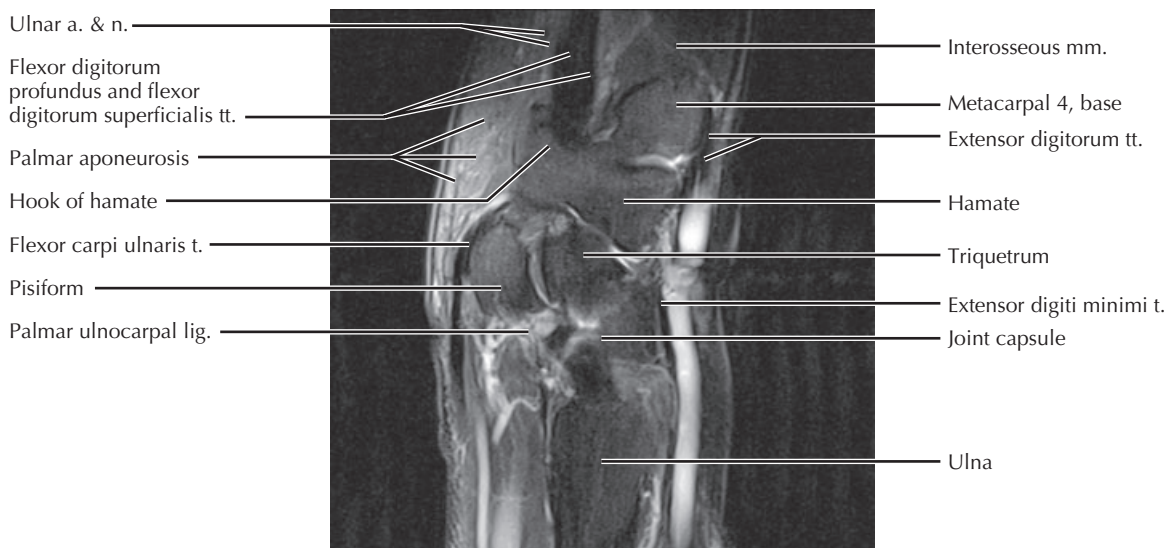
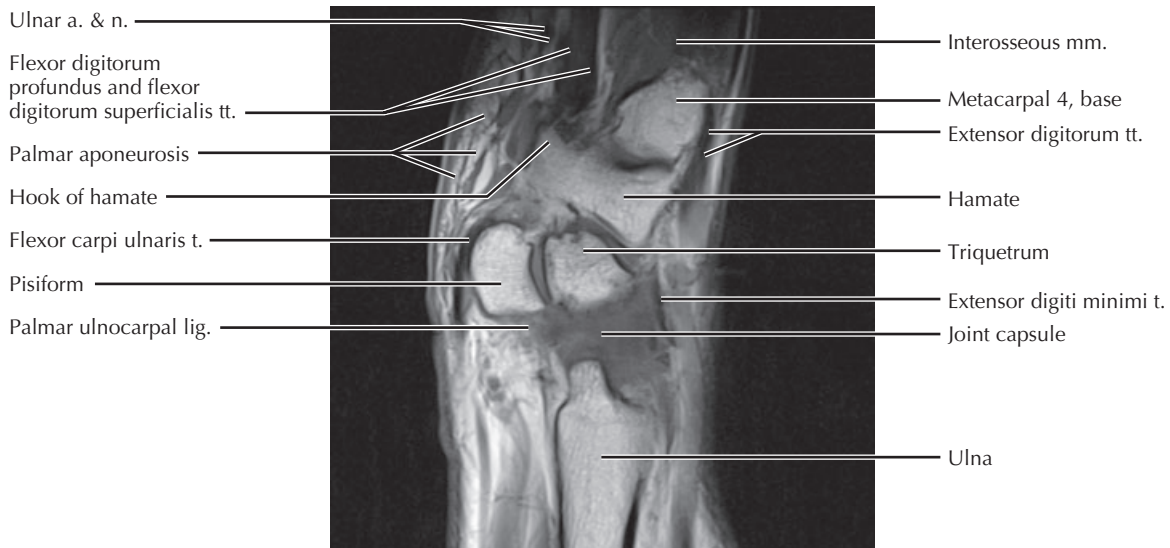
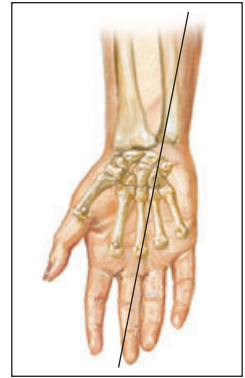
The pisotriquetral synovial recess normally may contain a small amount of fluid. Large amounts of fluid, however, may represent a cyst and can be a source of pain.

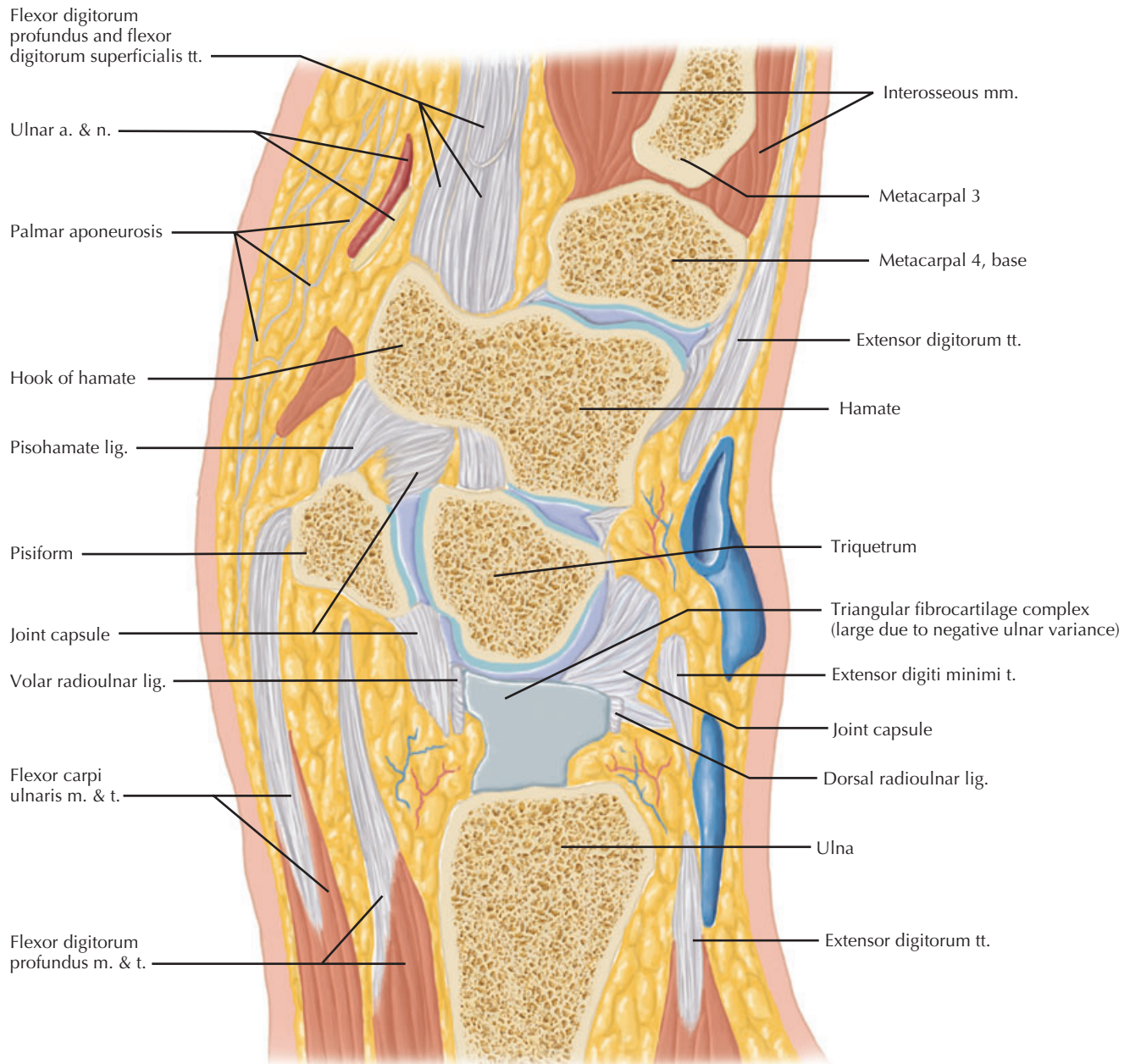


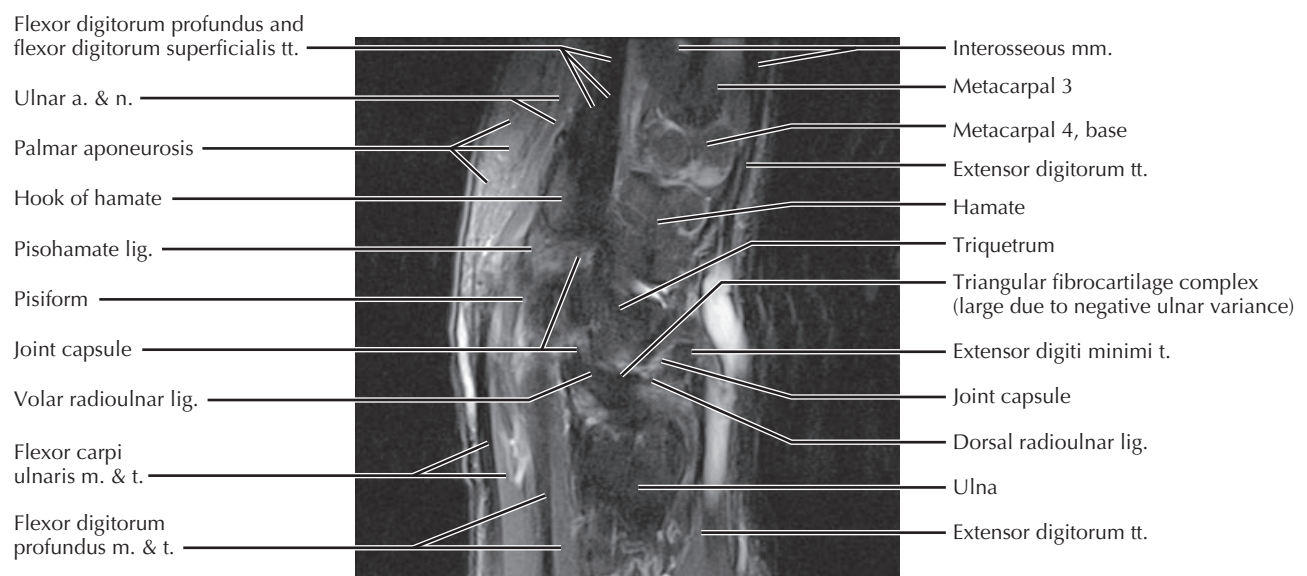
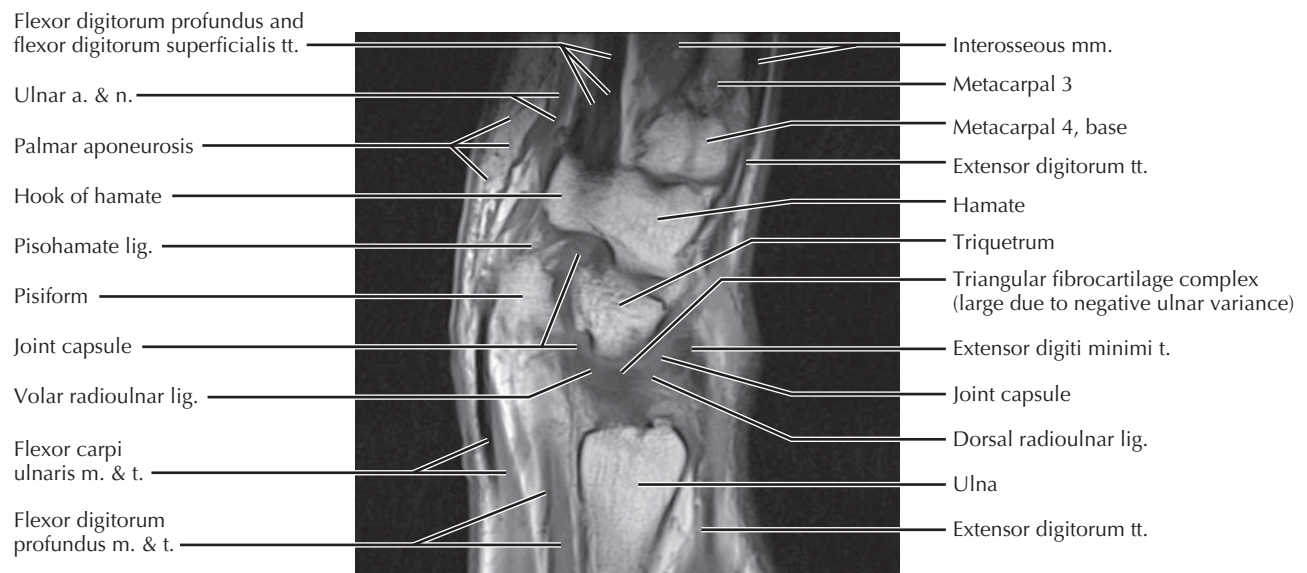
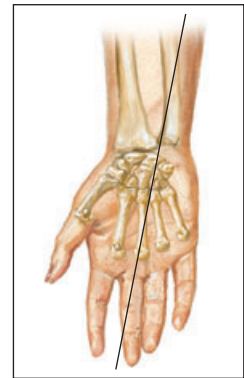


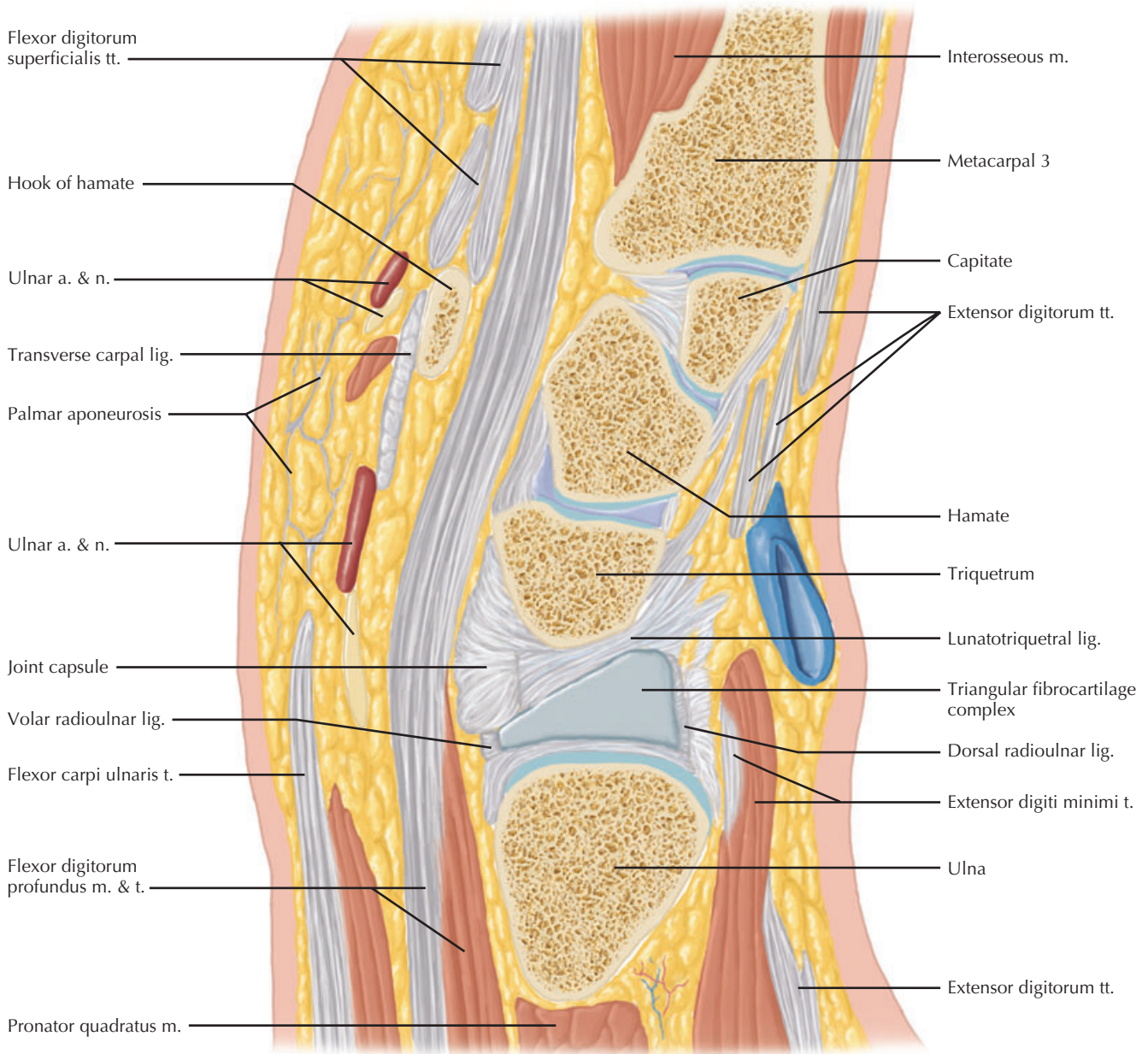
PATHOLOGIC PROCESS

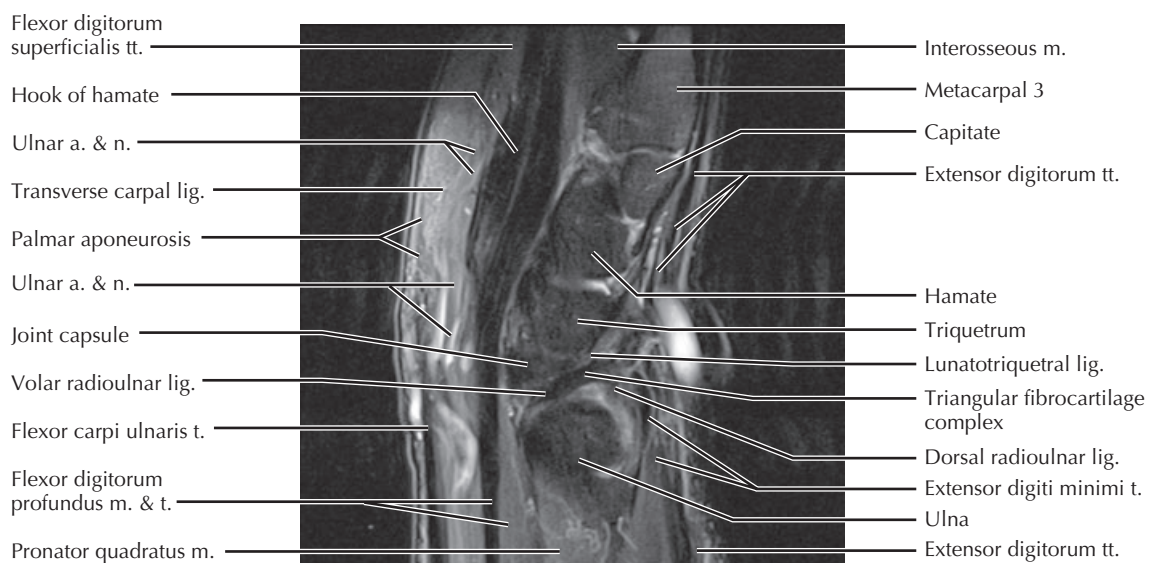
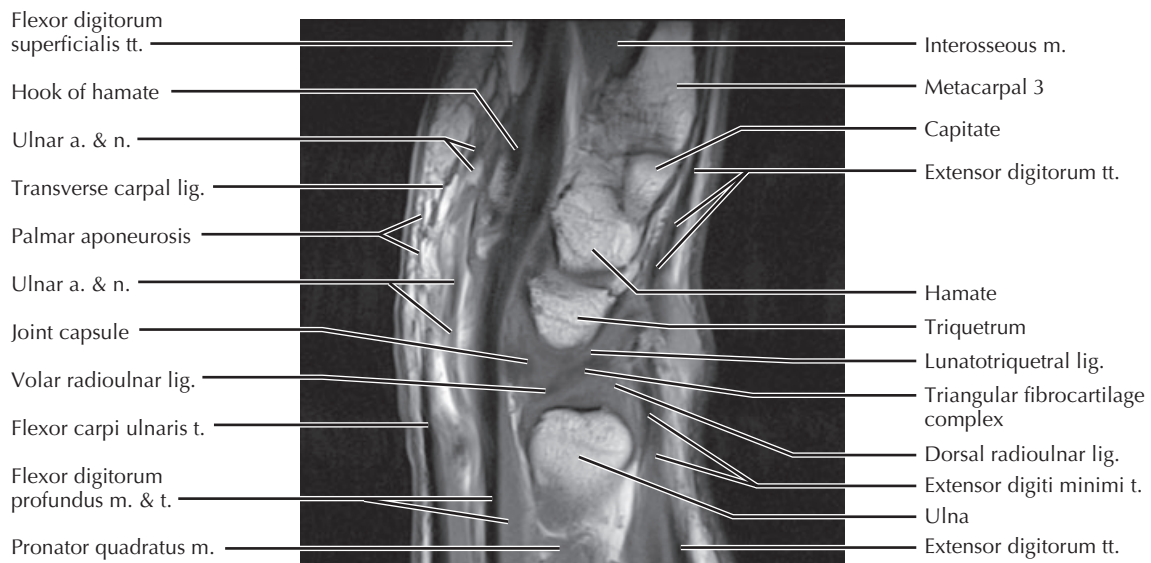
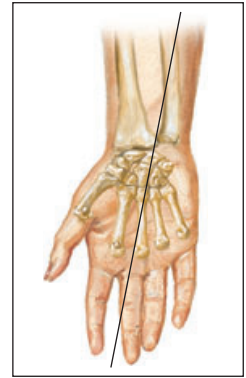
The first changes of rheumatoid arthritis can be seen at the pisotriquetral joint space as erosions and abnormal signal across the joint space.

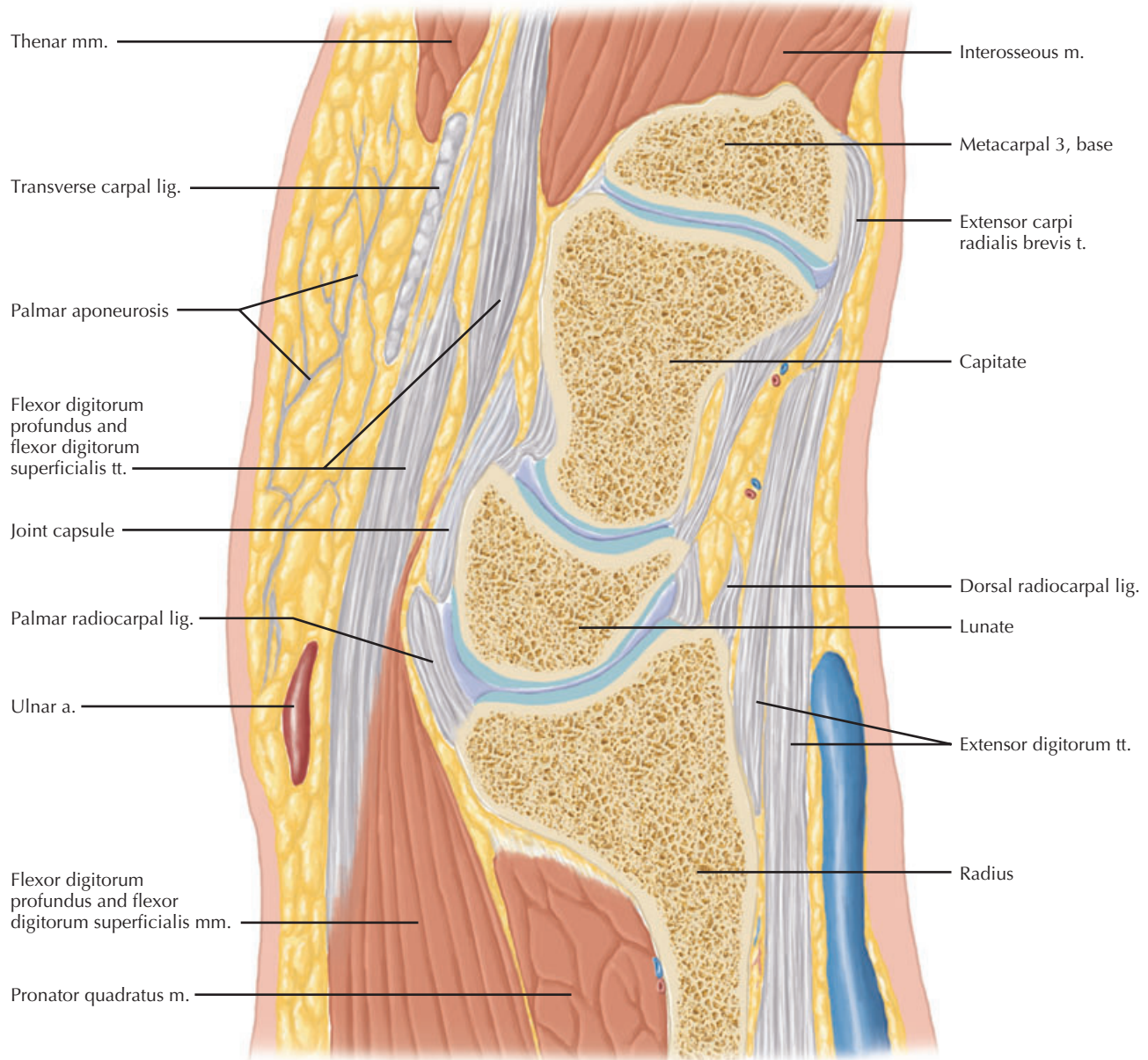






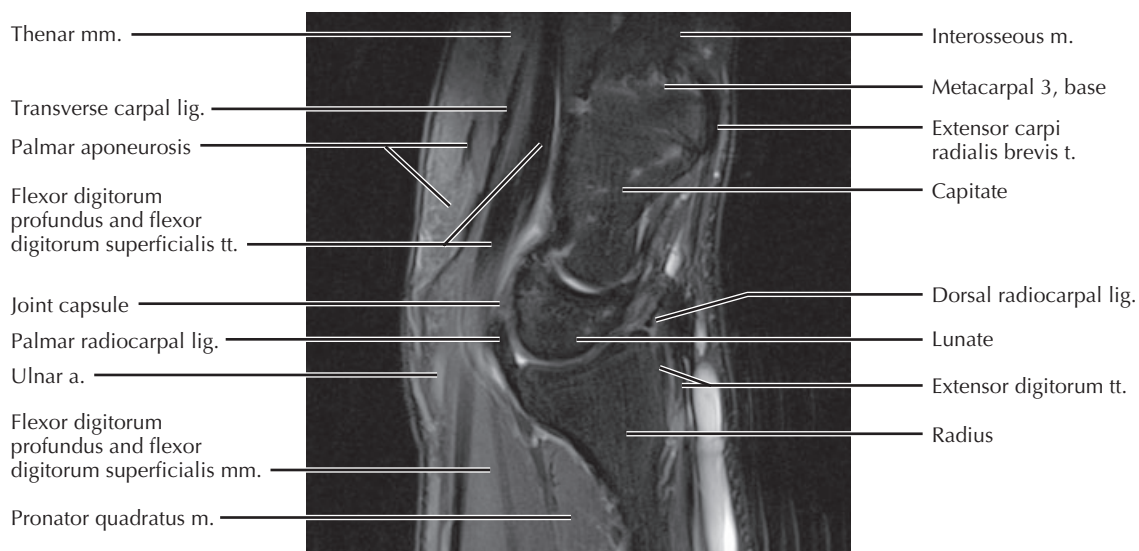
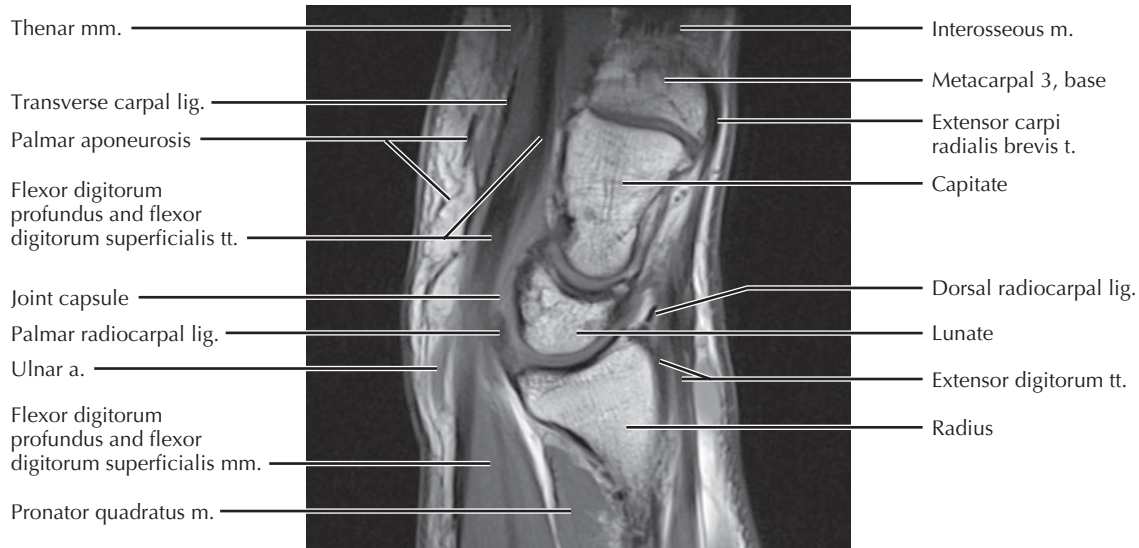
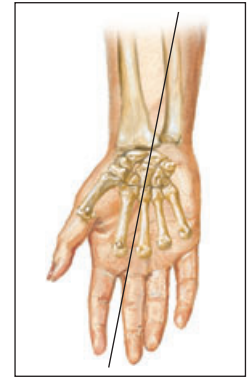


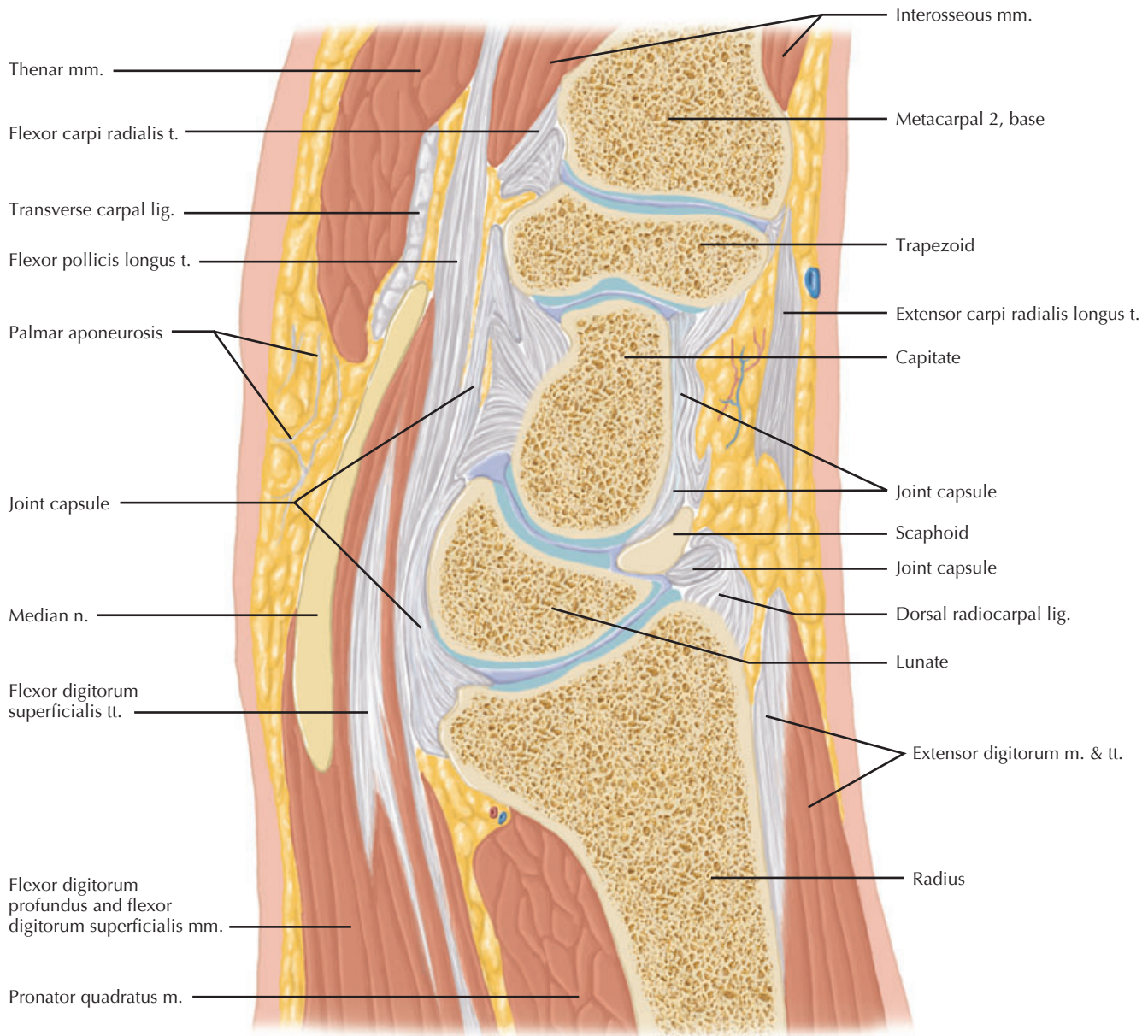




PATHOLOGIC PROCESS

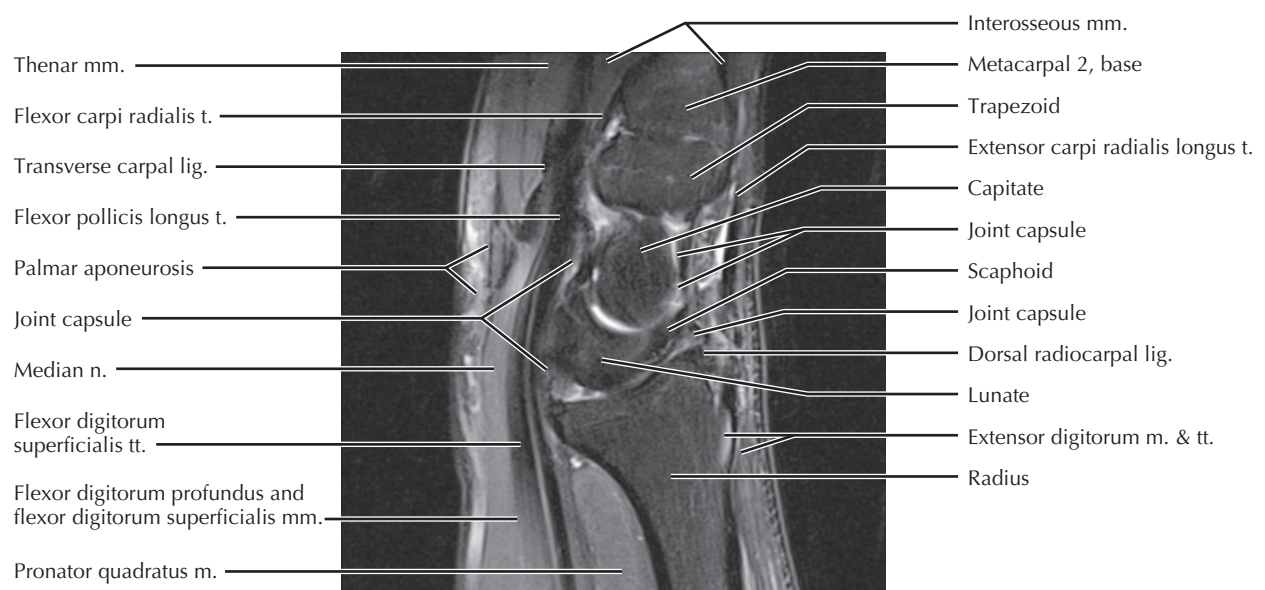
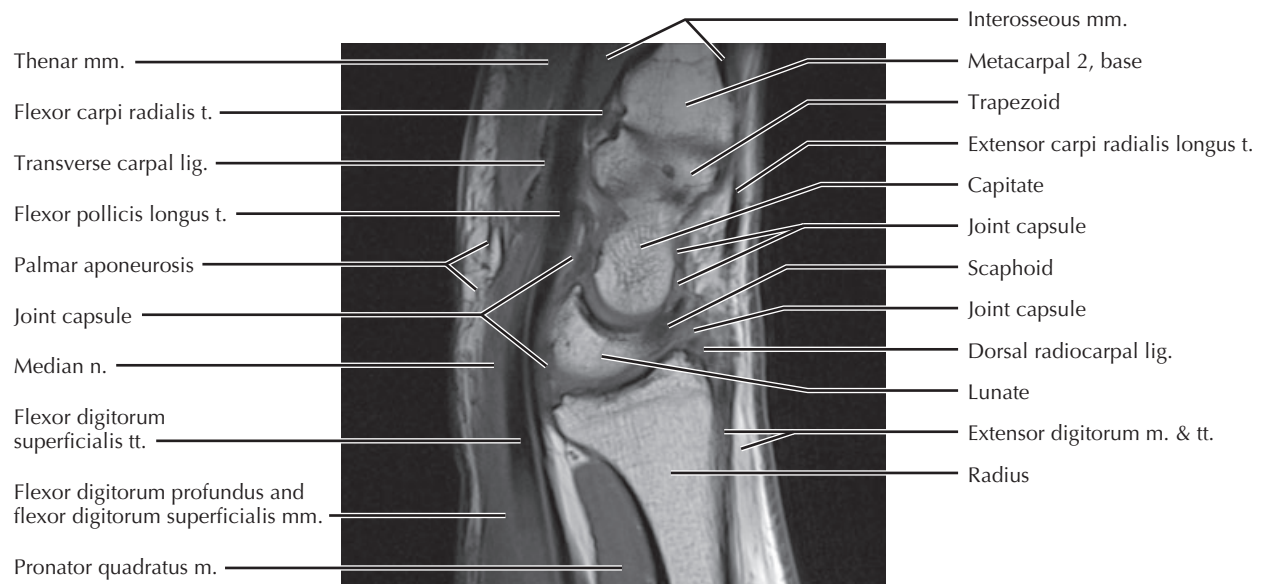
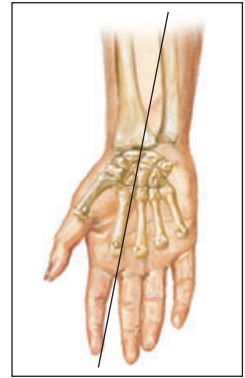
Disruption of the triquetral attachment of the lunatotriquetral ligament results in the distal lunate articular surface tilting in a volar direction (VISI). This finding is often associated with triangular fibrocartilage tears.

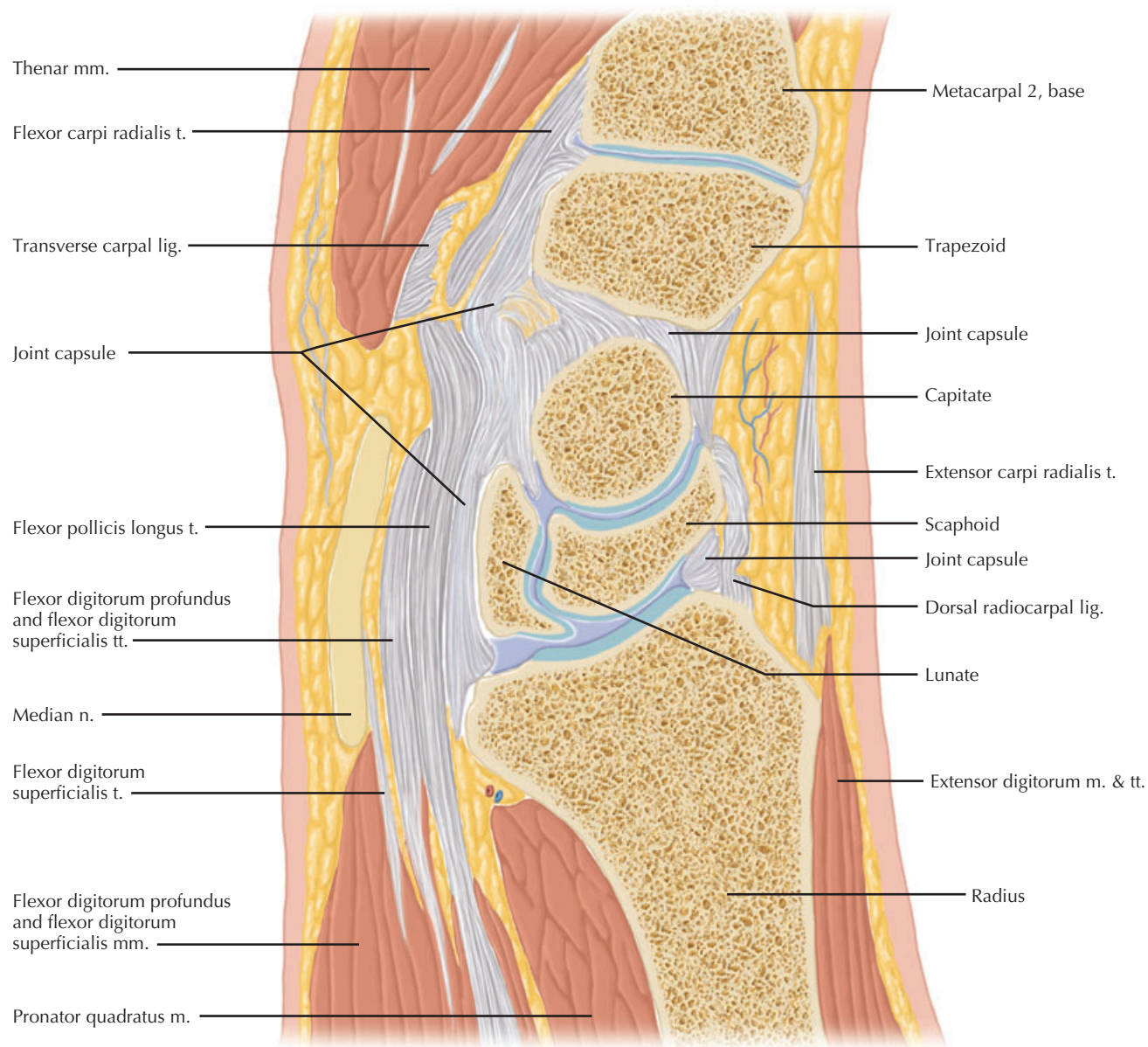


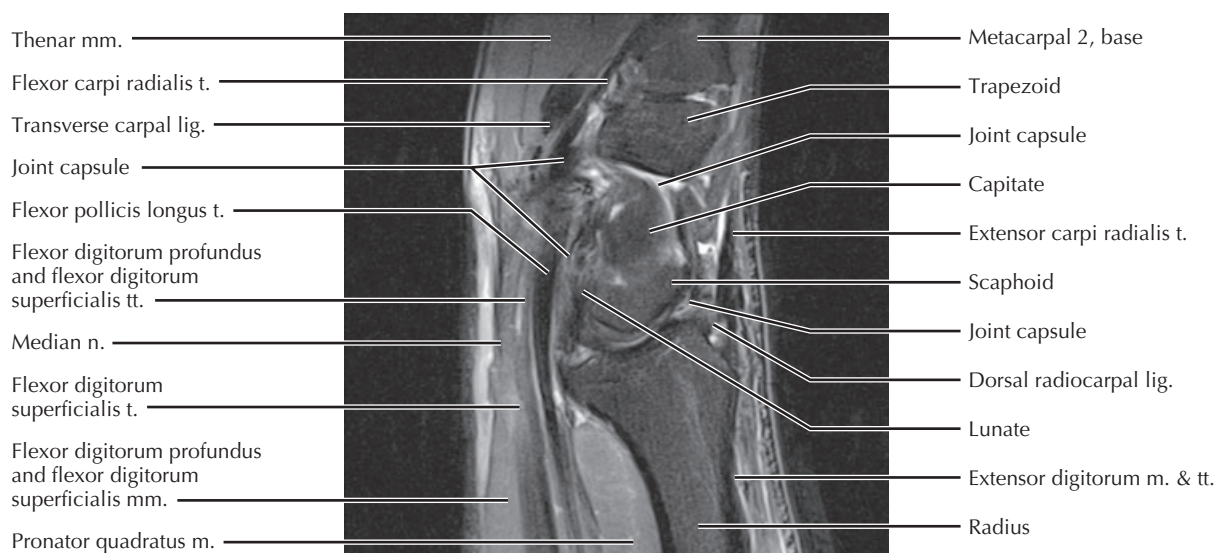
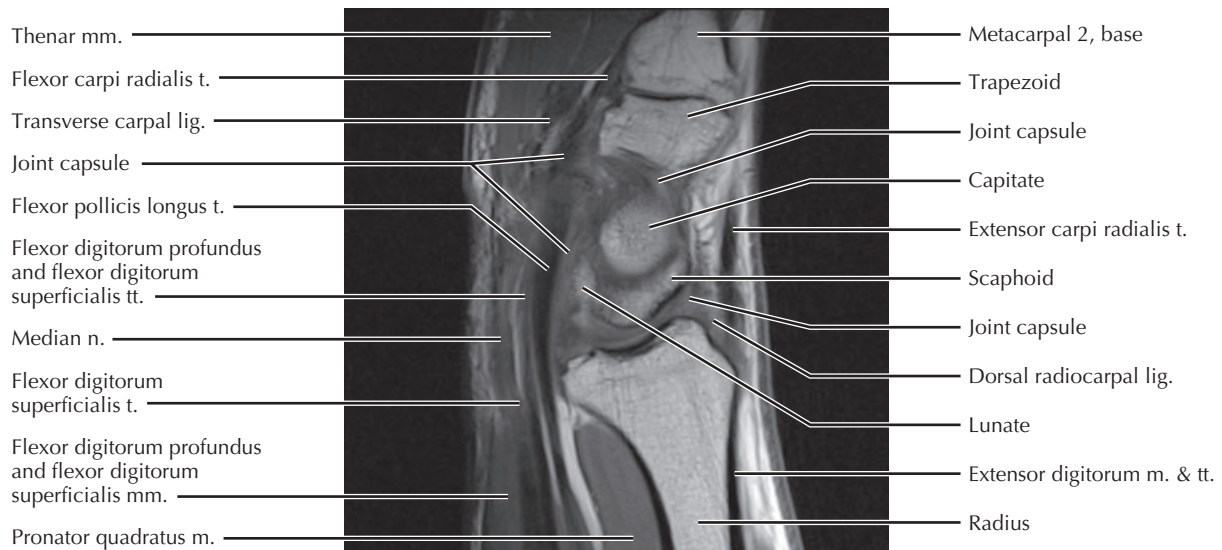
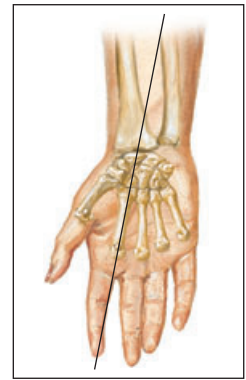


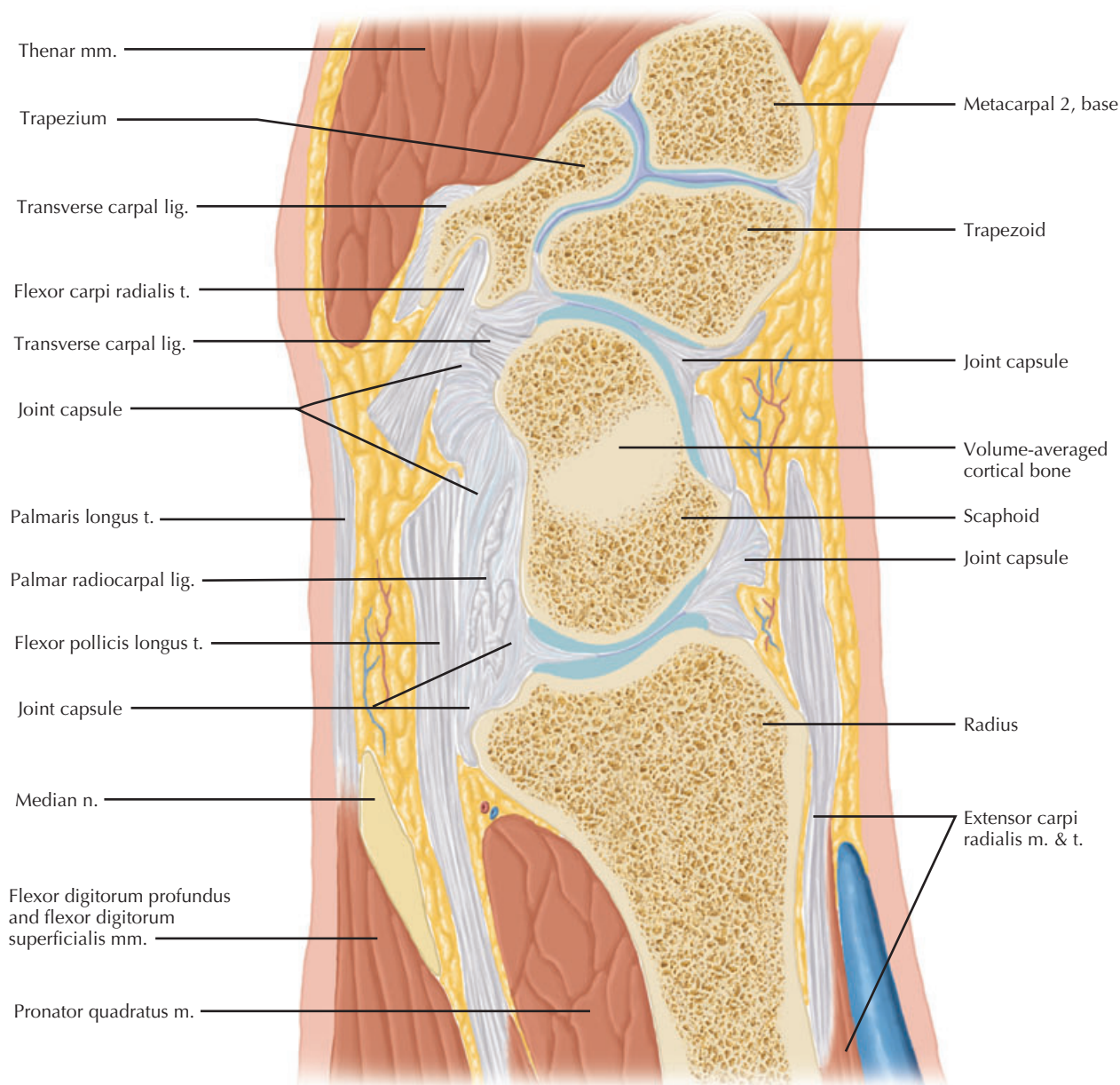
PATHOLOGIC PROCESS

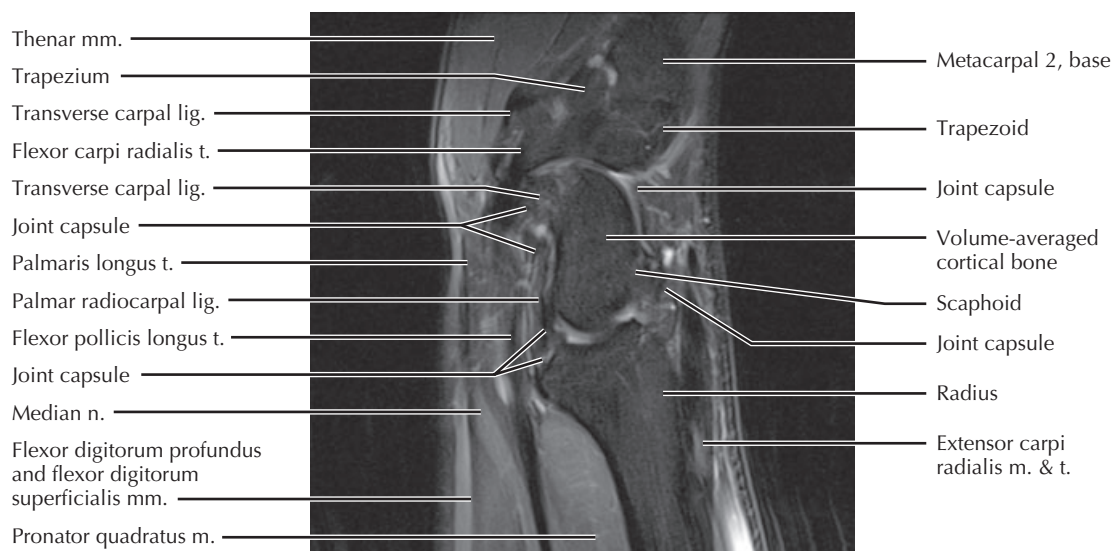
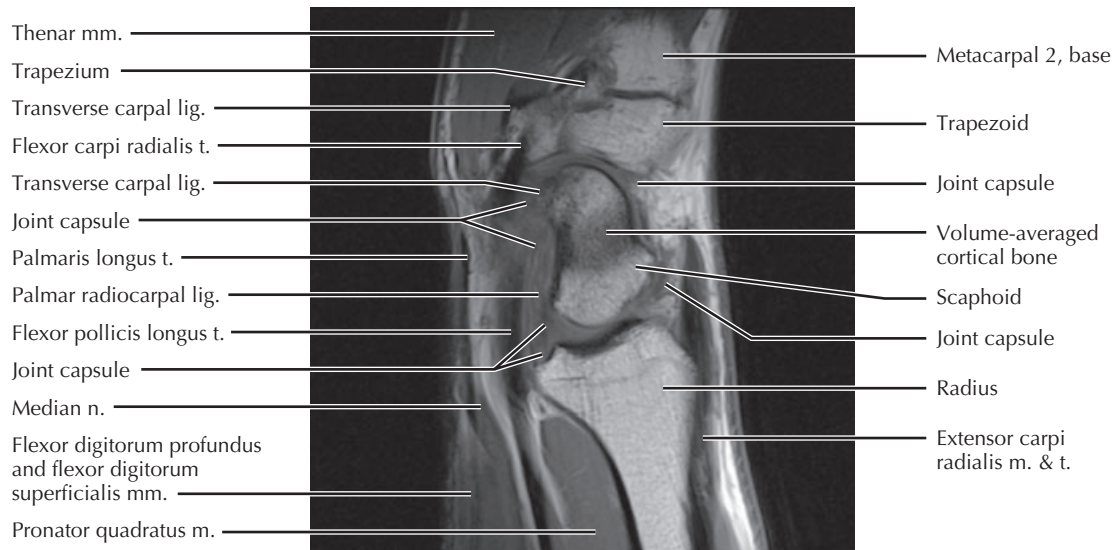
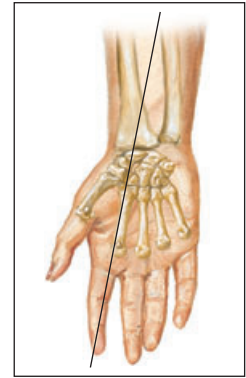
As noted earlier, dorsal intercalated segmental instability is a rotatory subluxation of the scaphoid secondary to disruption of the scapholunate ligament. DISI also appears as dorsal tilting of the distal lunate articular surface.

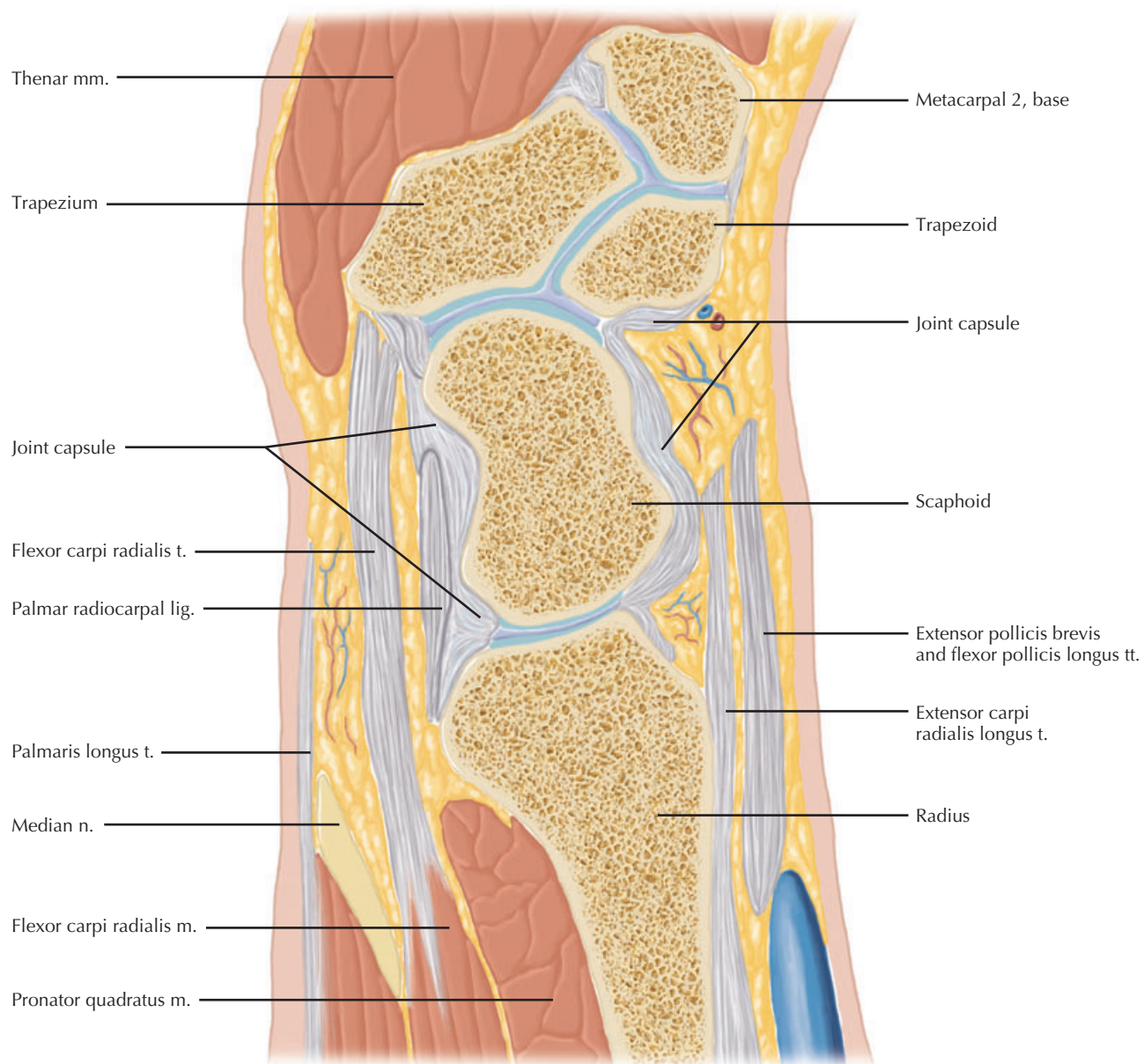


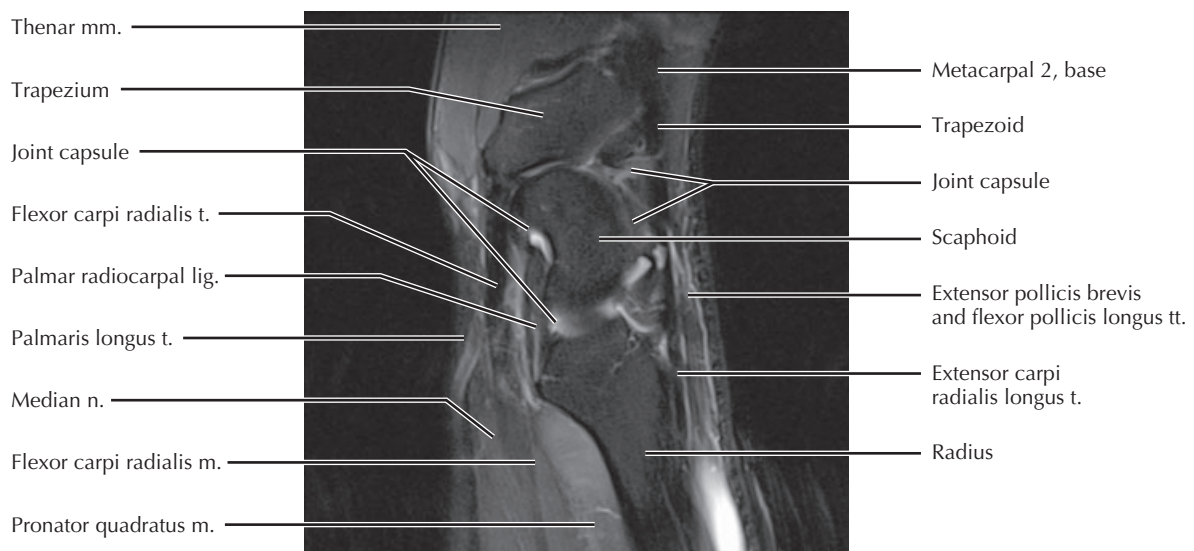
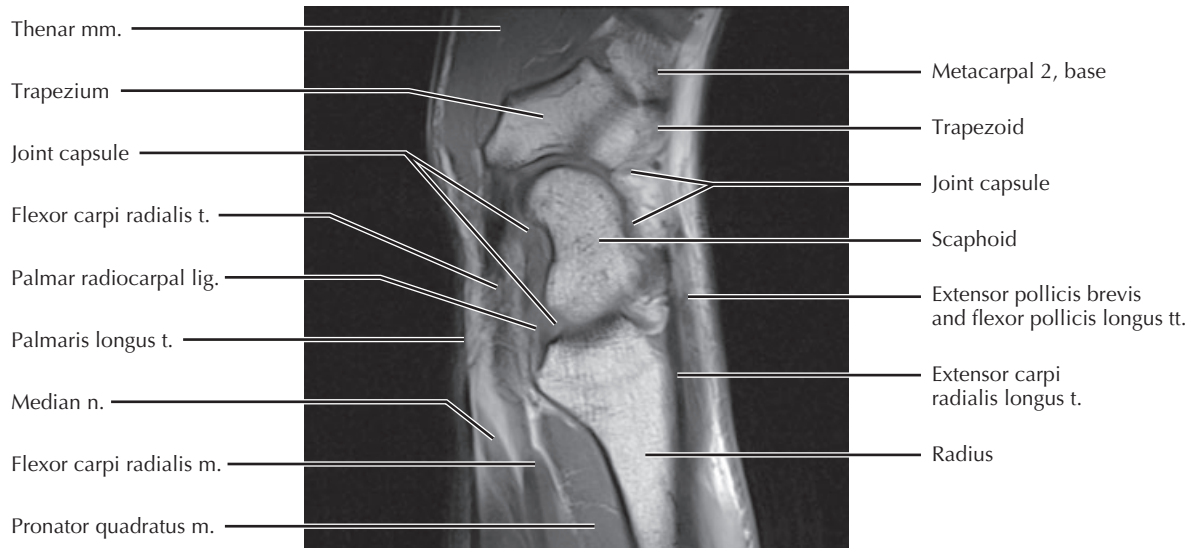
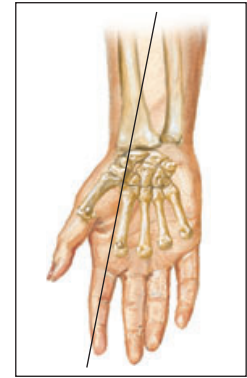


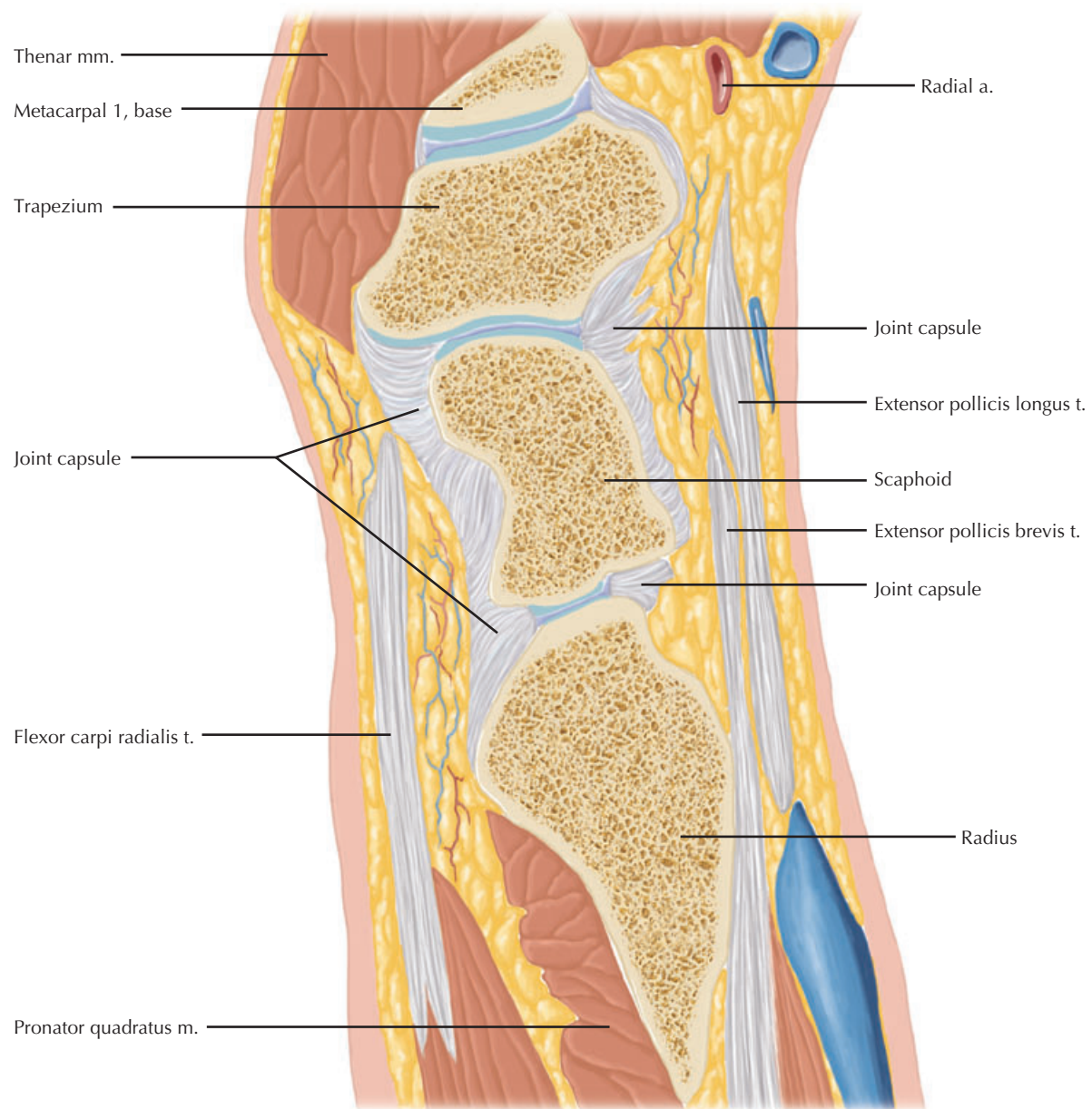


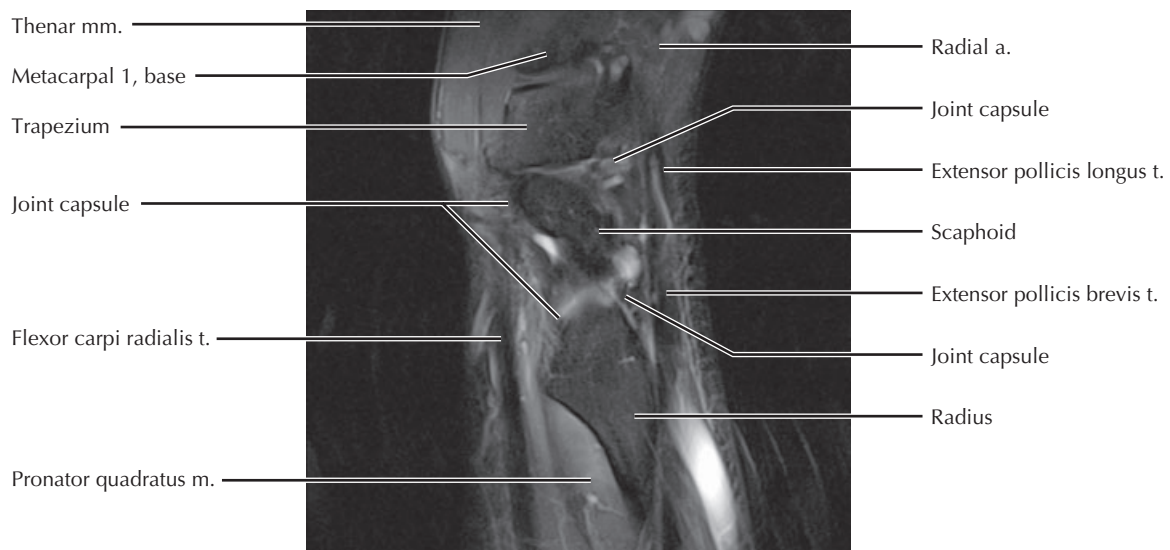
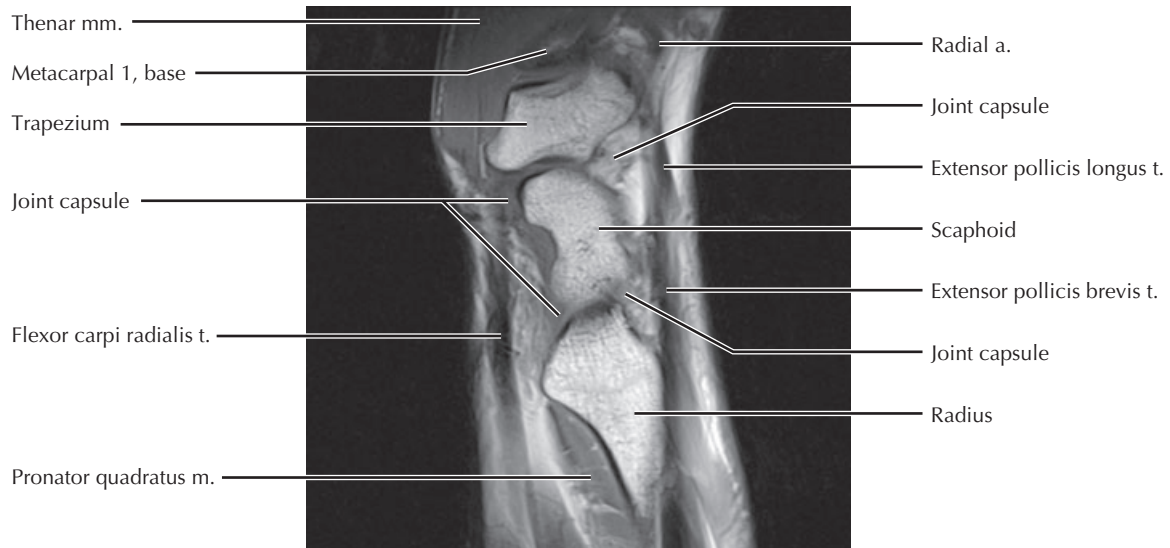
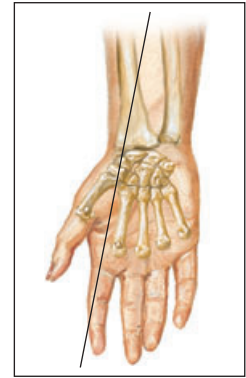


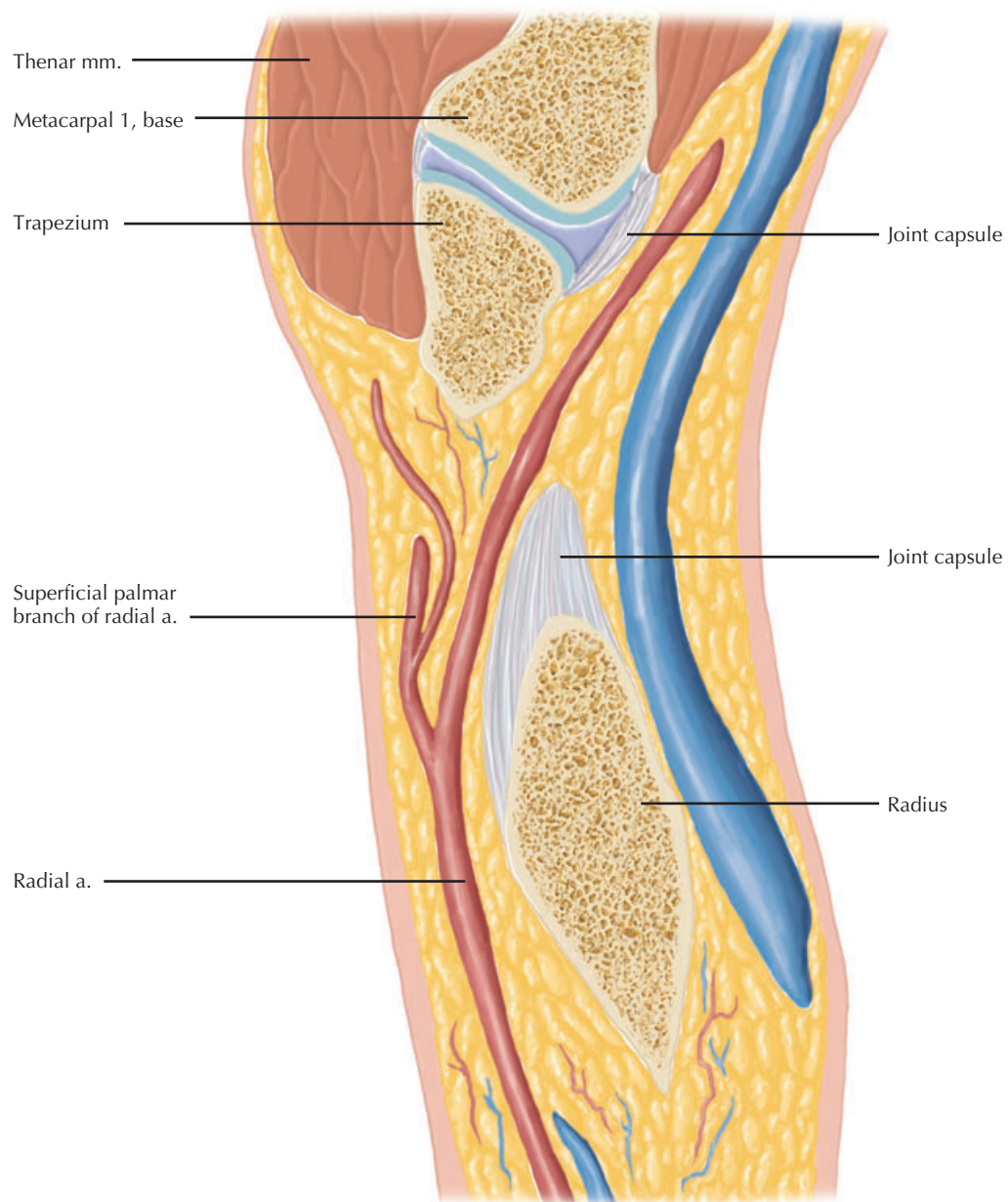


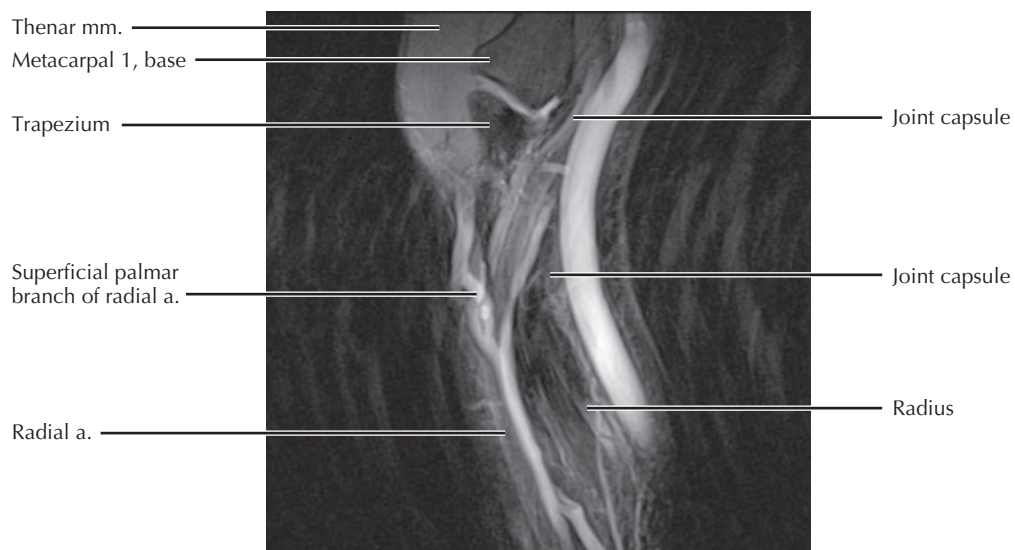
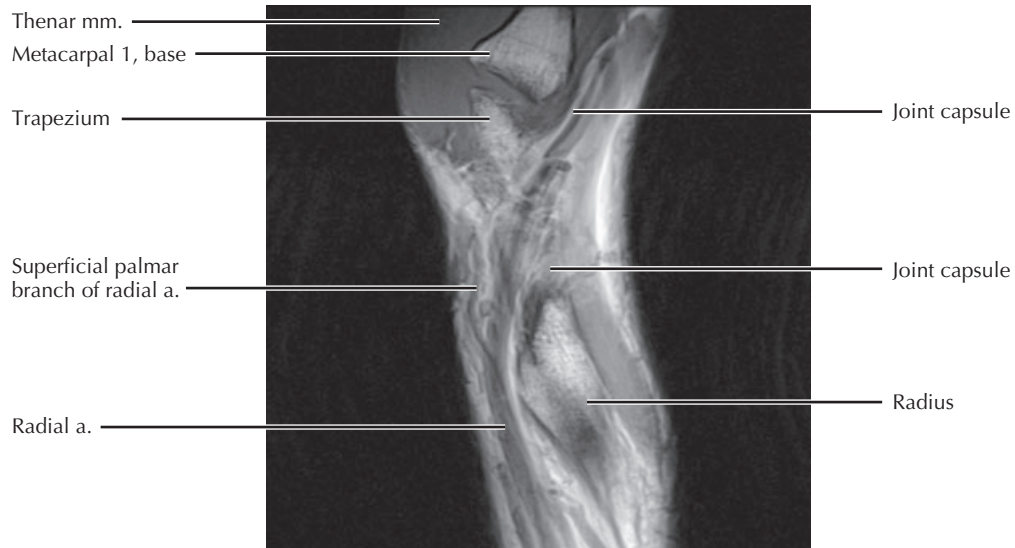
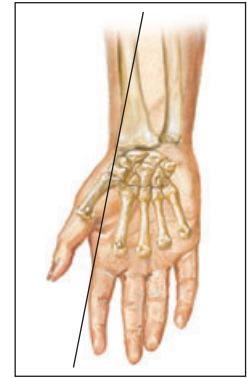


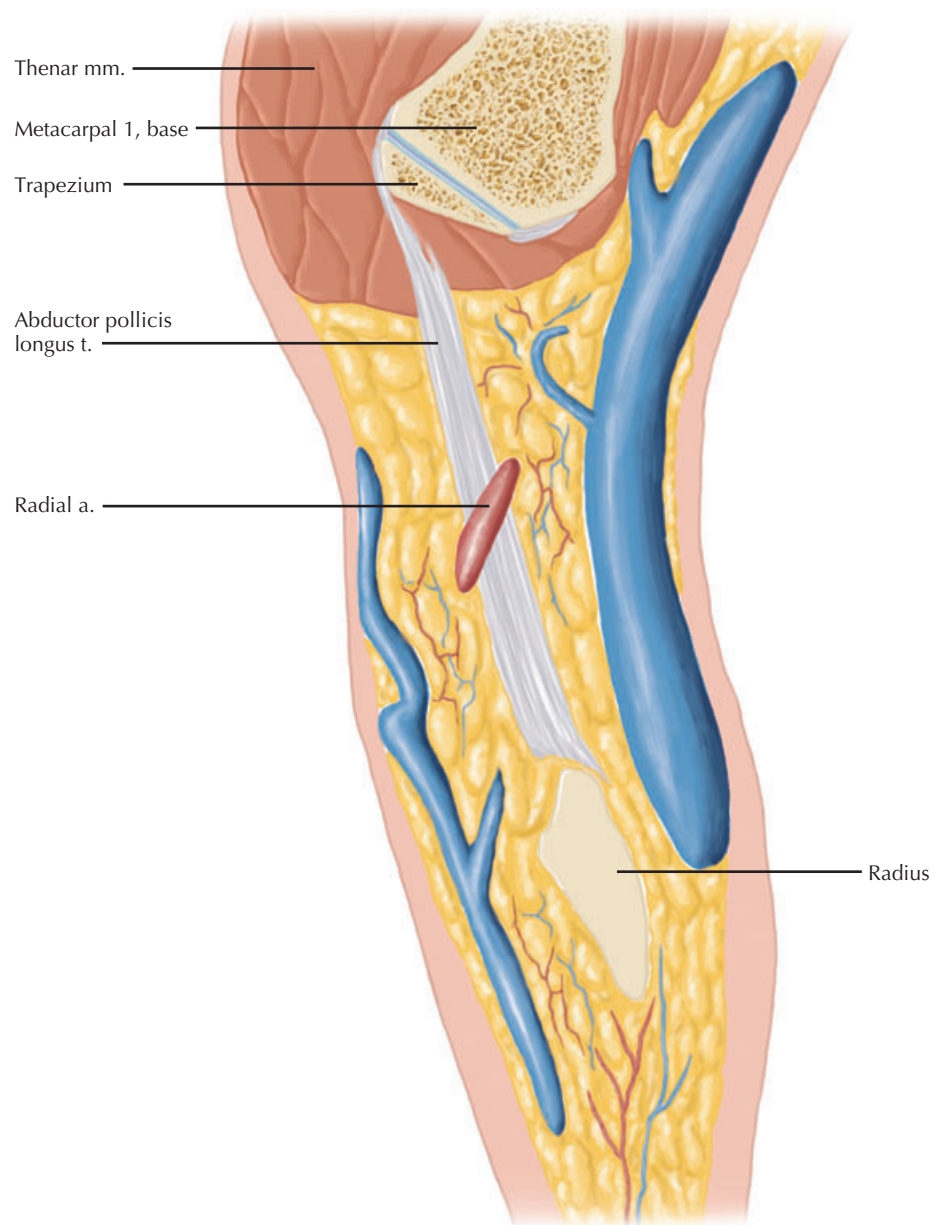


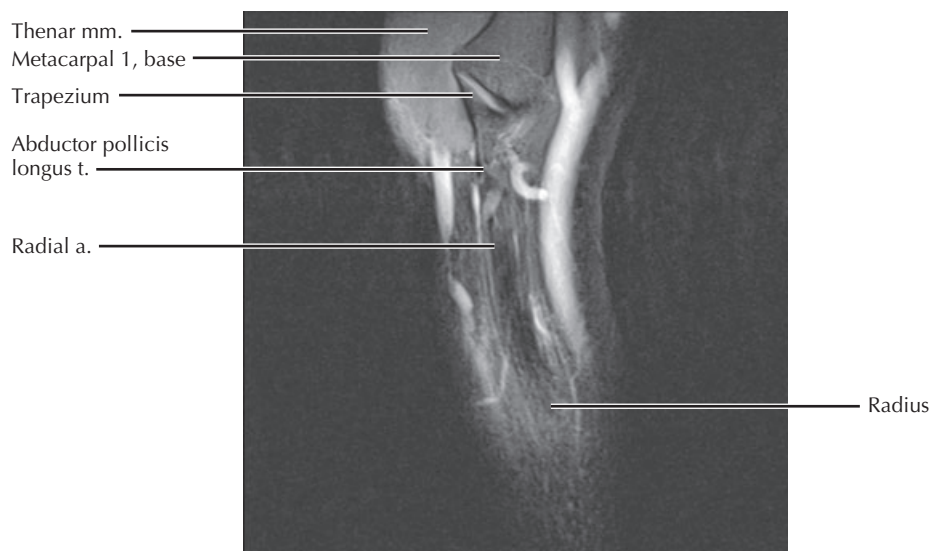
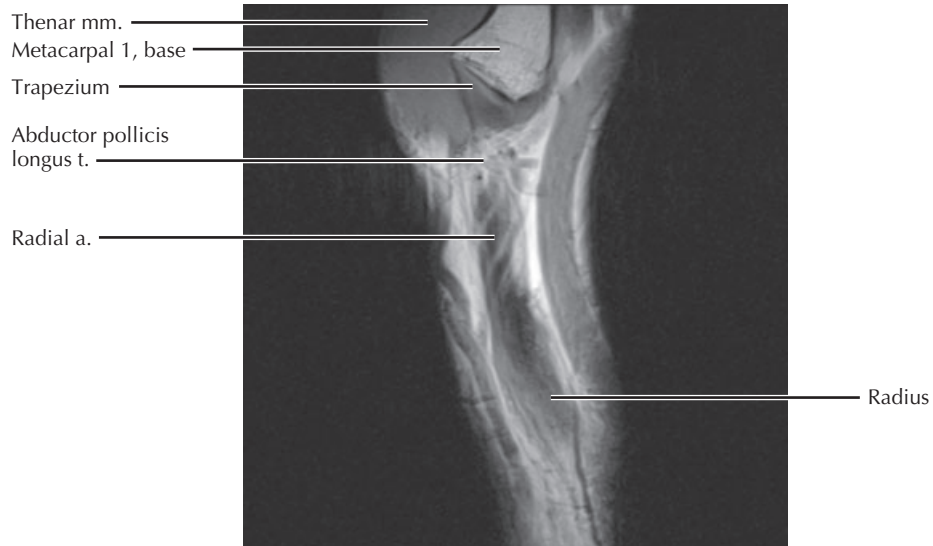
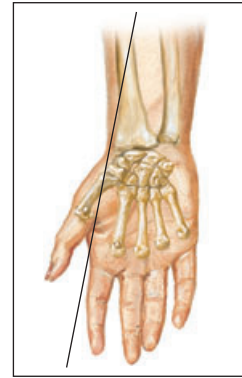










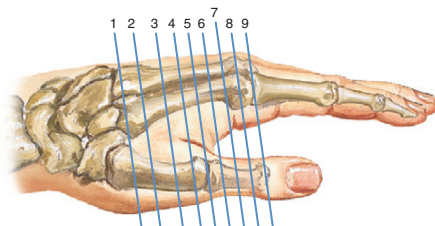


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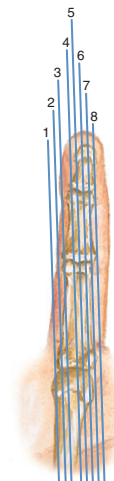
Chapter

7

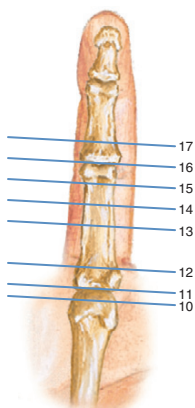
HAND AND FINGER



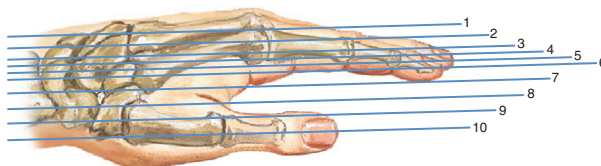
AXIAL—Hand 240



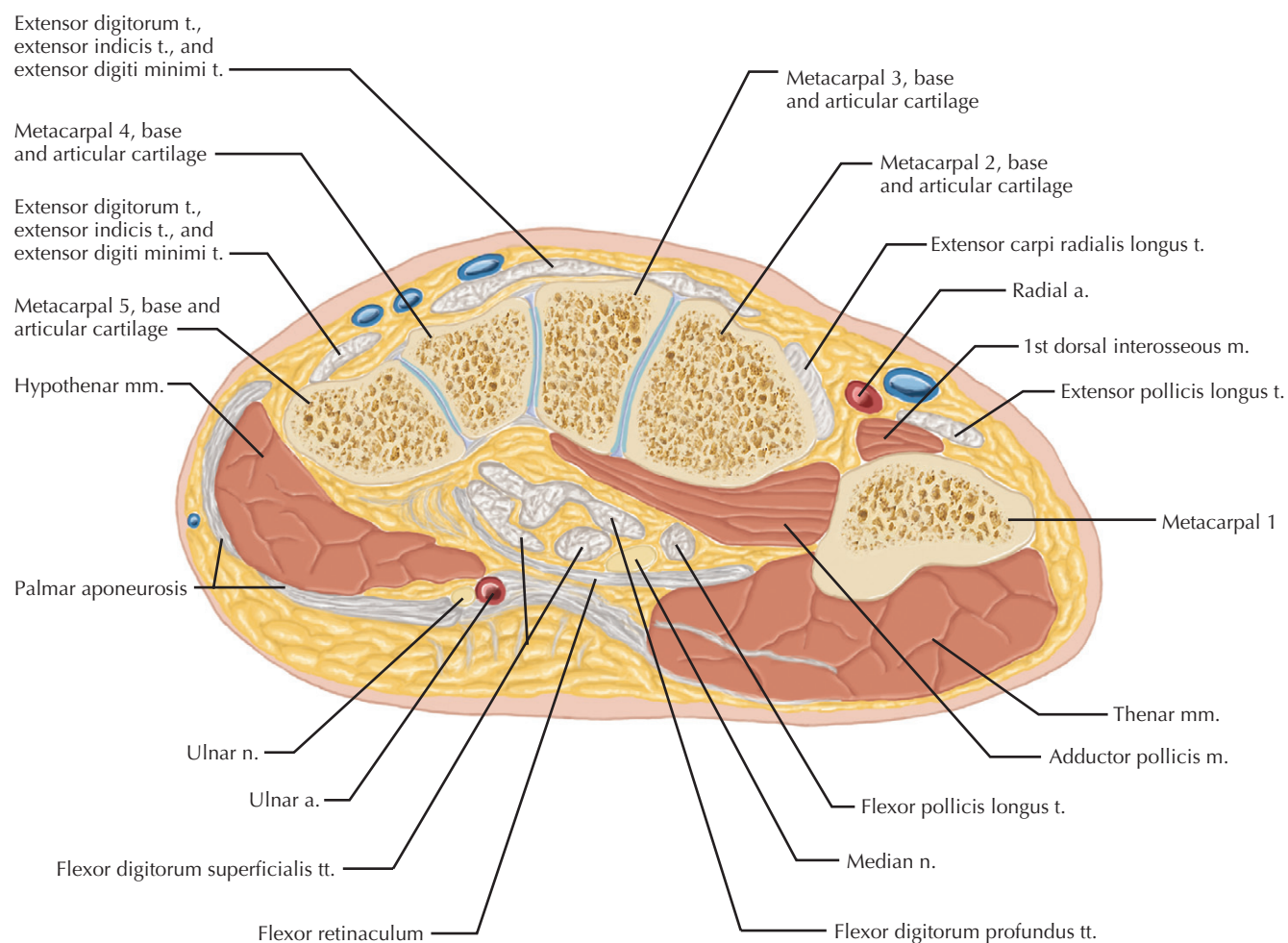
SAGITTAL 286

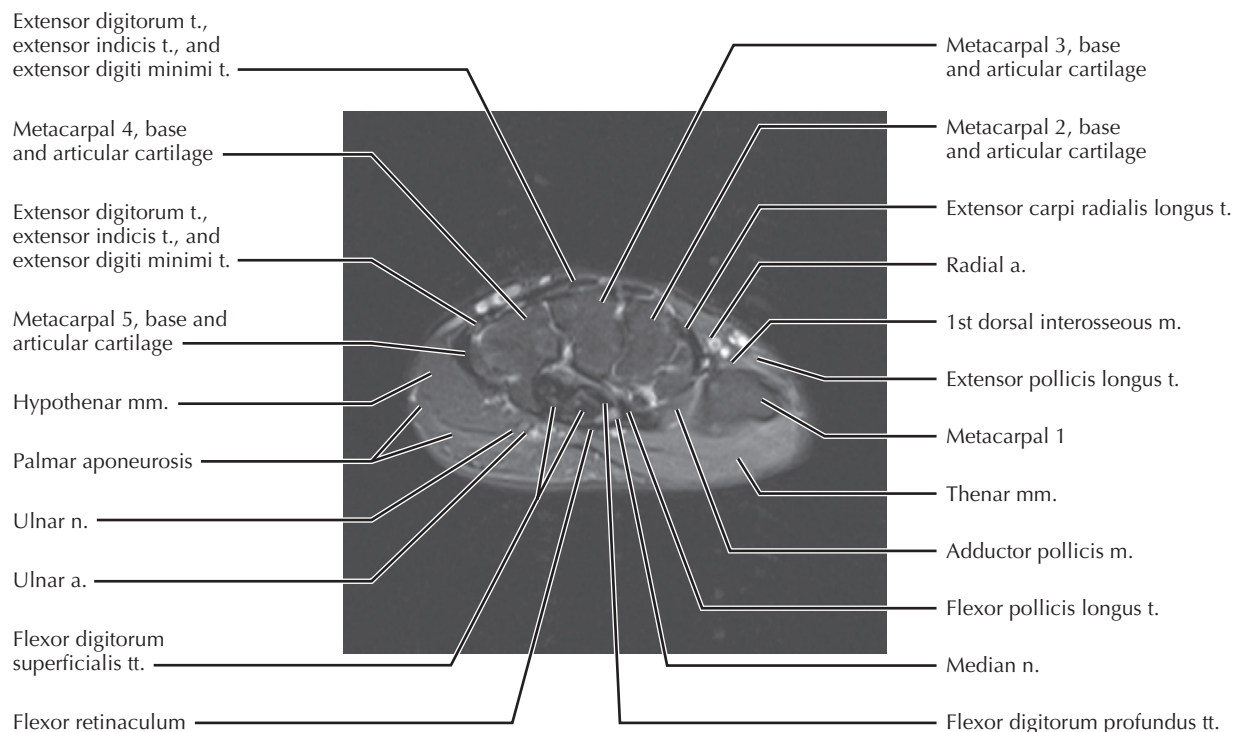
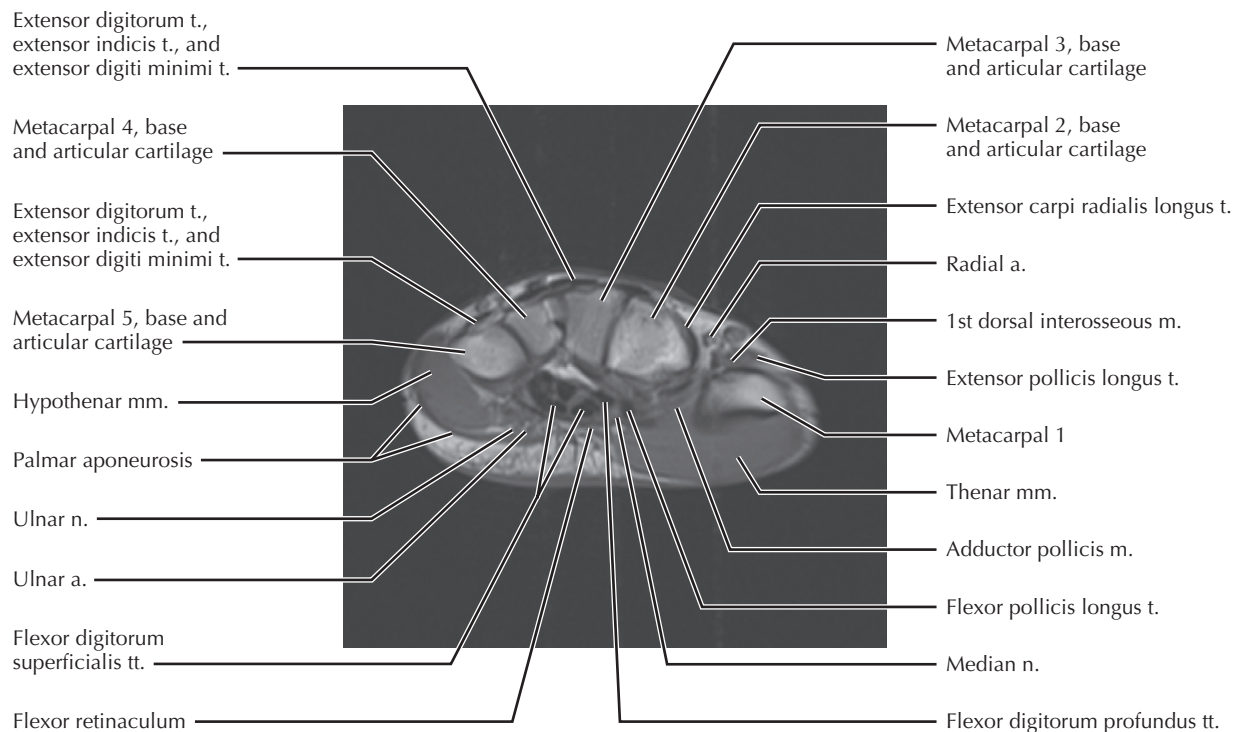
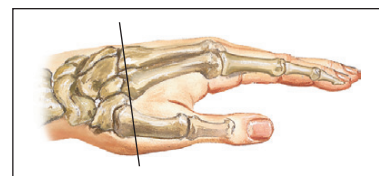


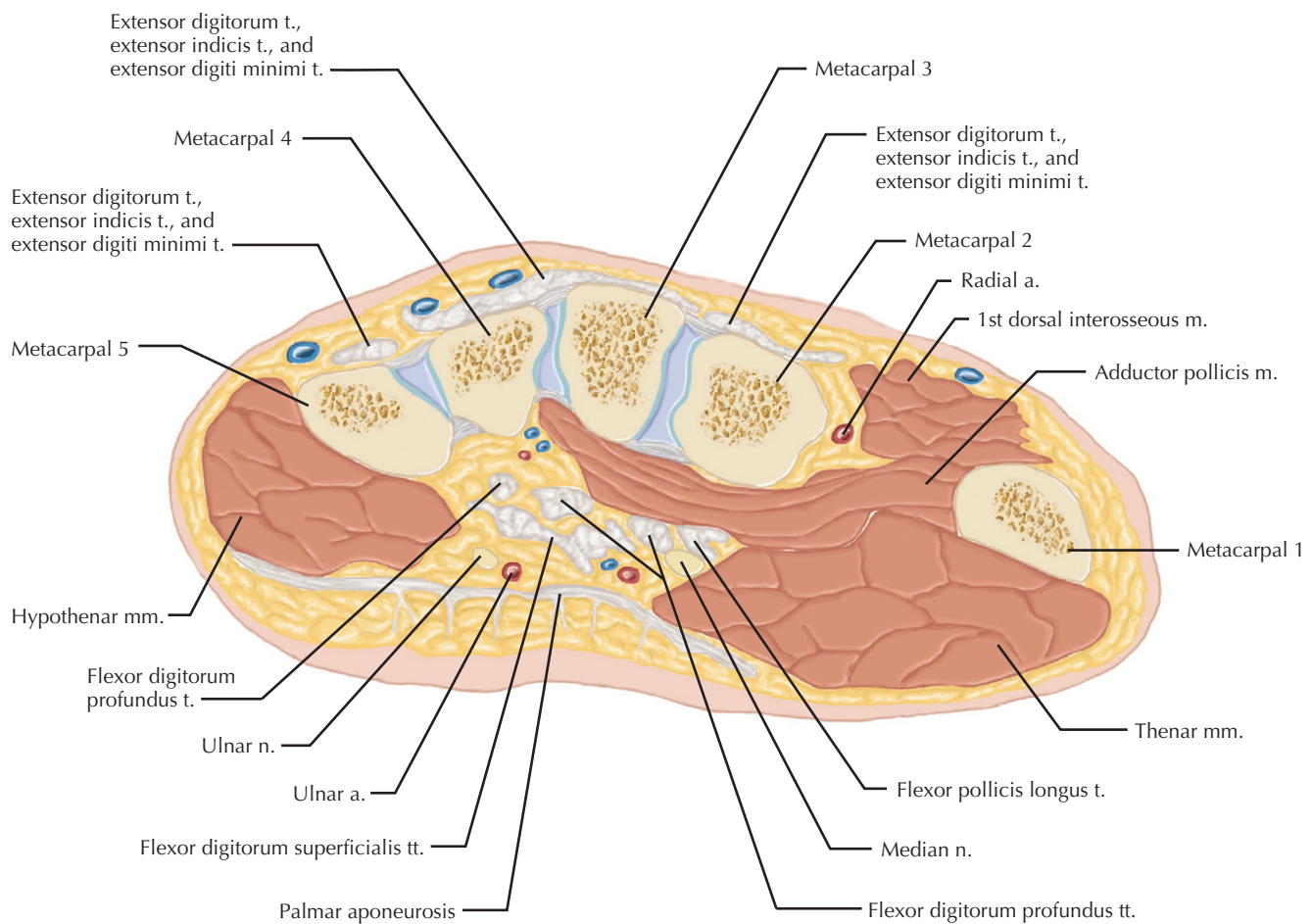
AXIAL—Finger 258

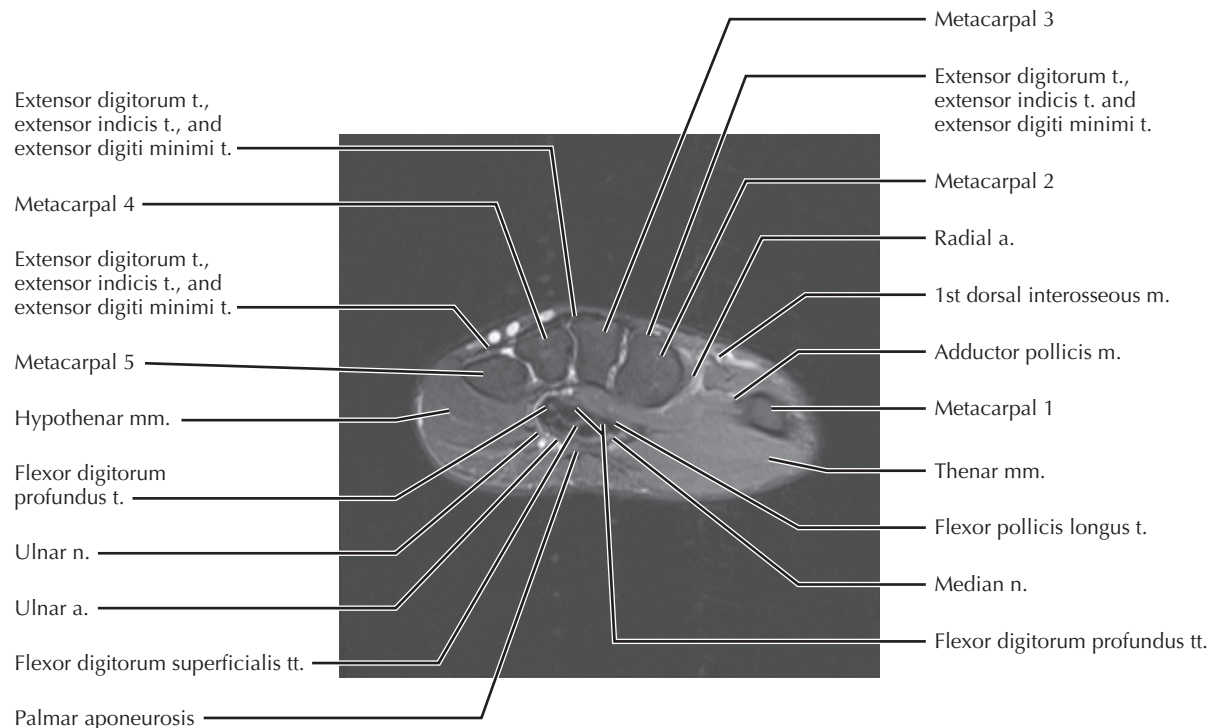
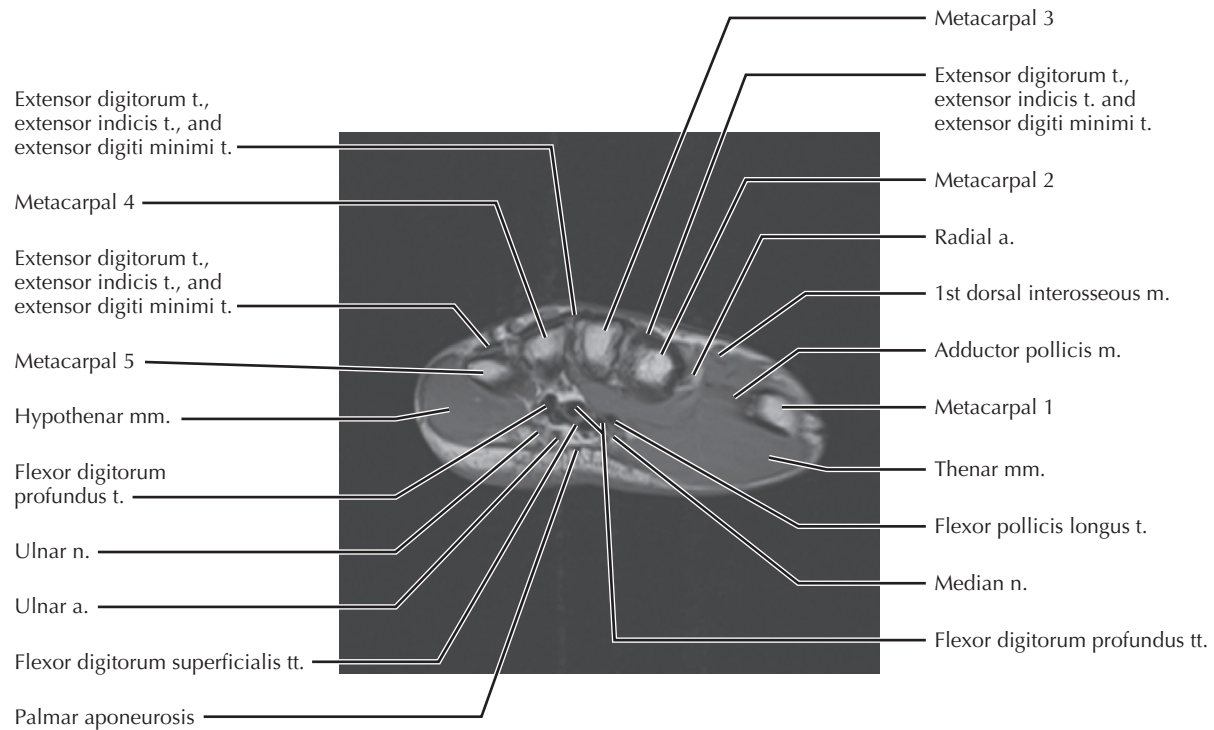
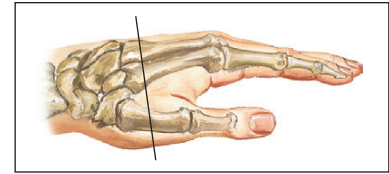


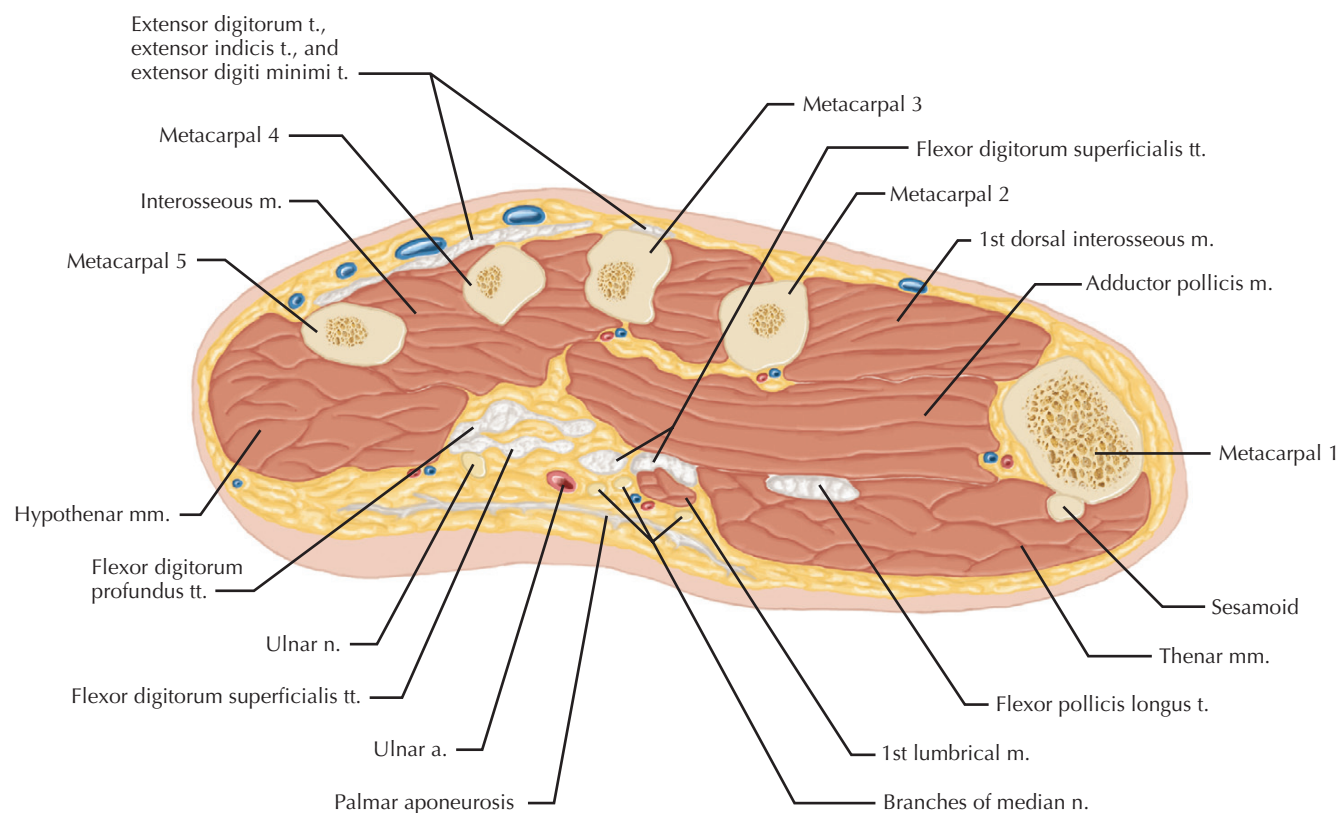
CORONAL 266

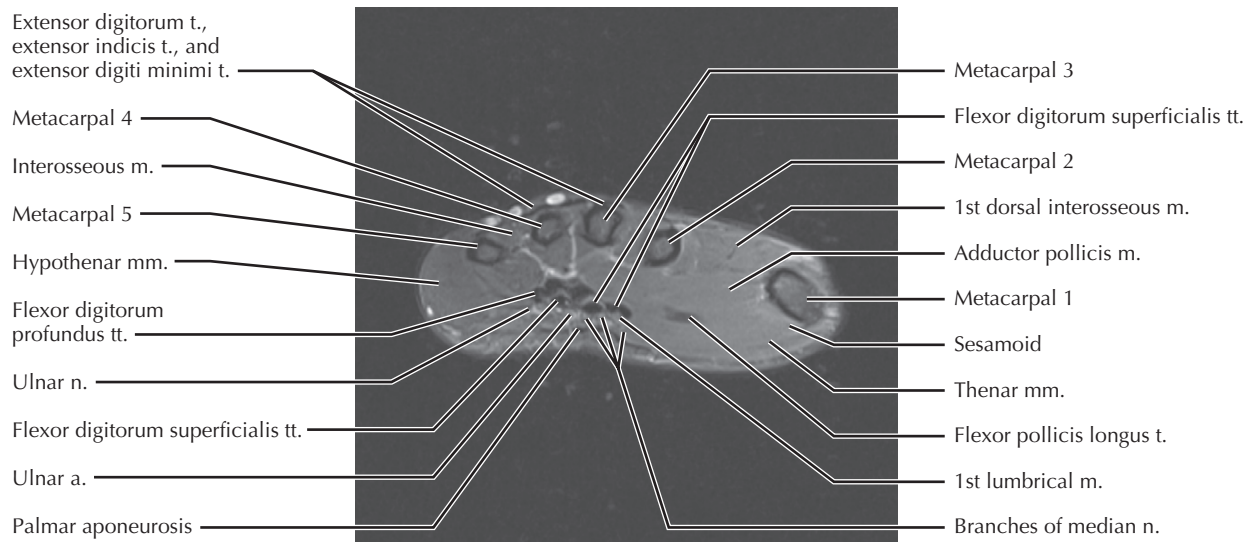
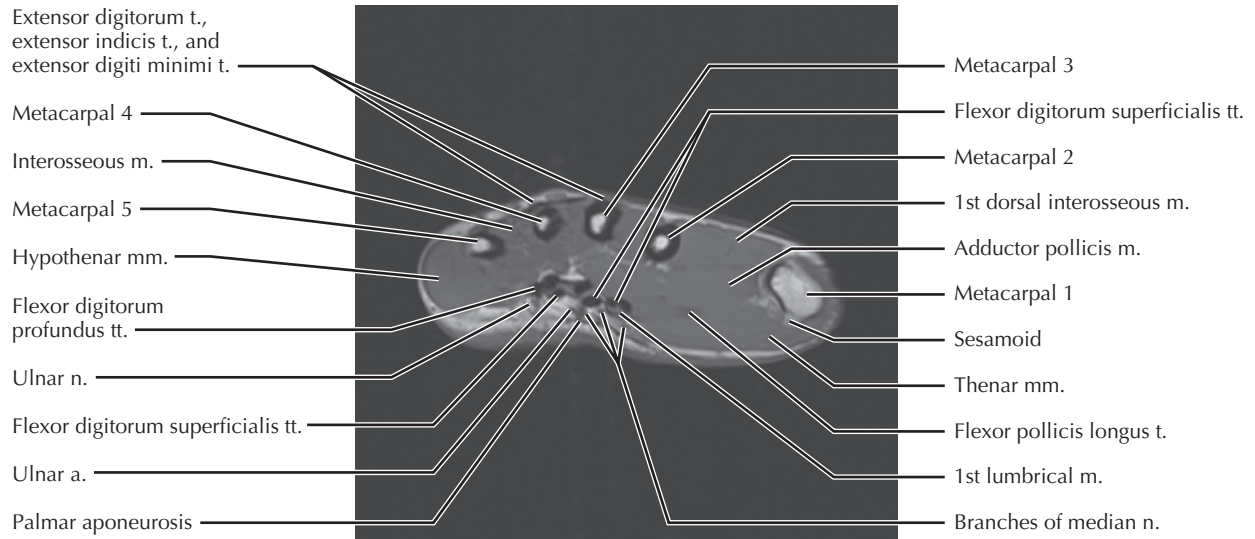
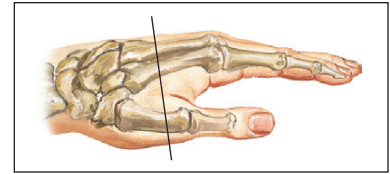


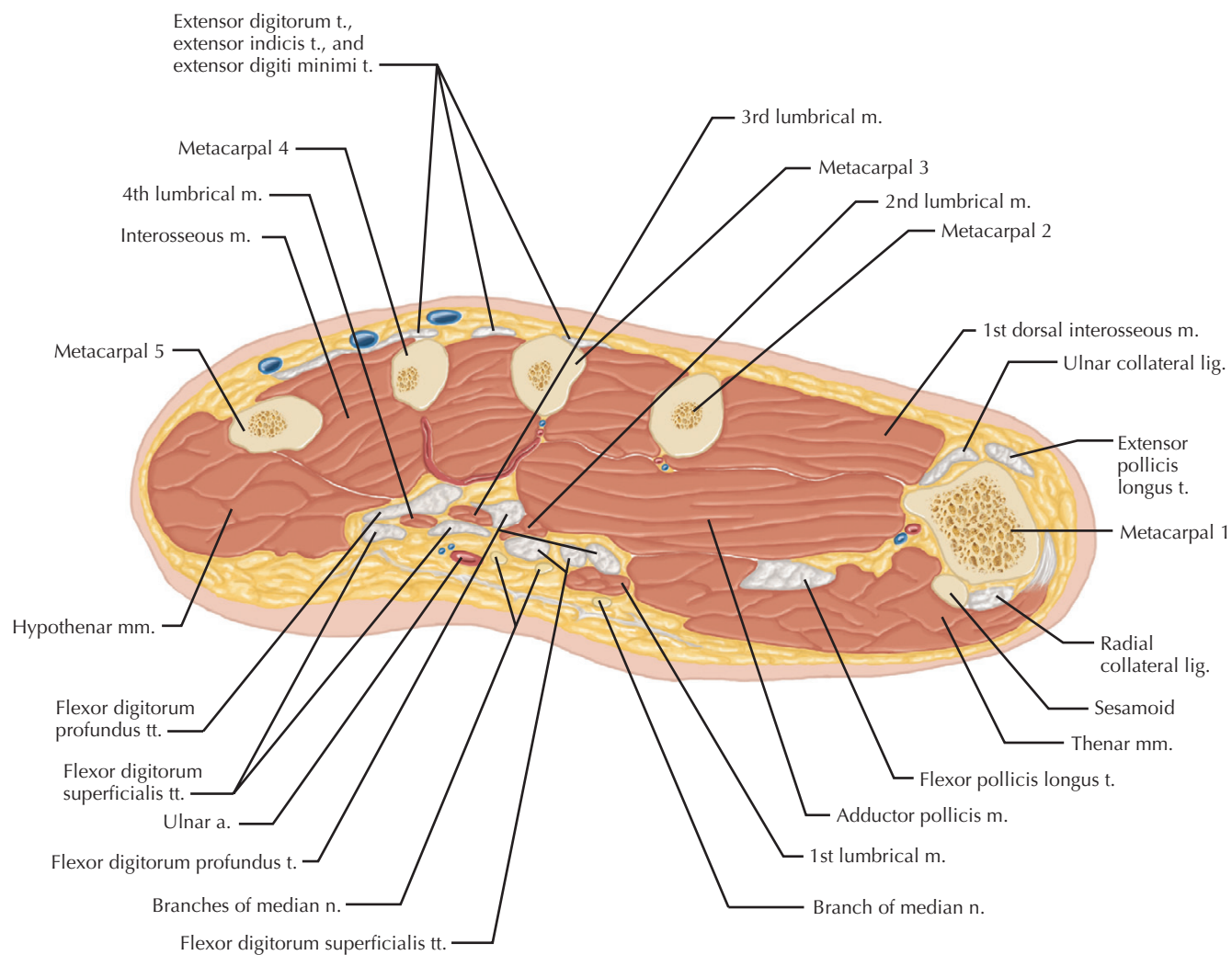


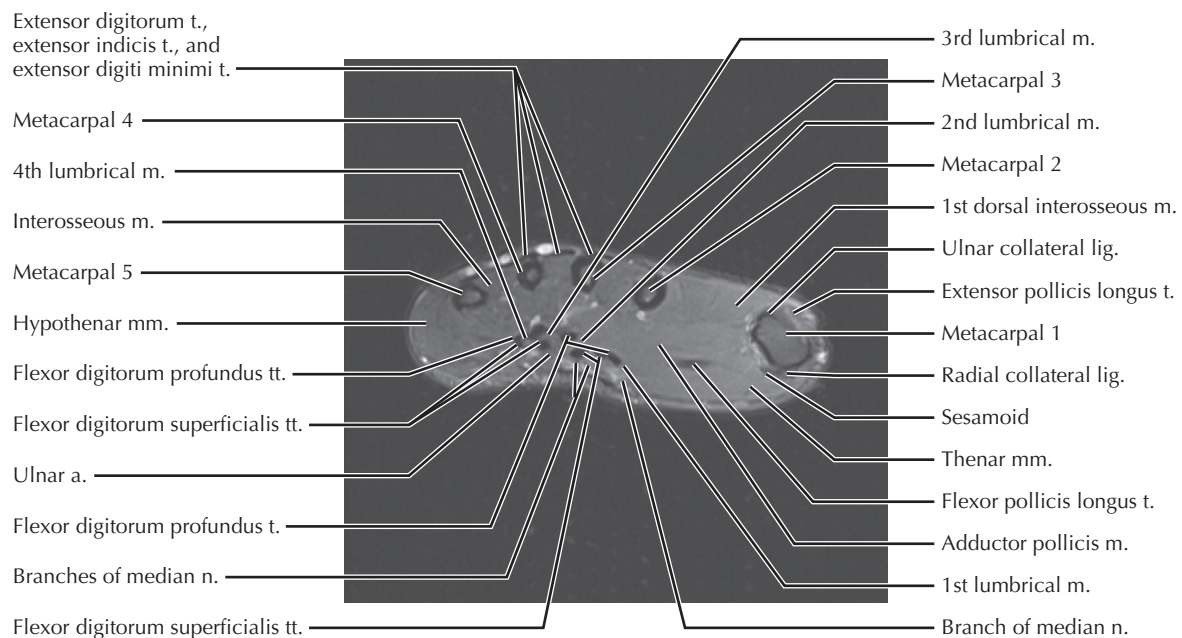
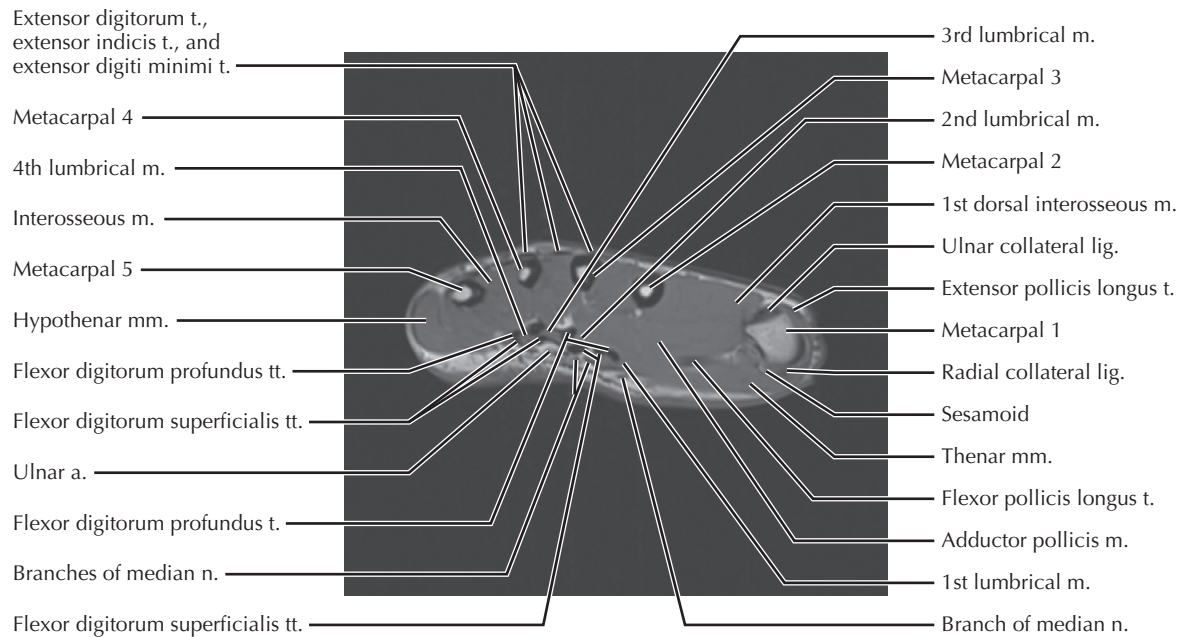
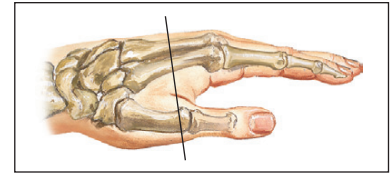


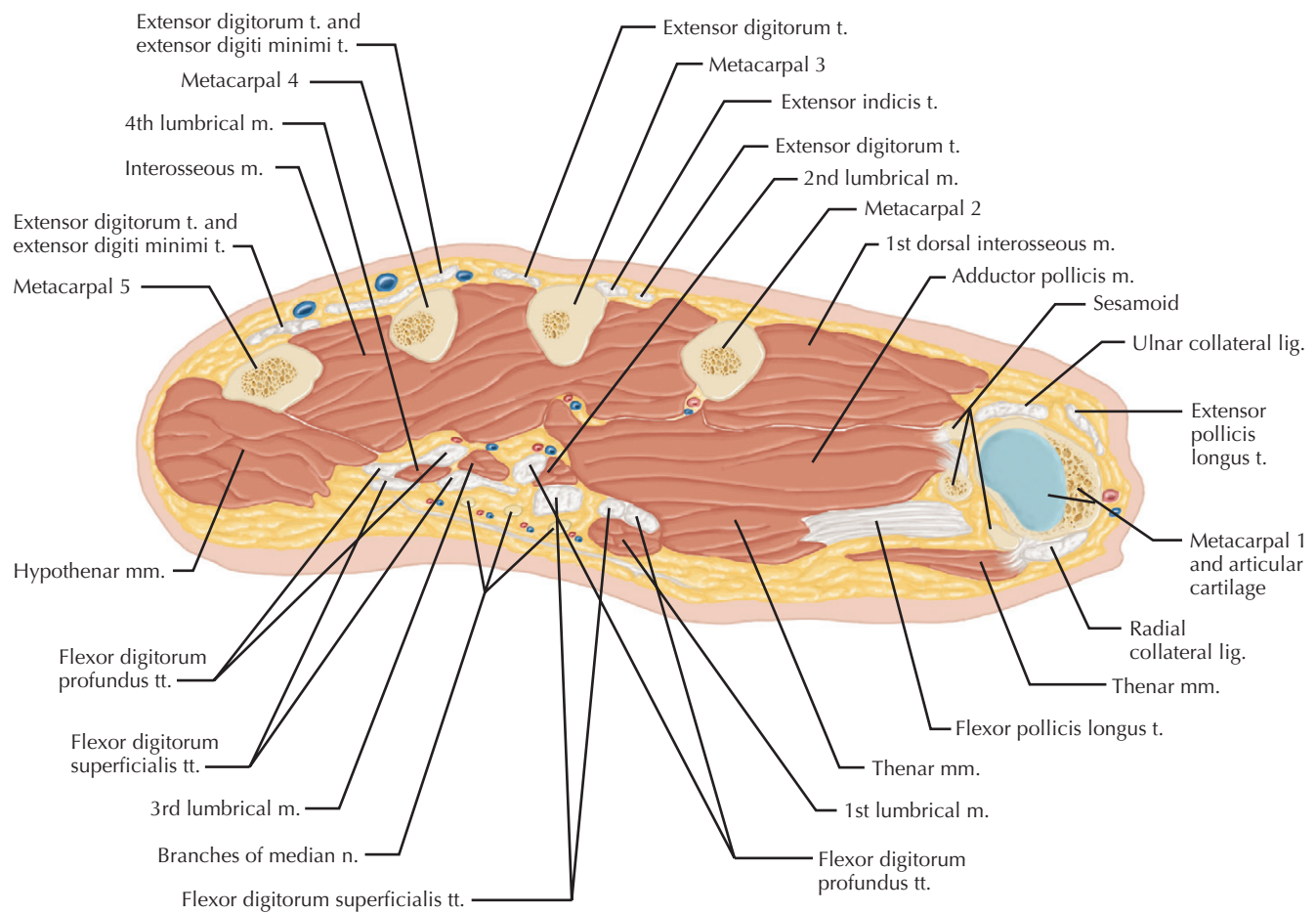


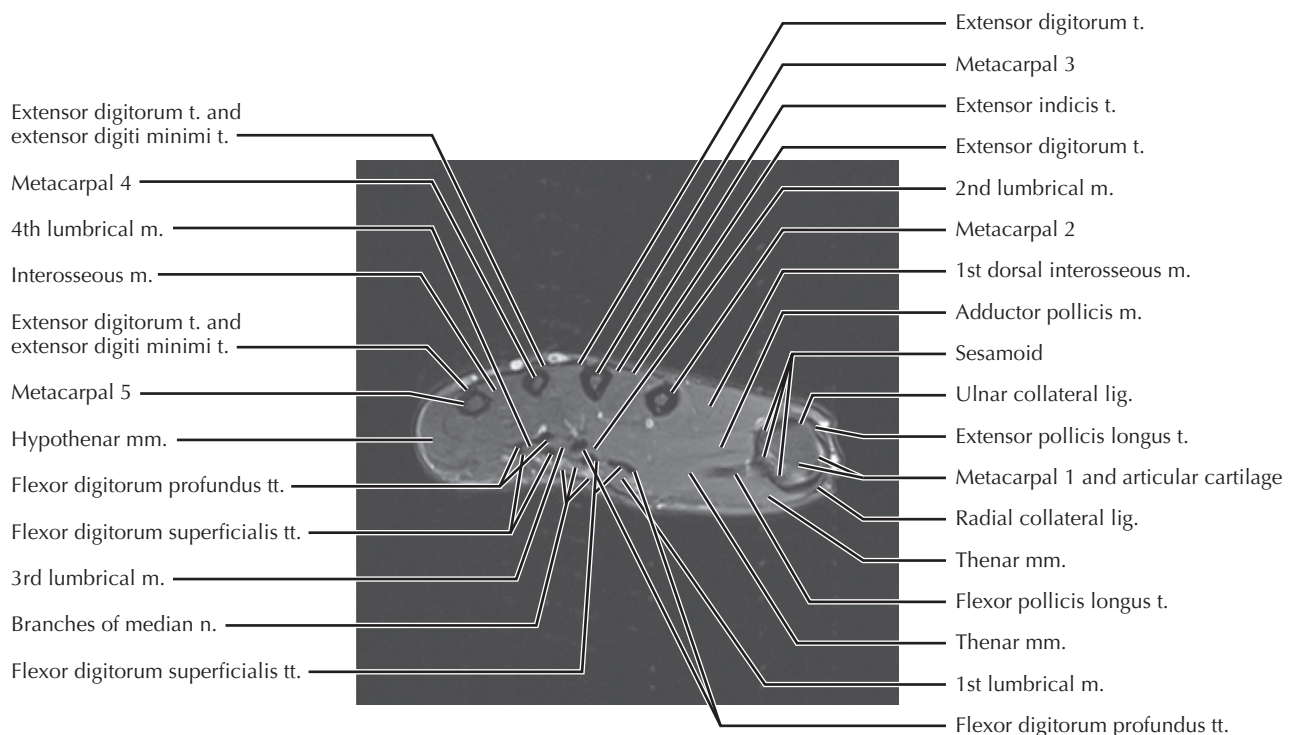
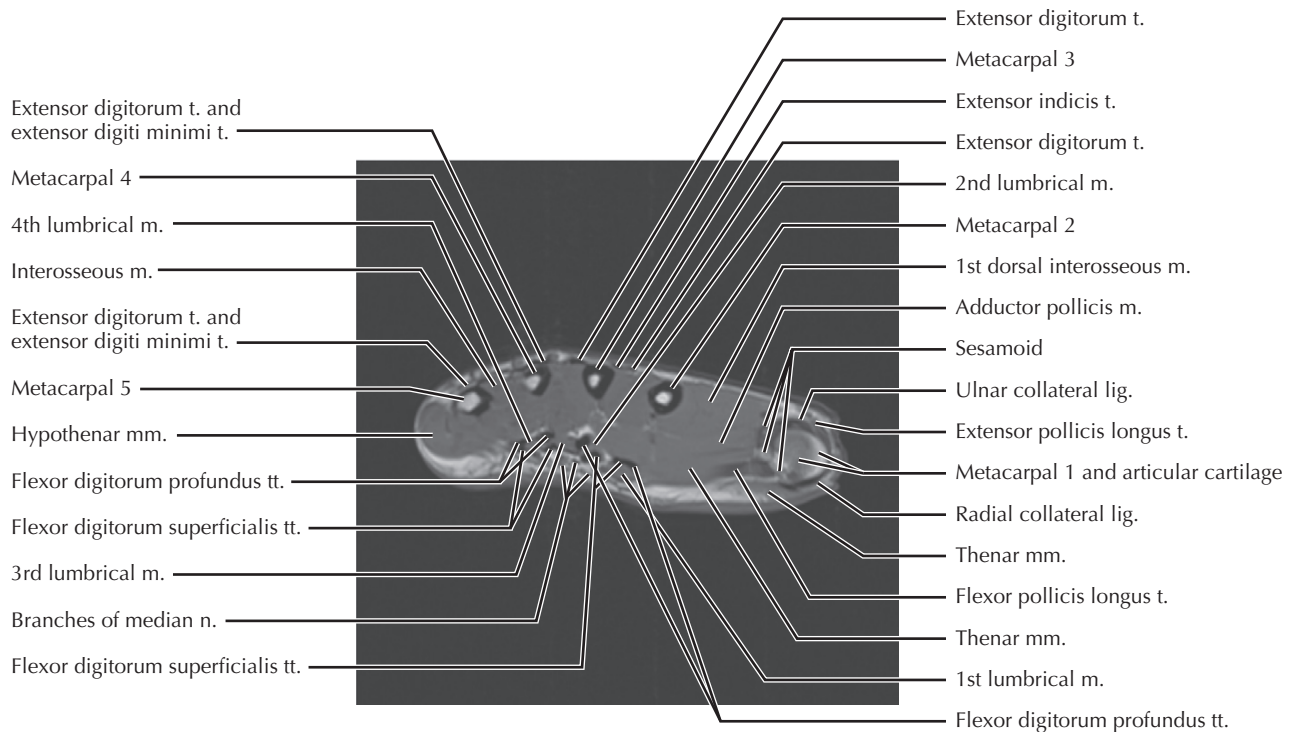
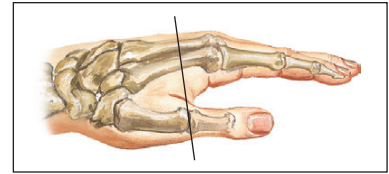


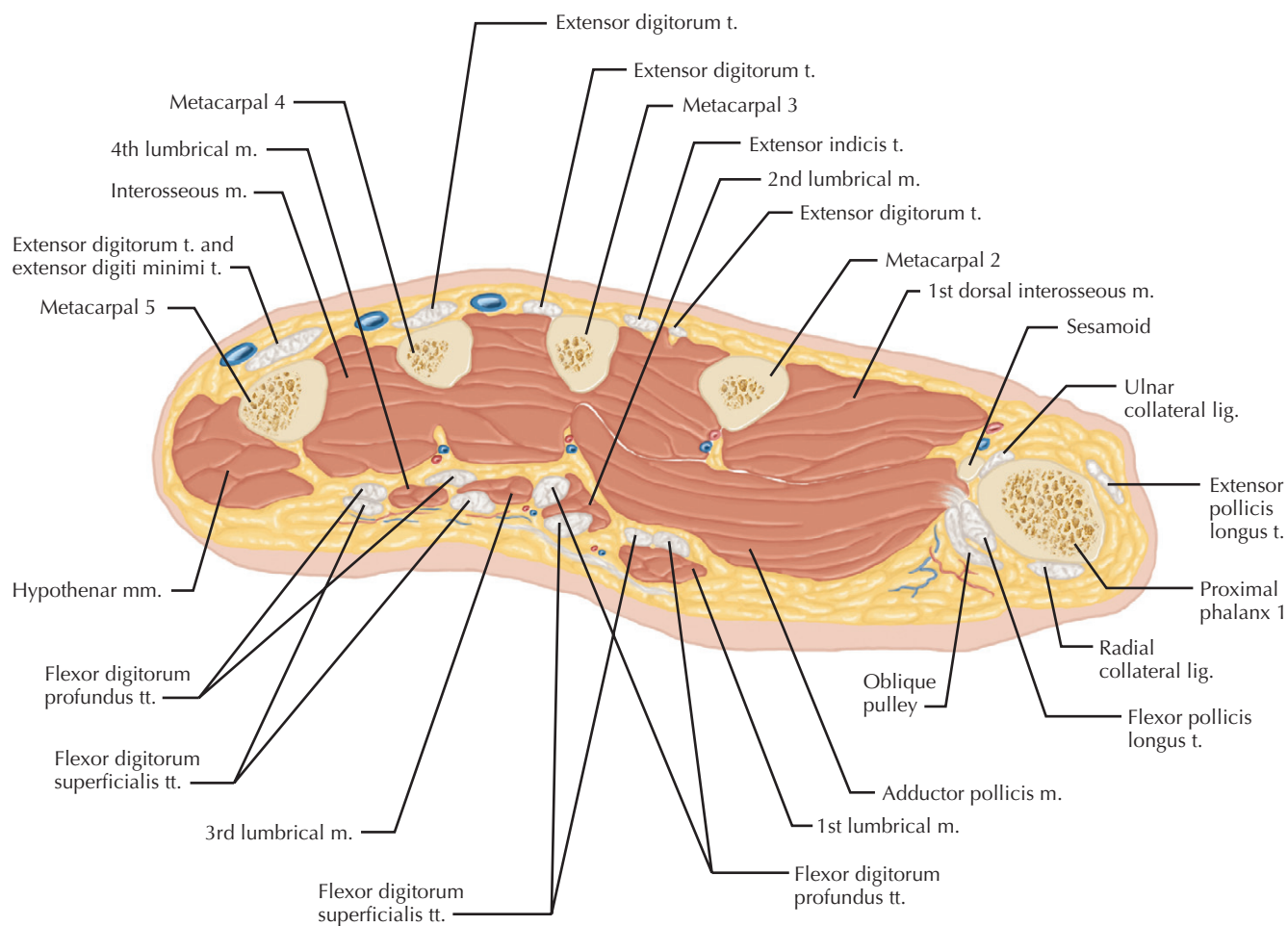


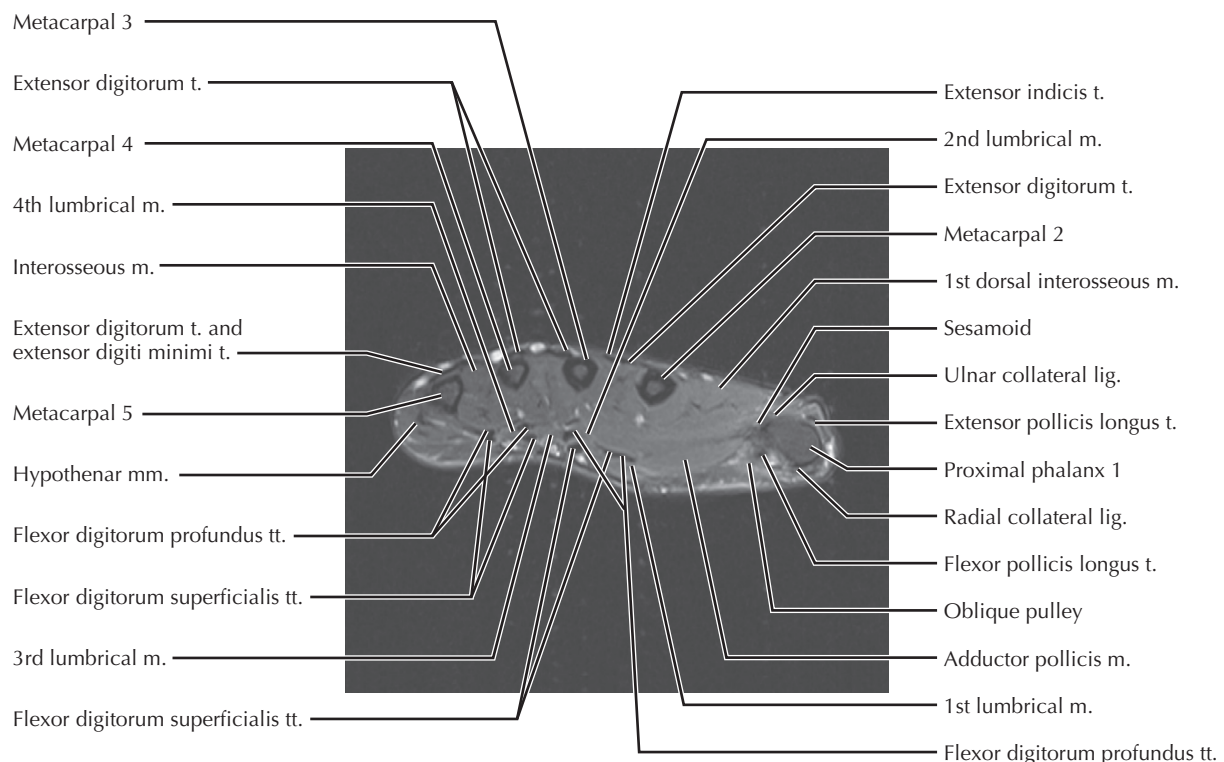
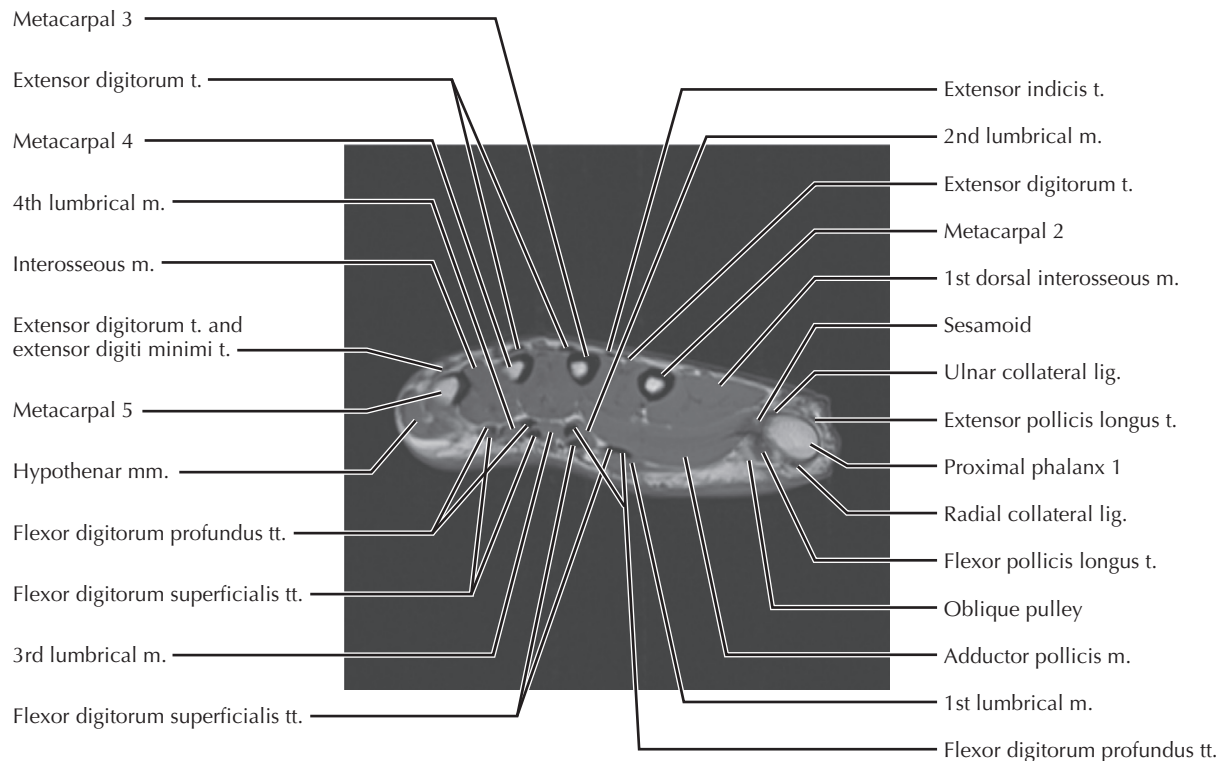
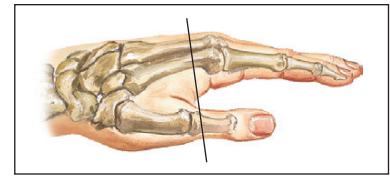


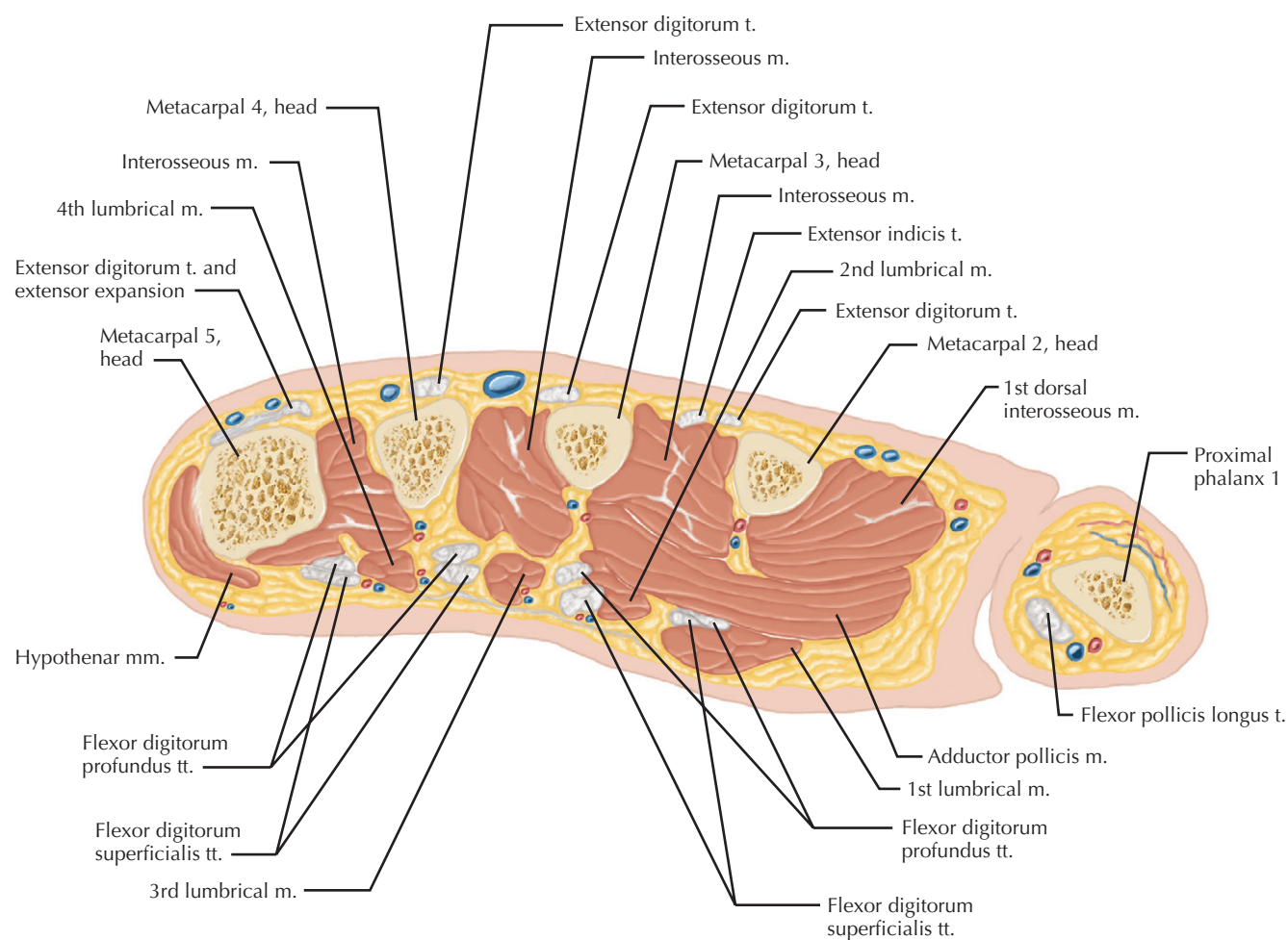


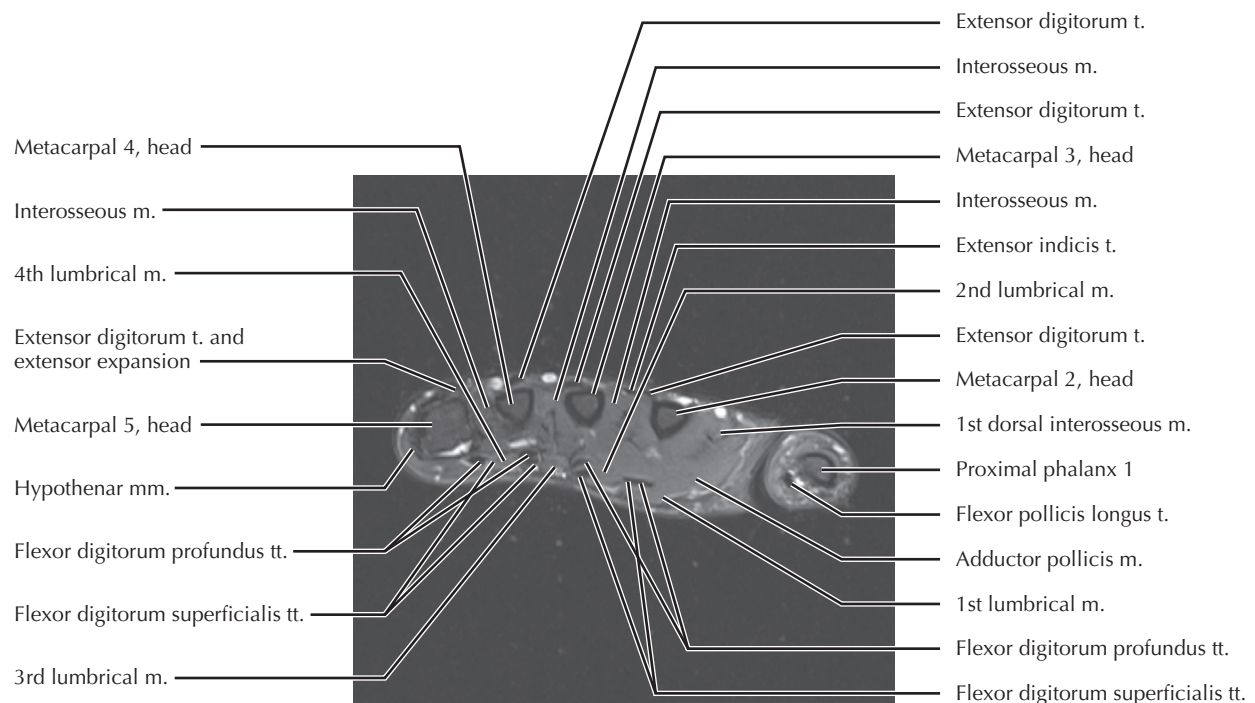
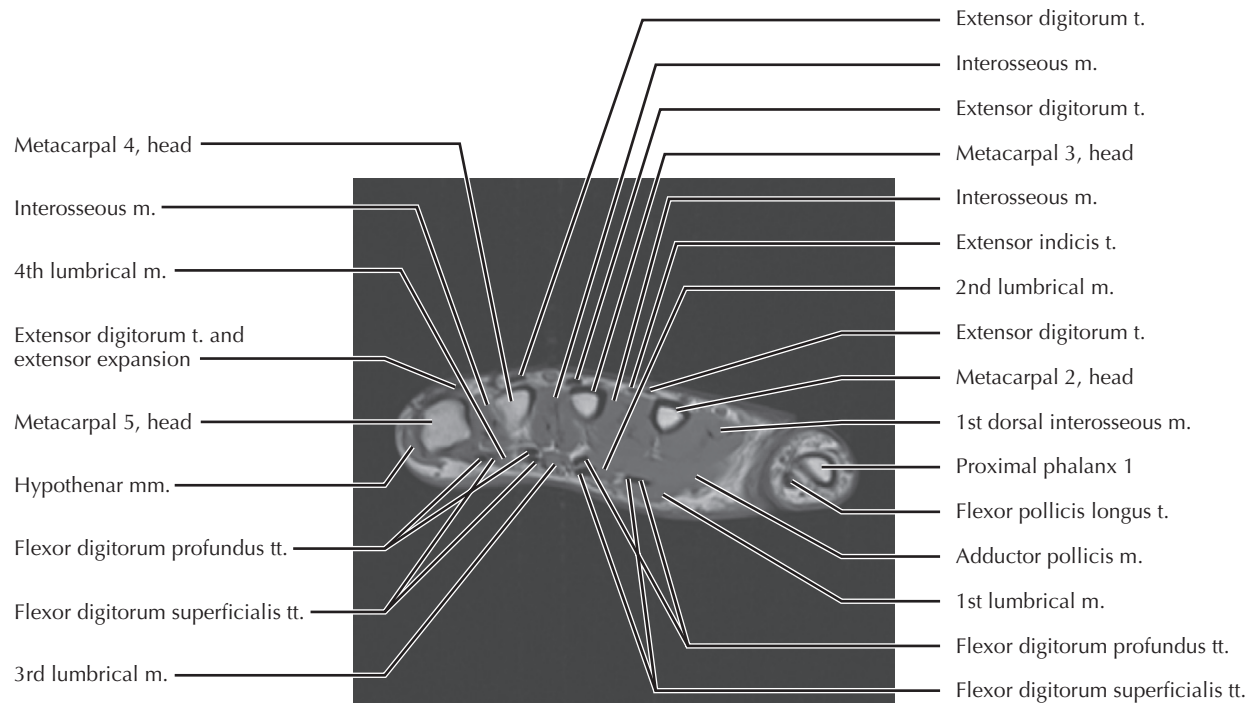
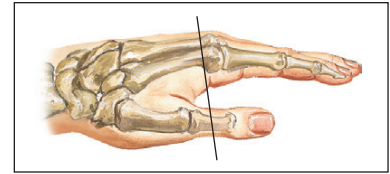


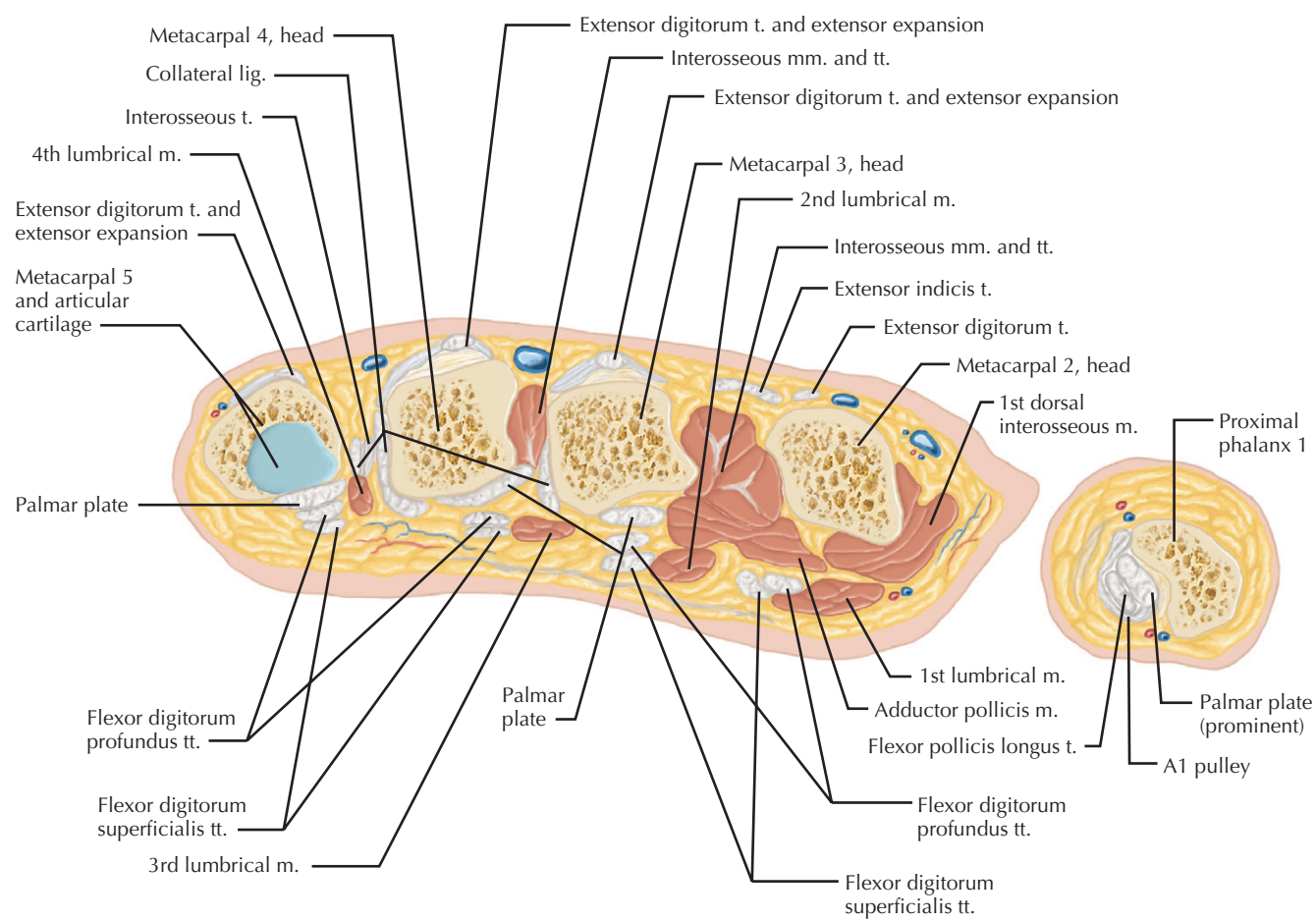


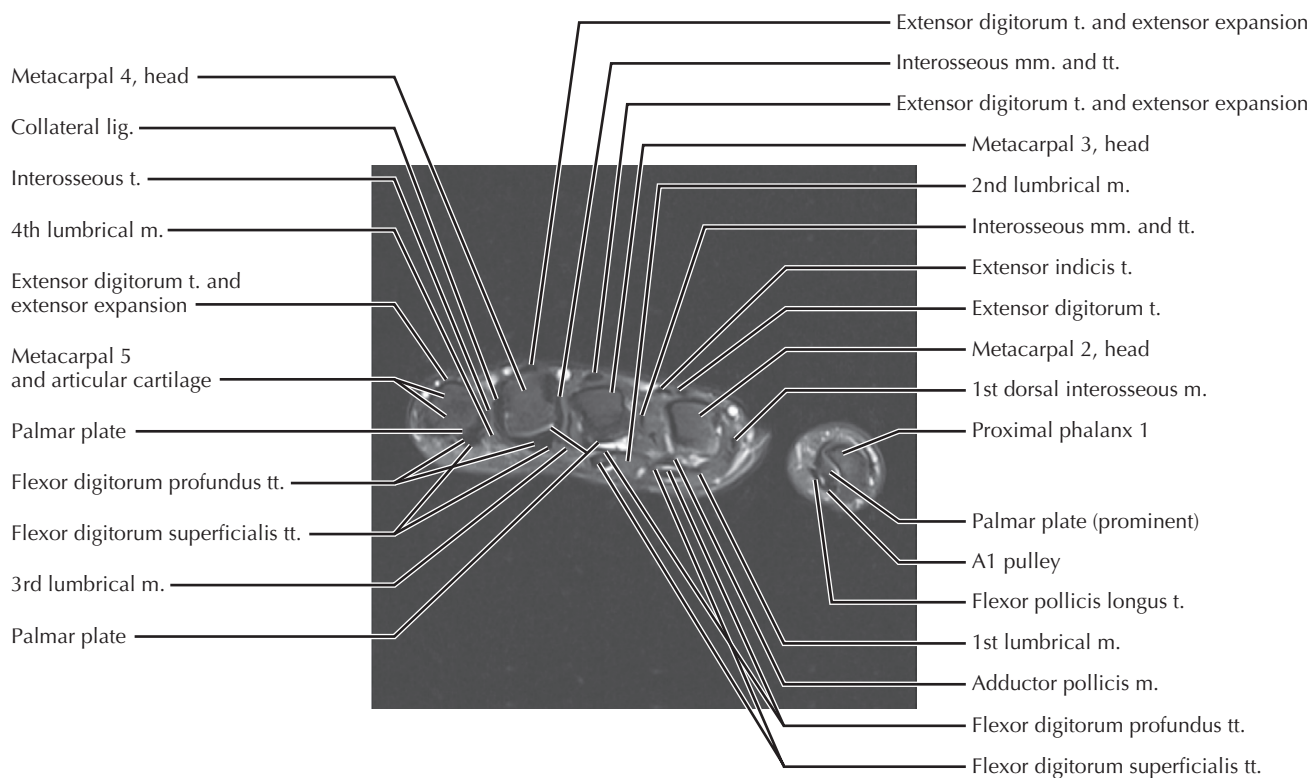
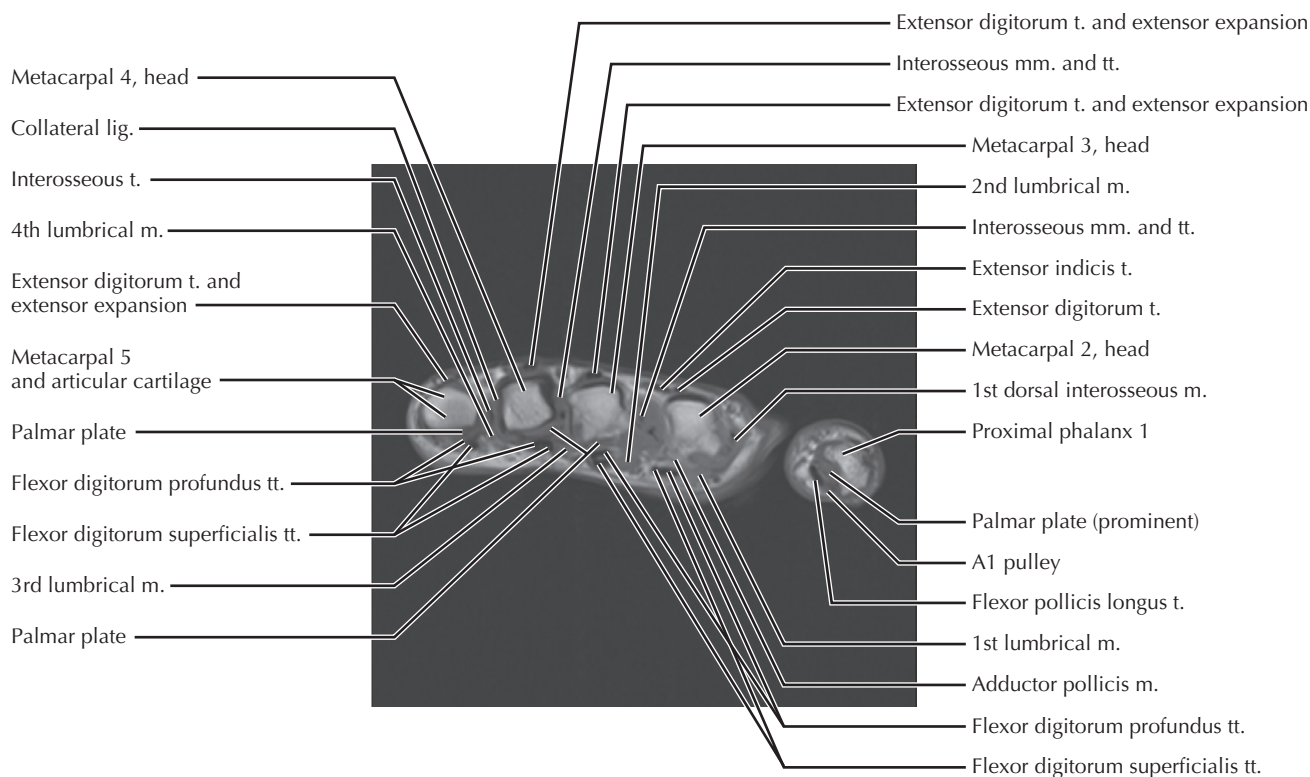
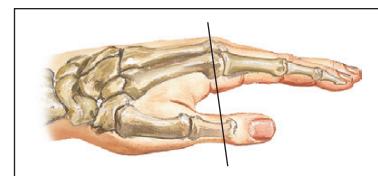


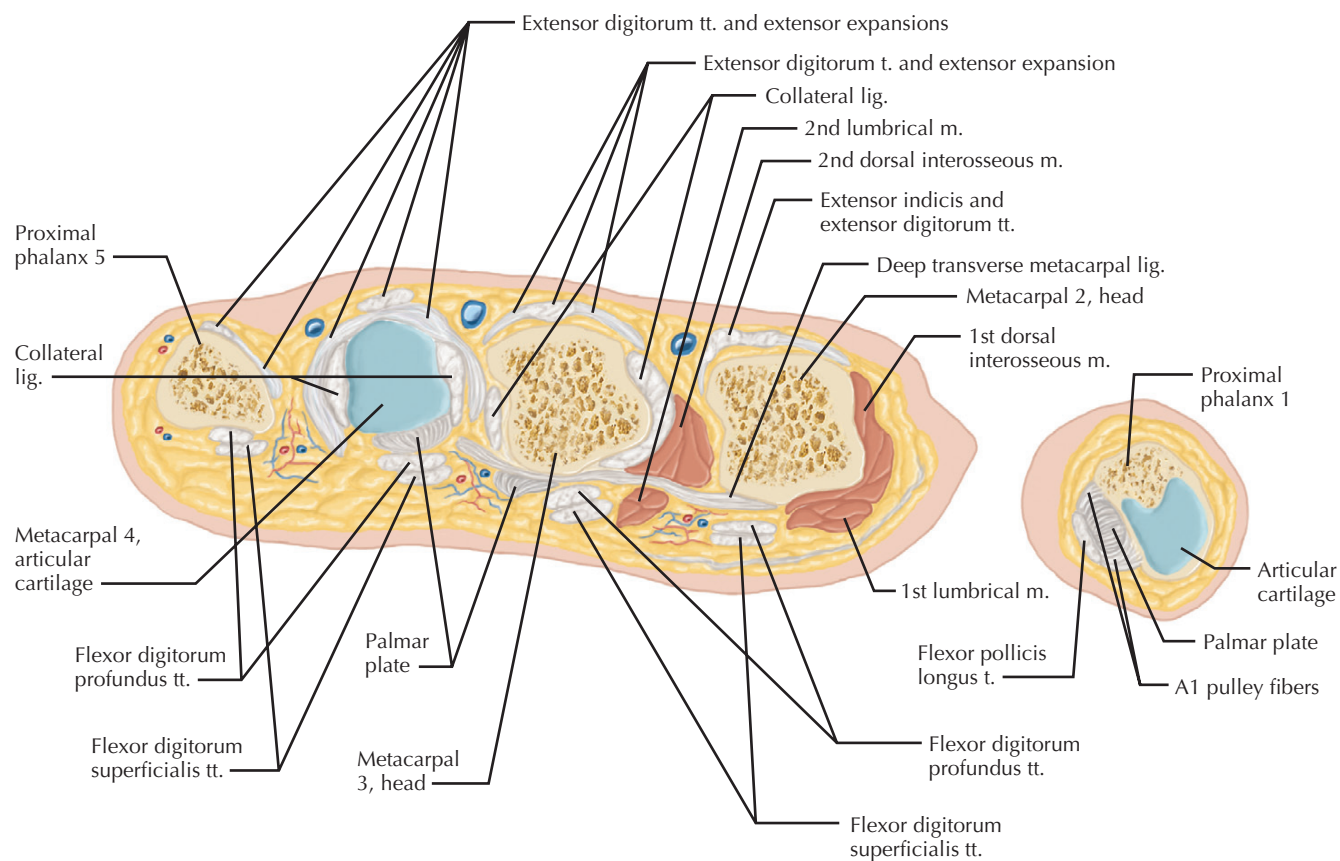


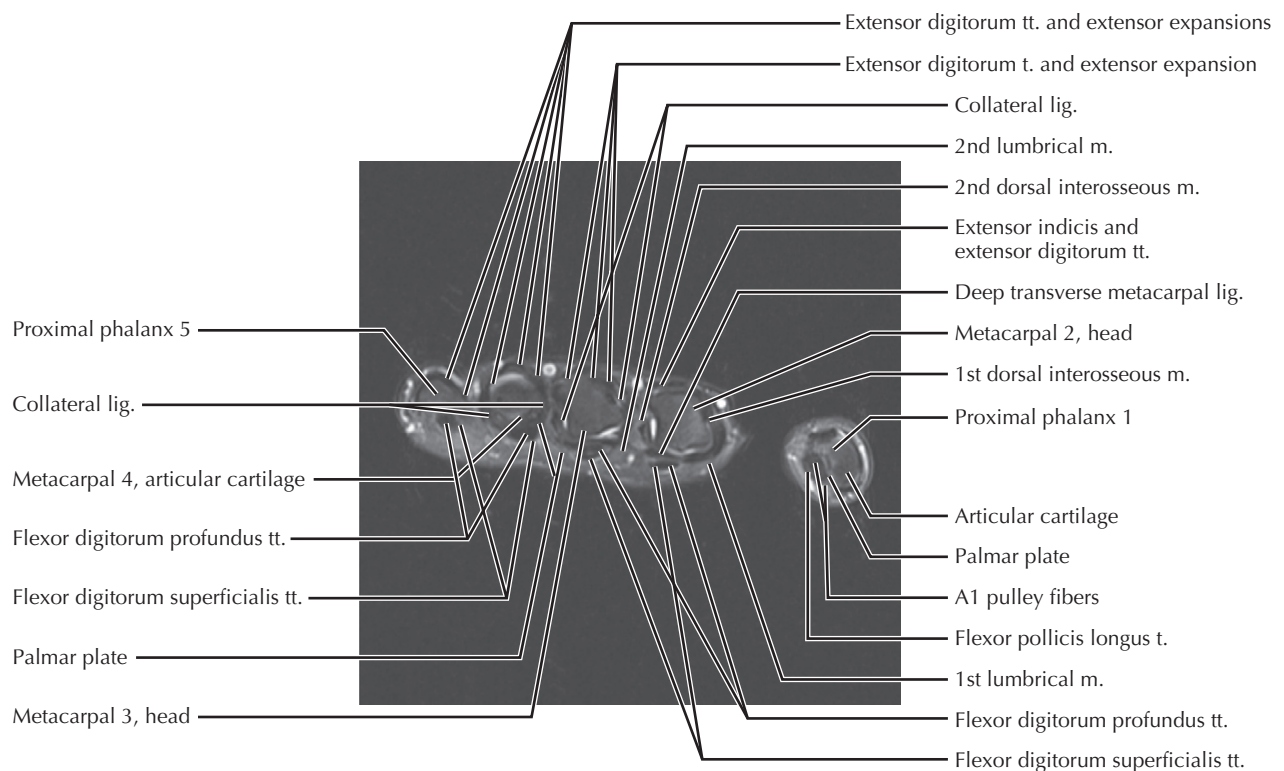
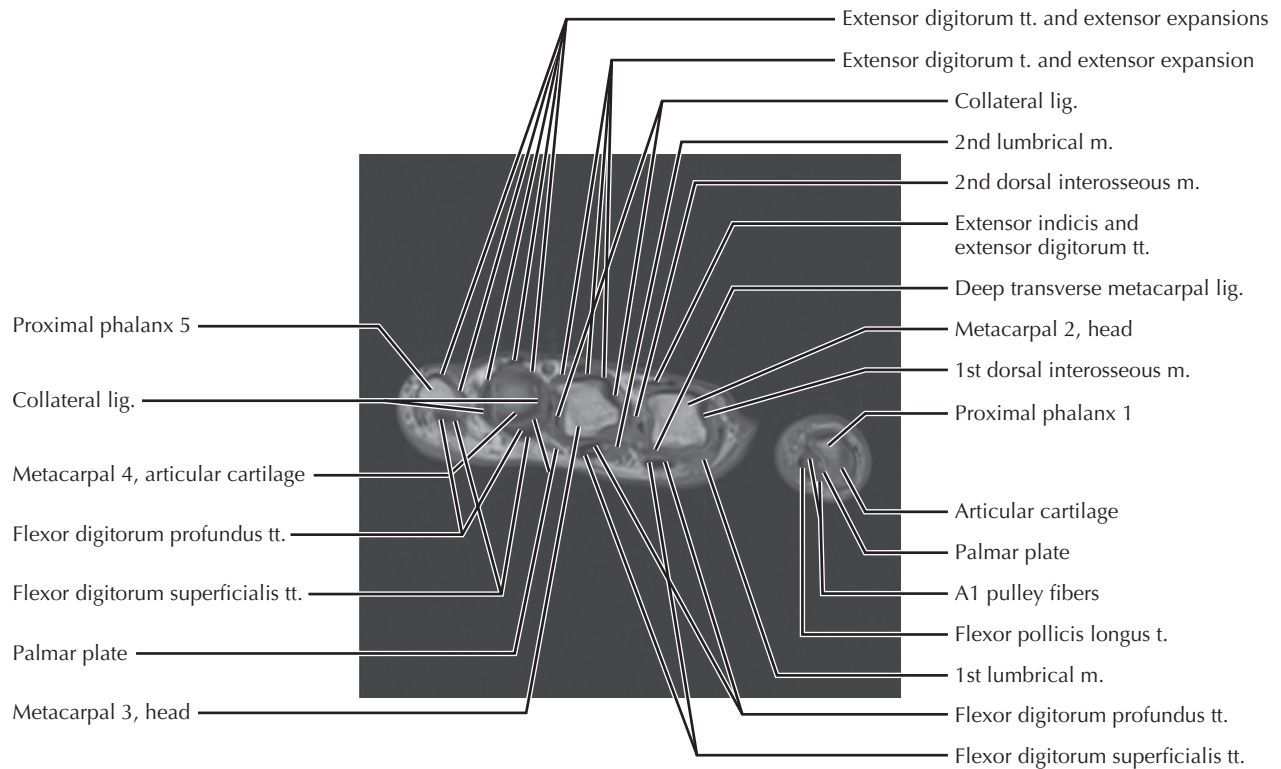
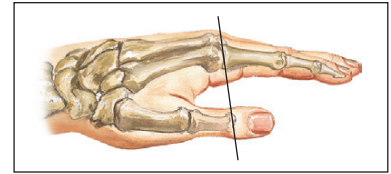


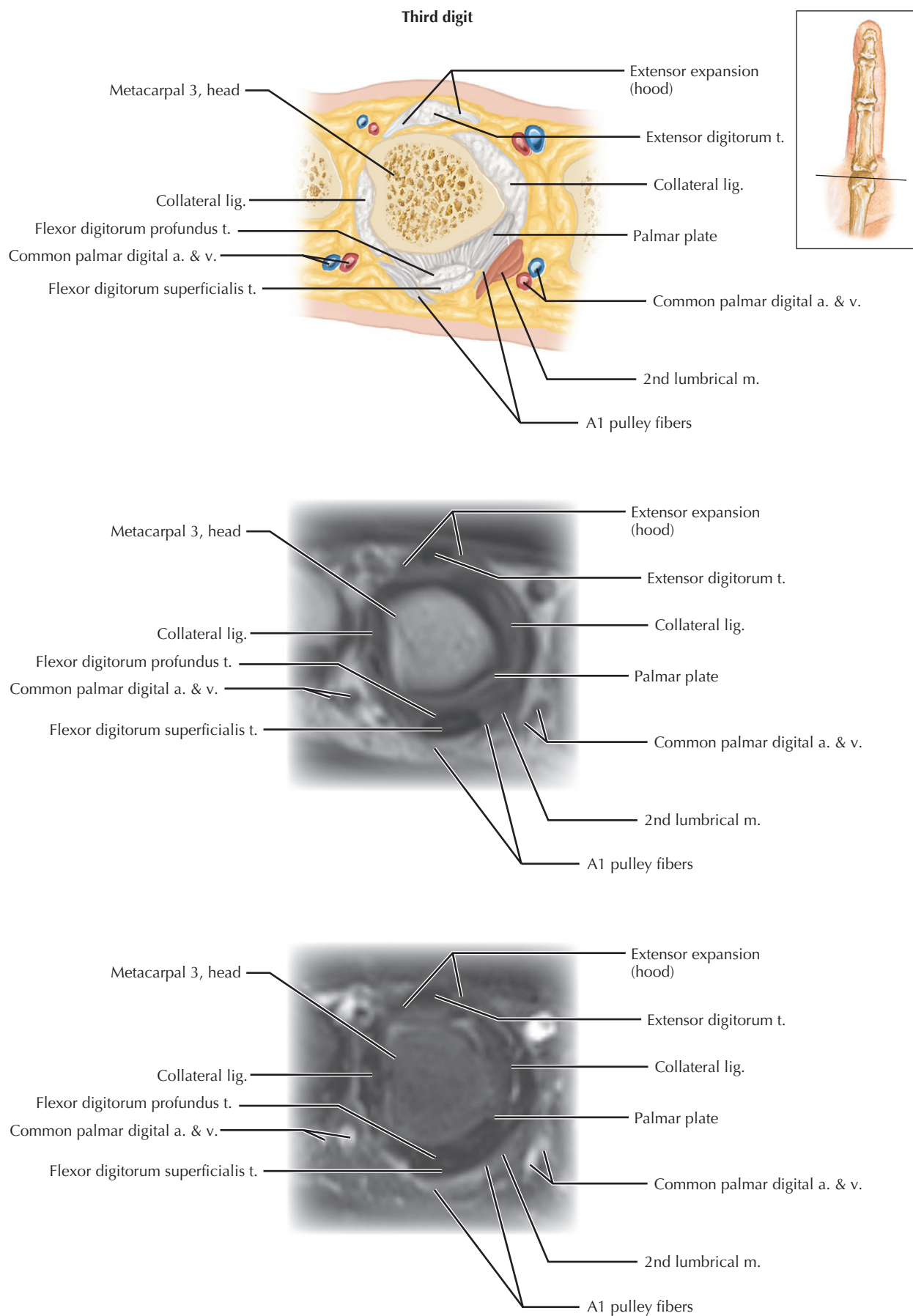


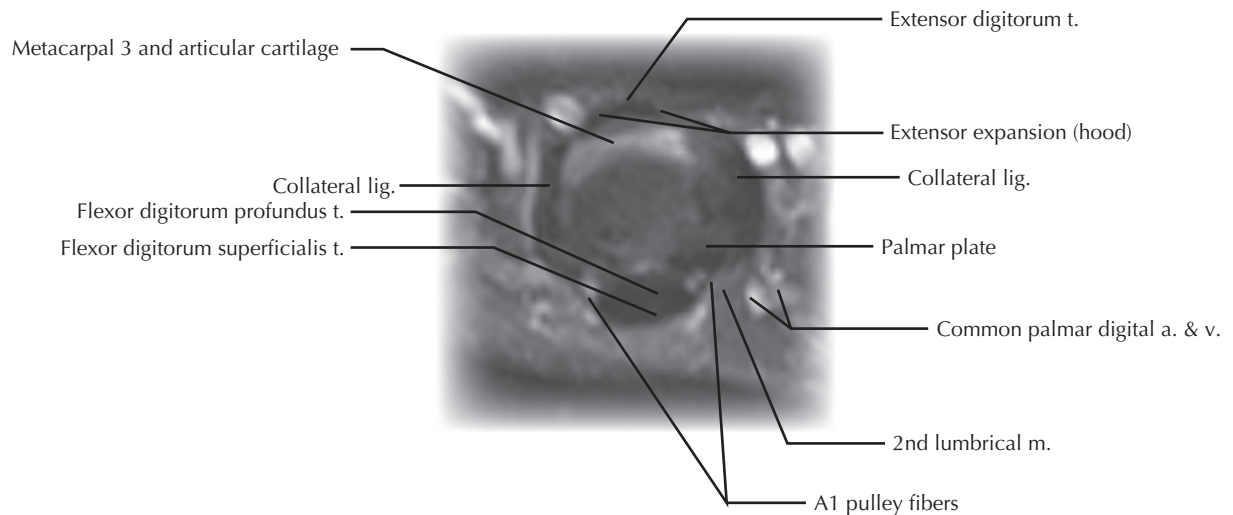
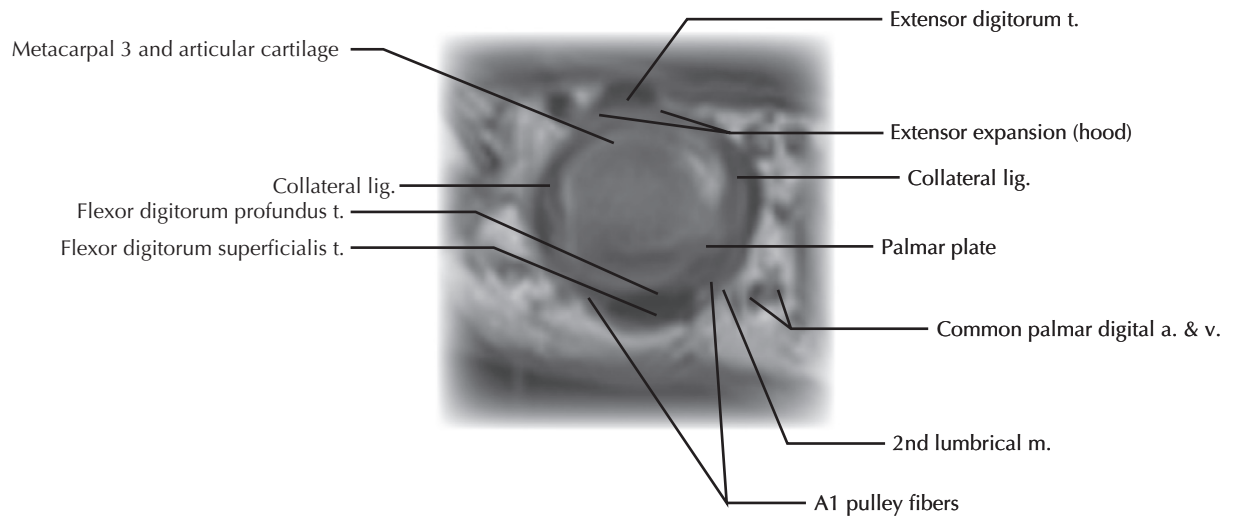
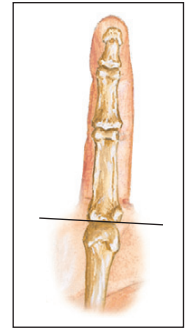
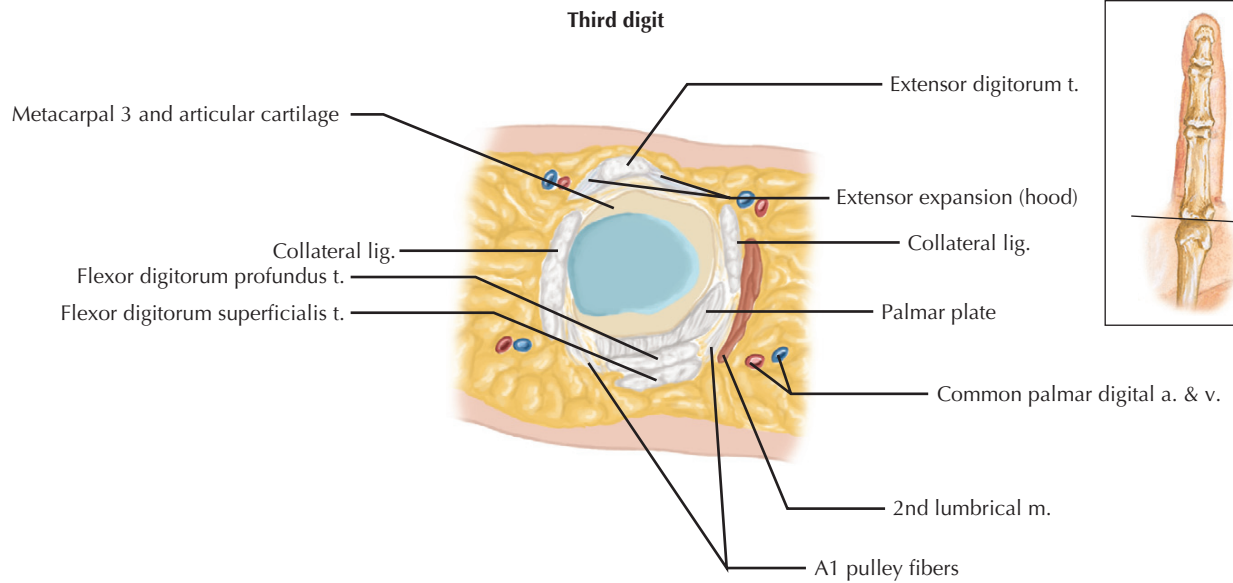


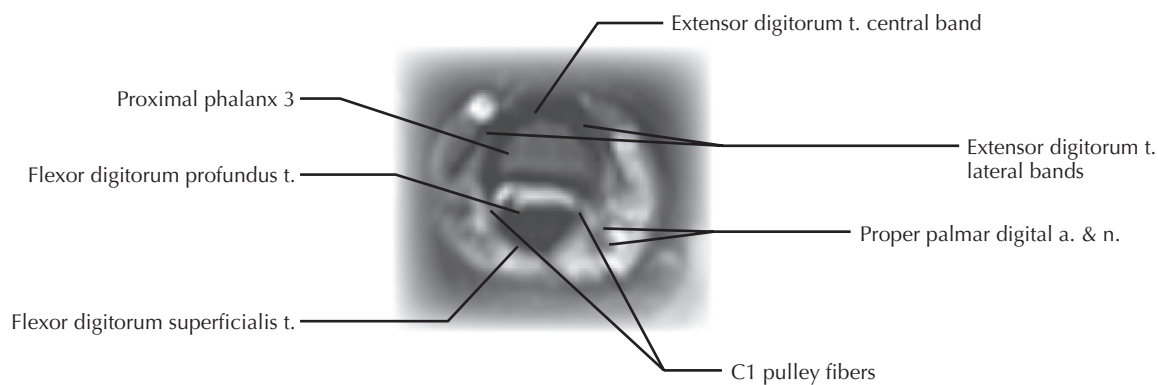
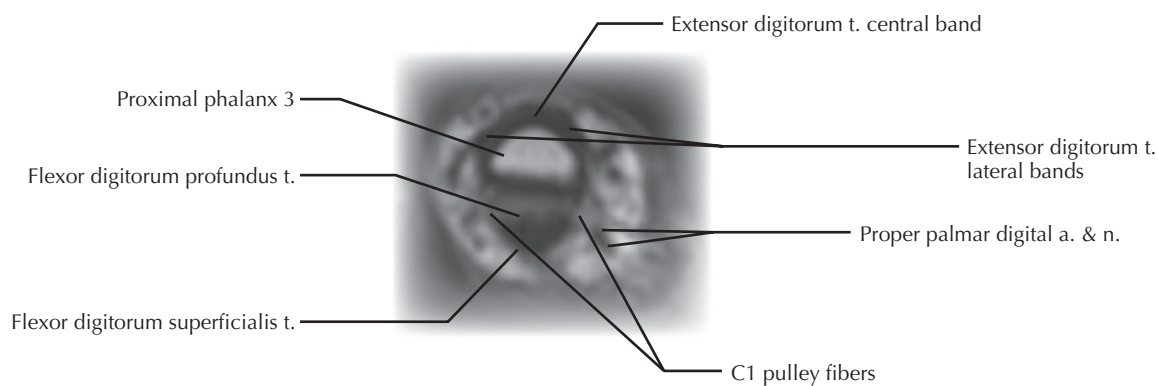
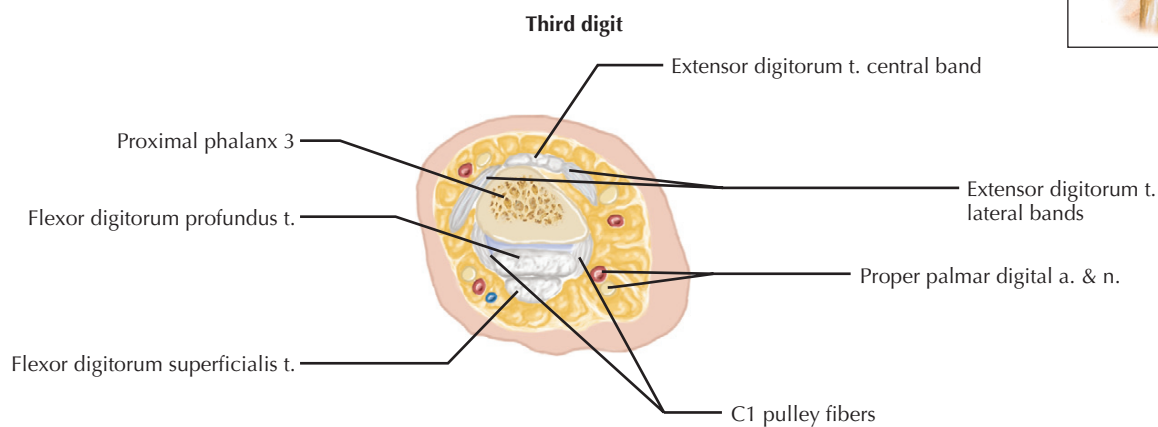
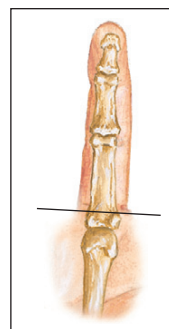


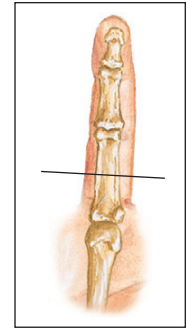




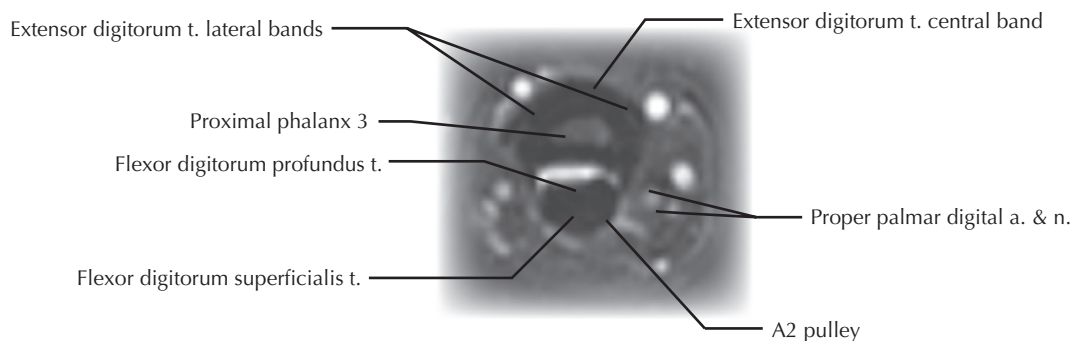
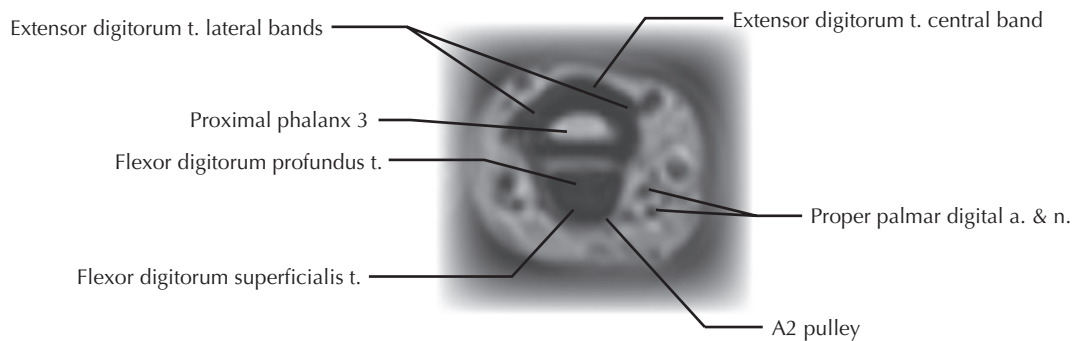
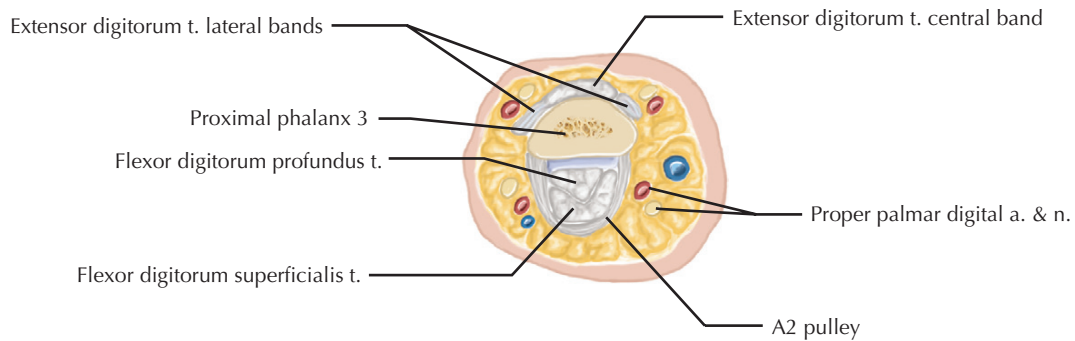


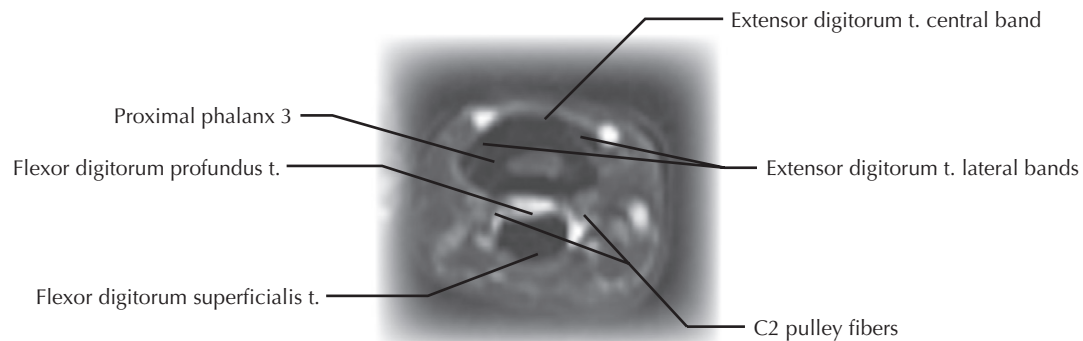
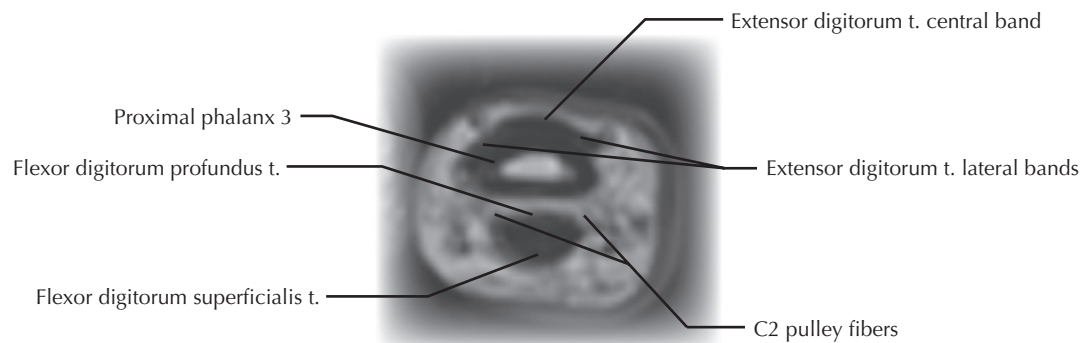
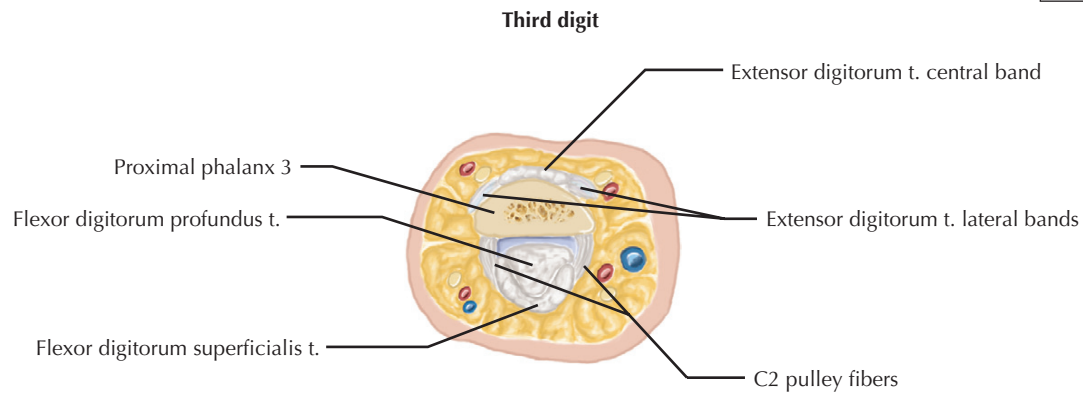
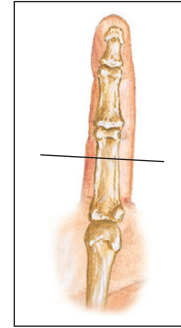


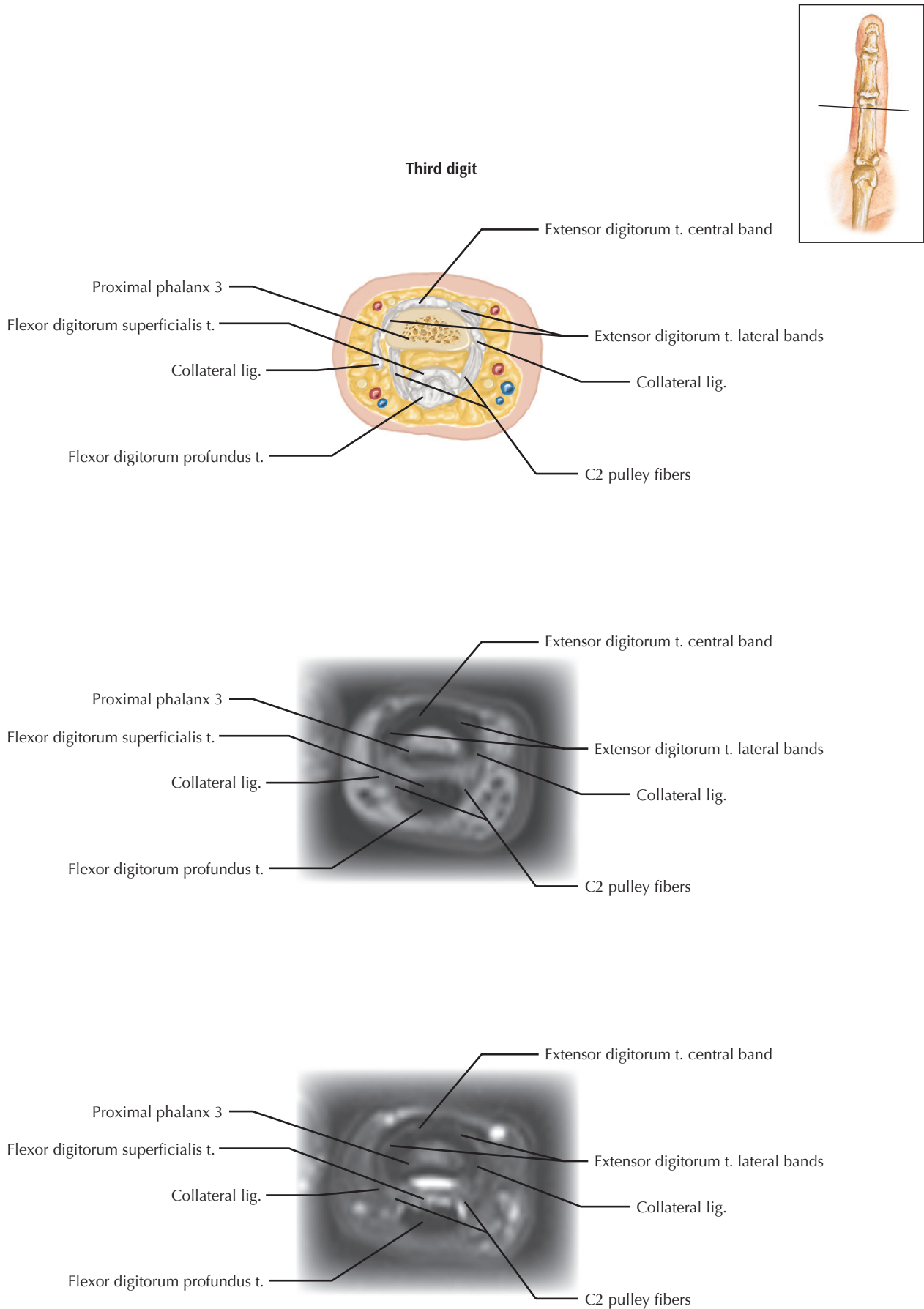


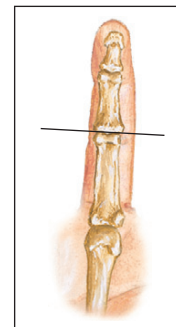


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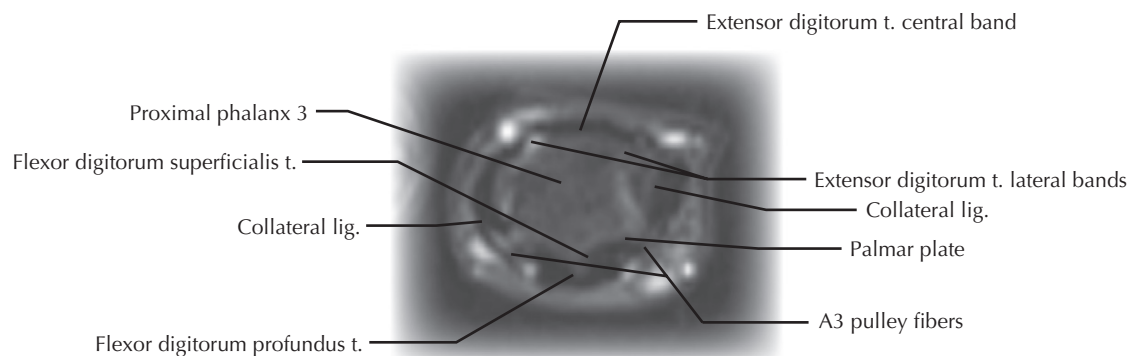
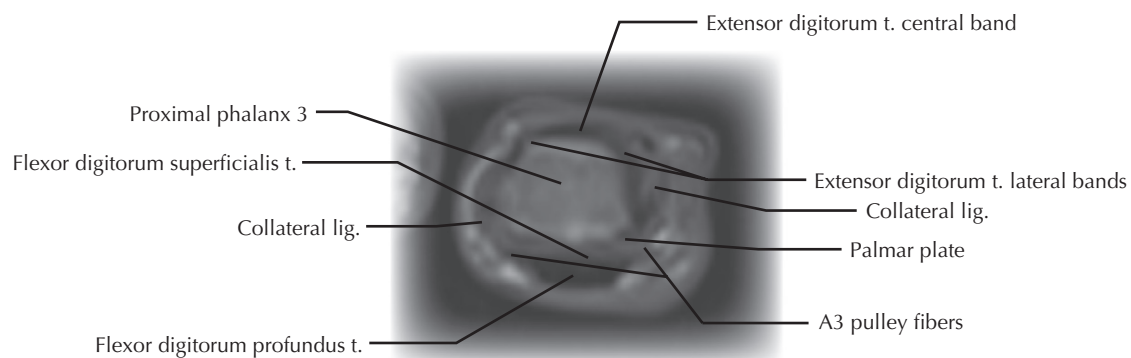
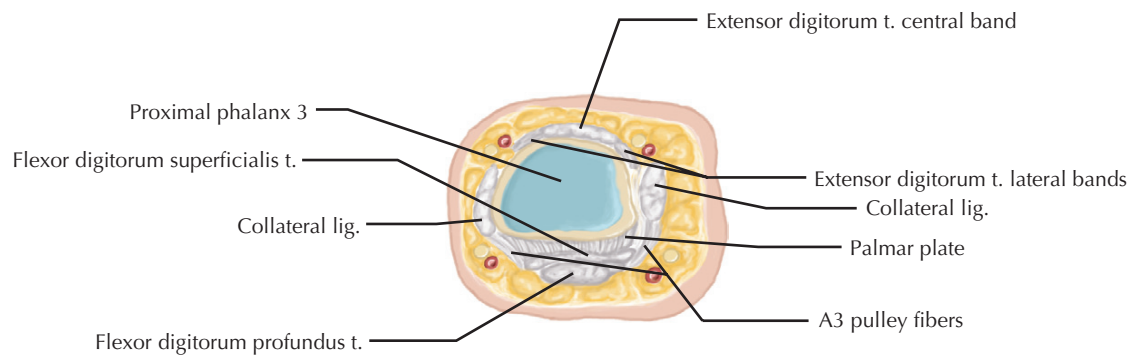


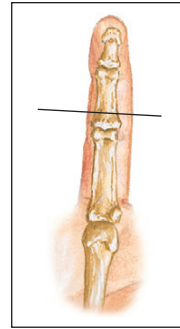




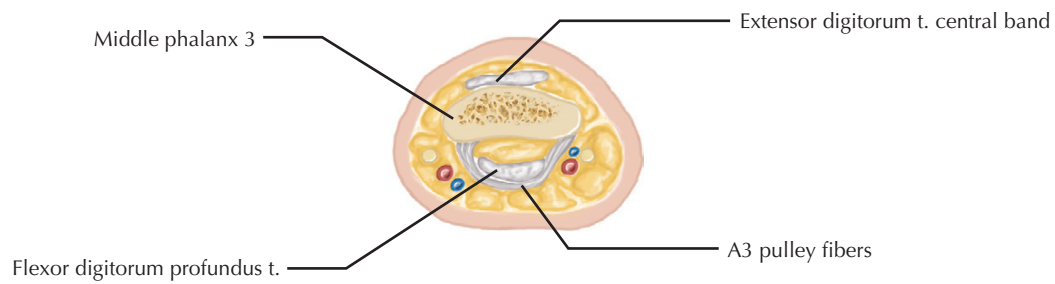


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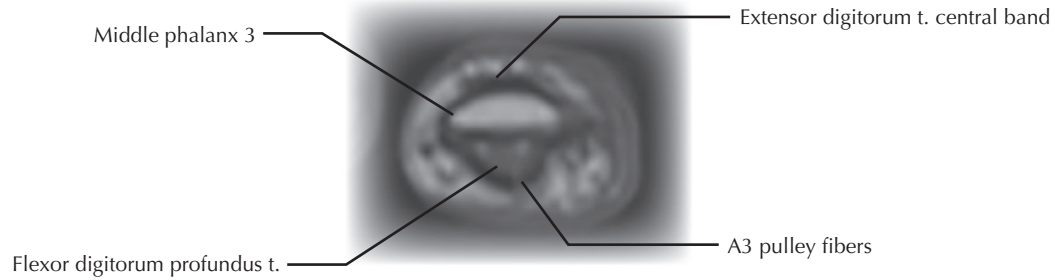




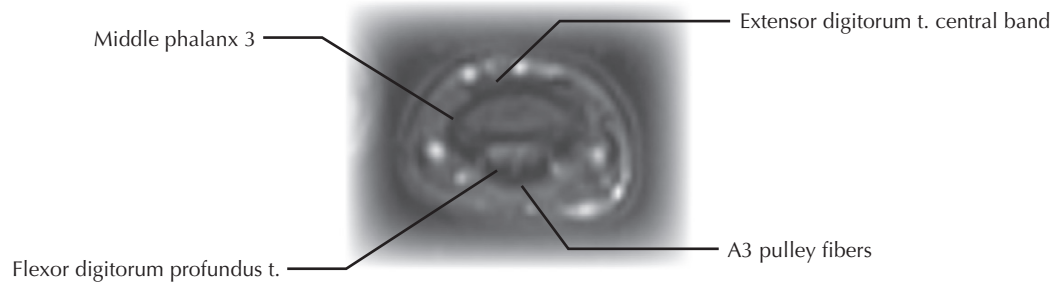
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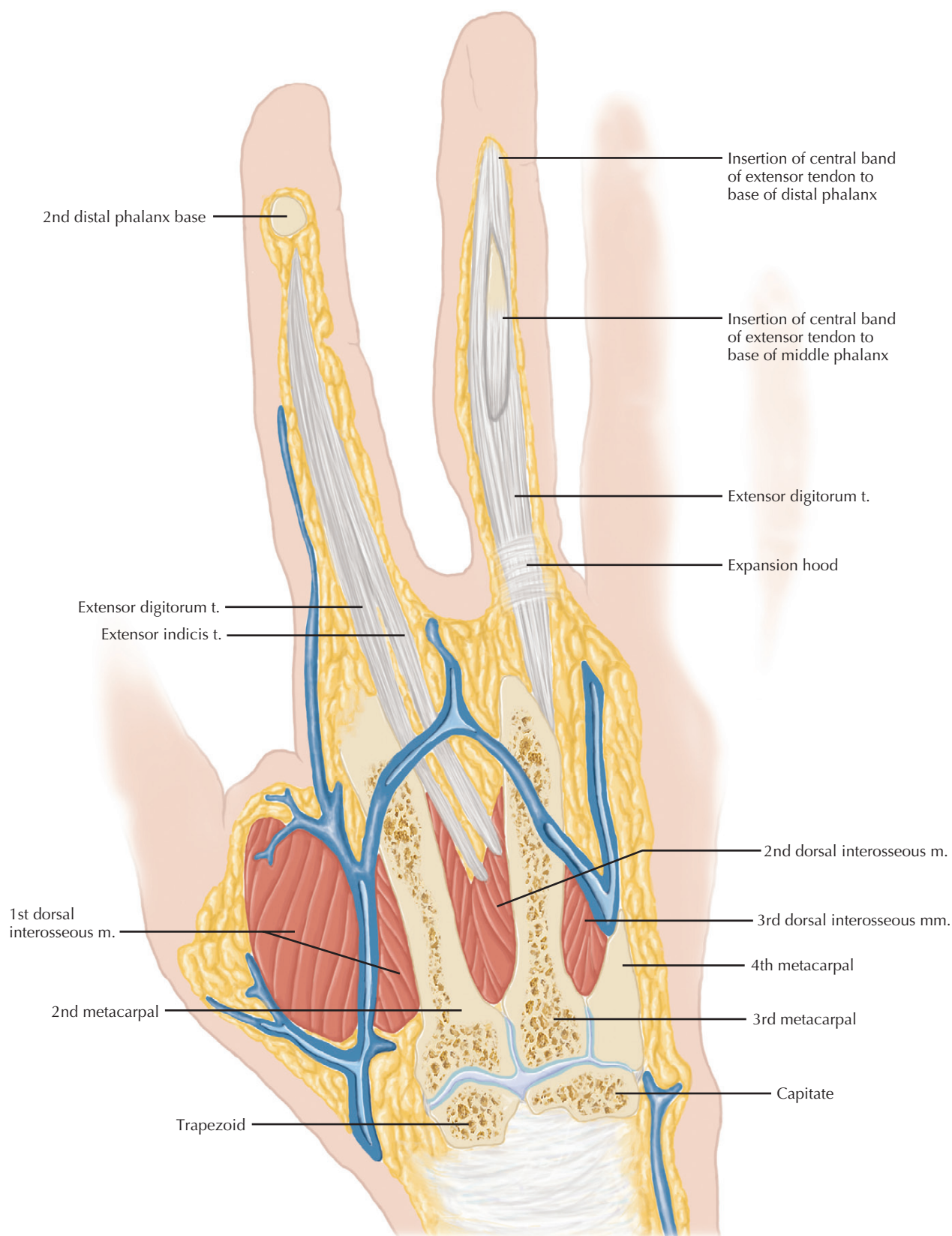


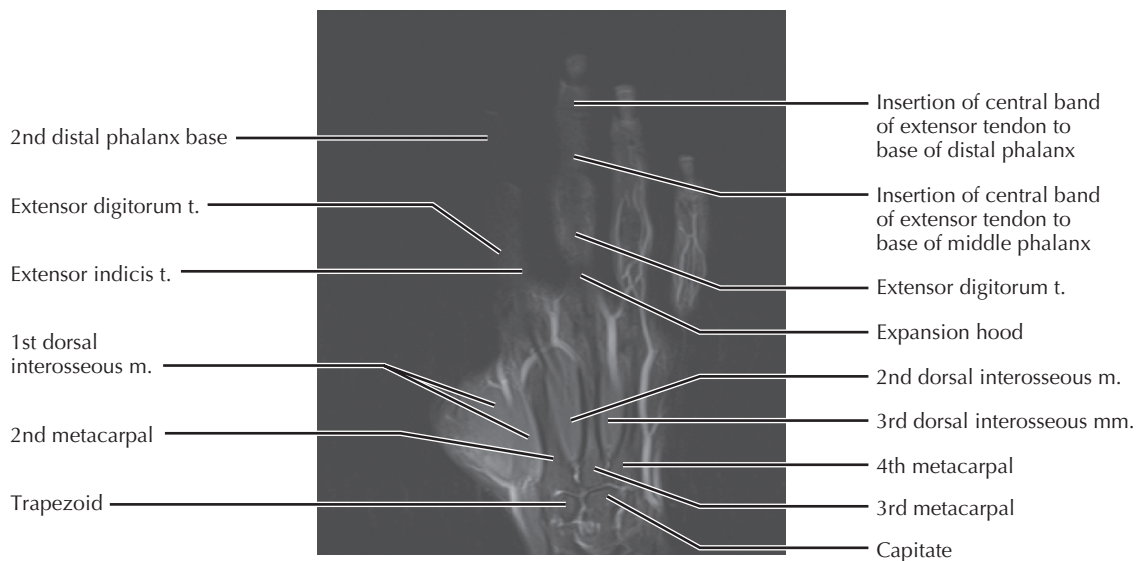
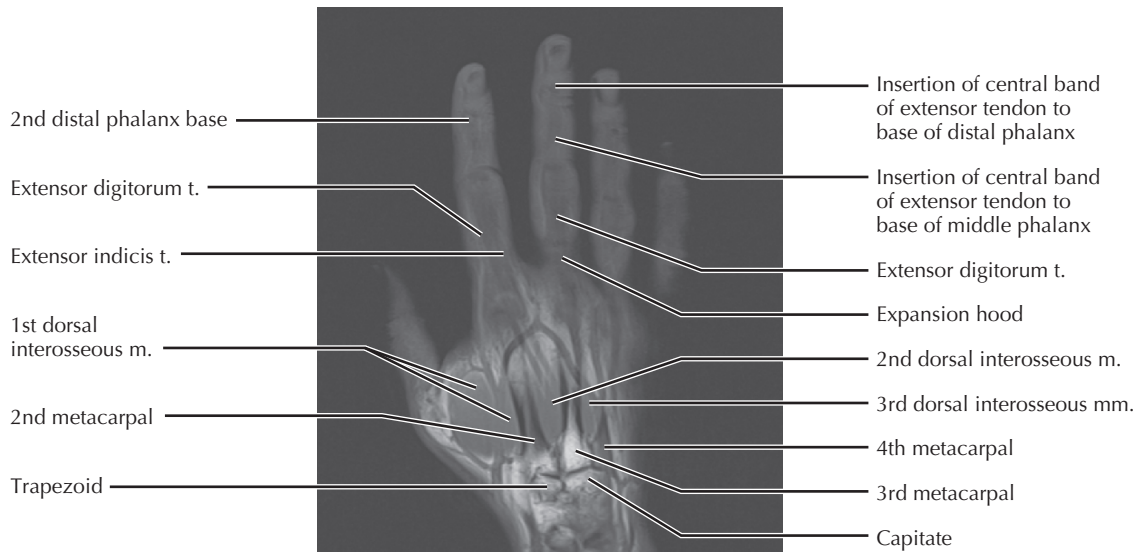
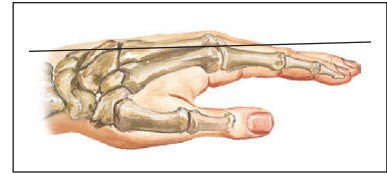
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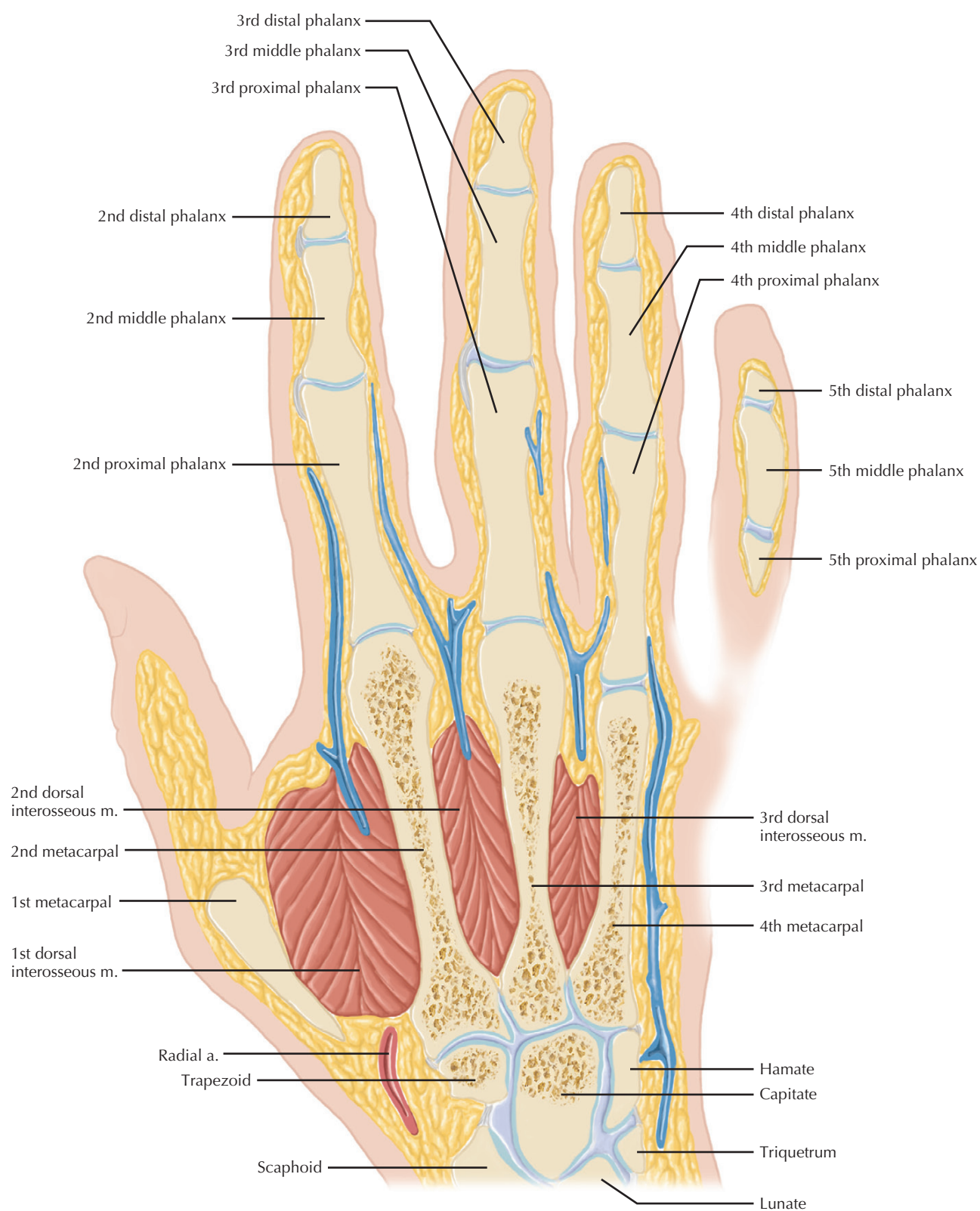


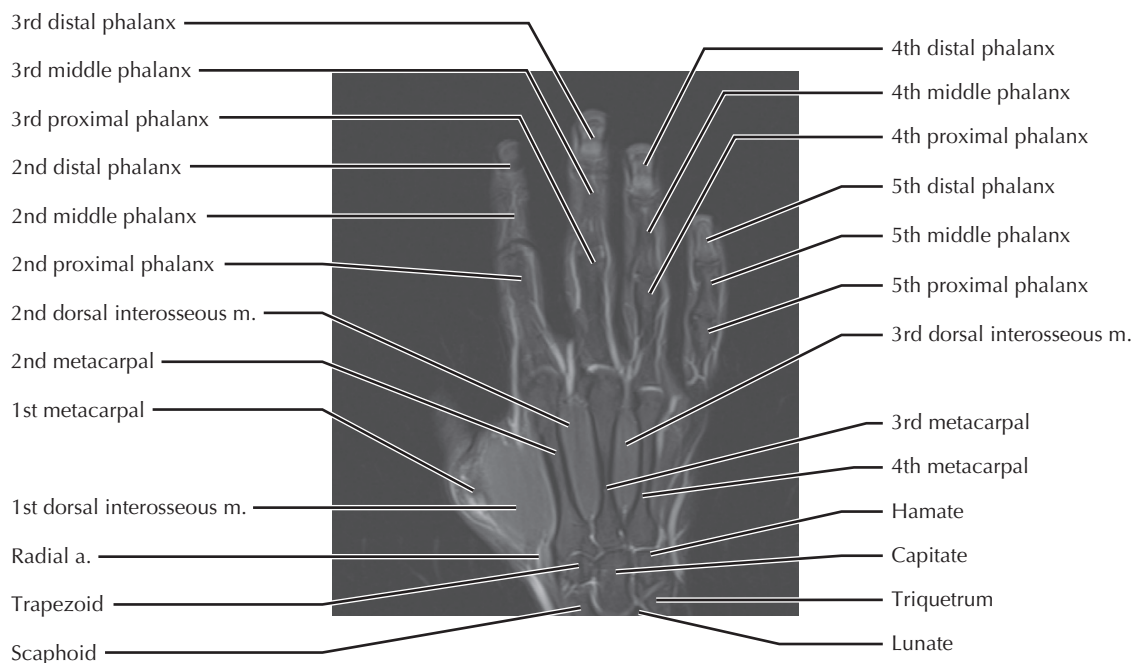
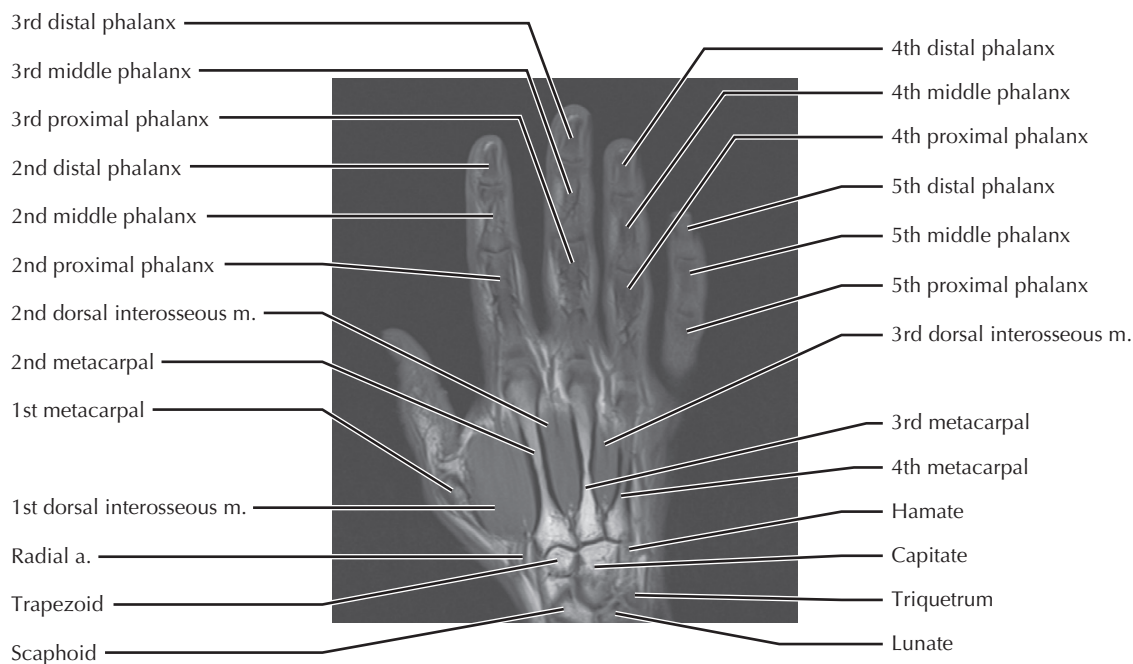
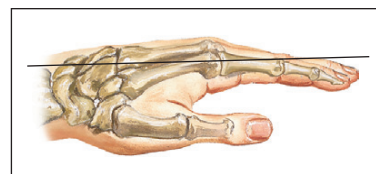
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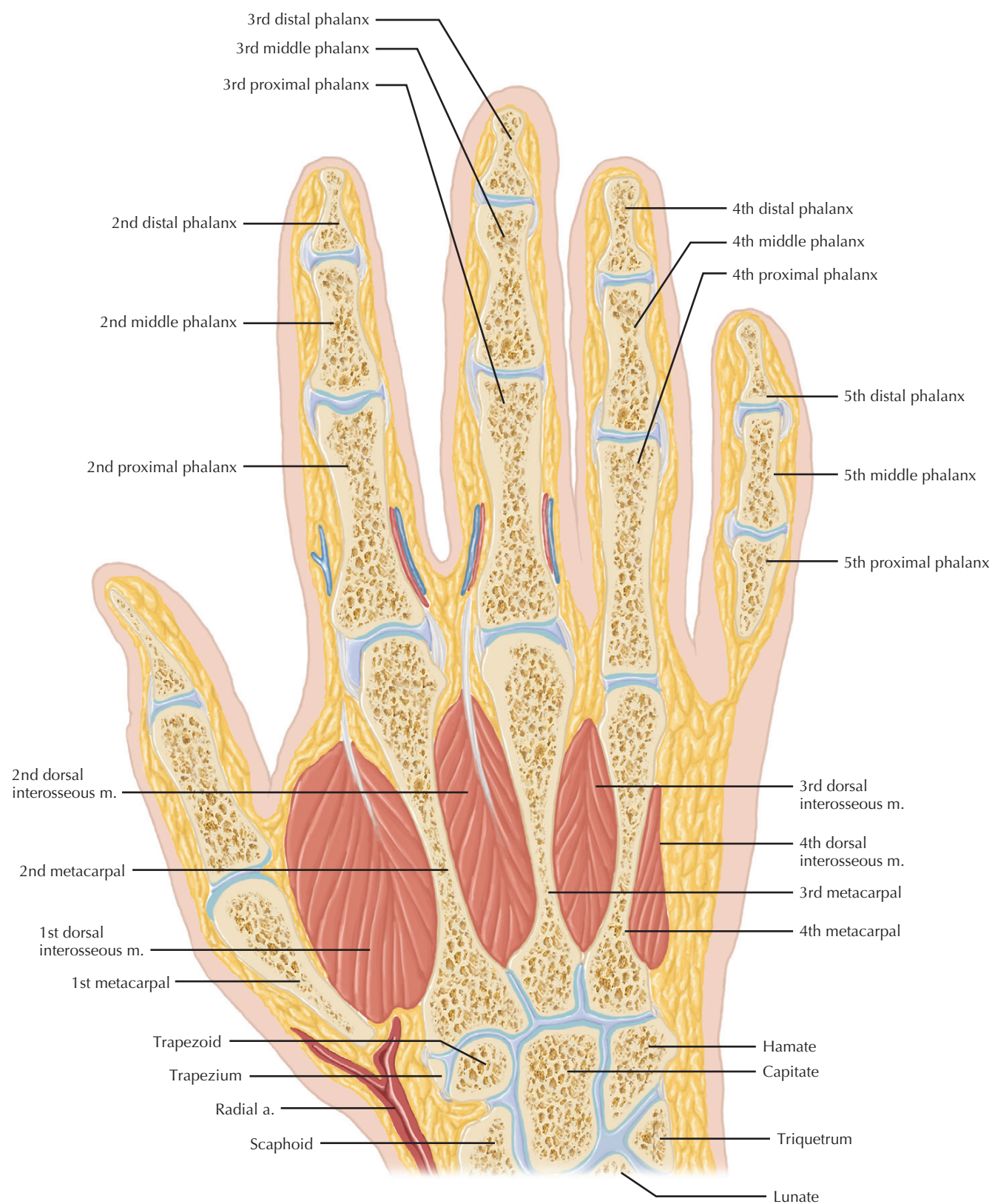






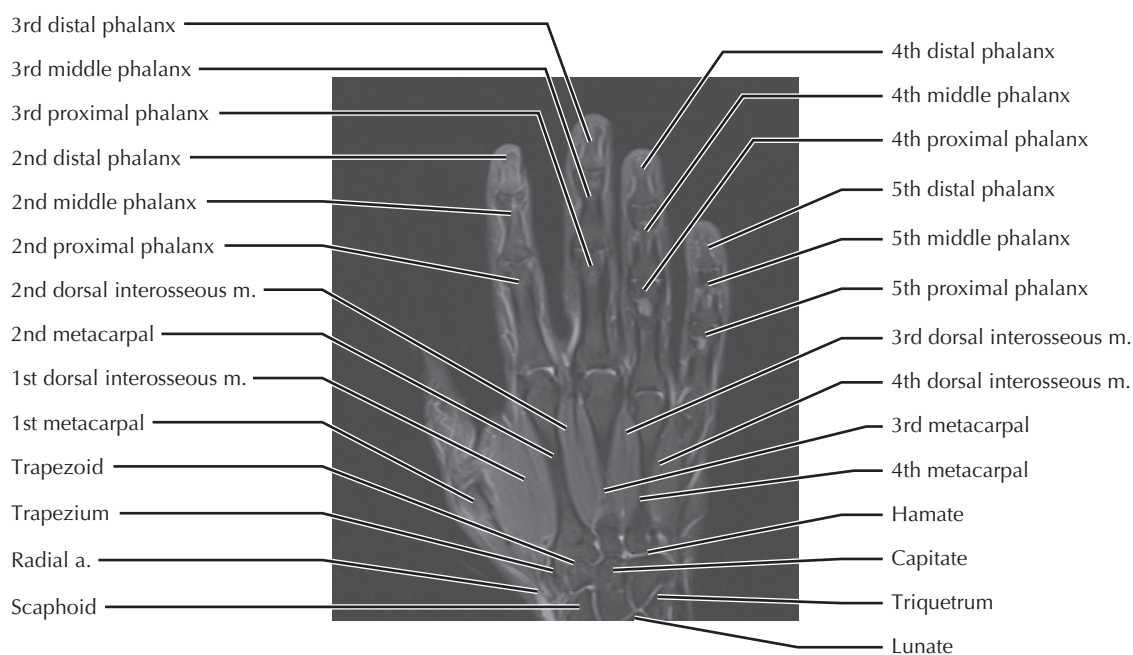
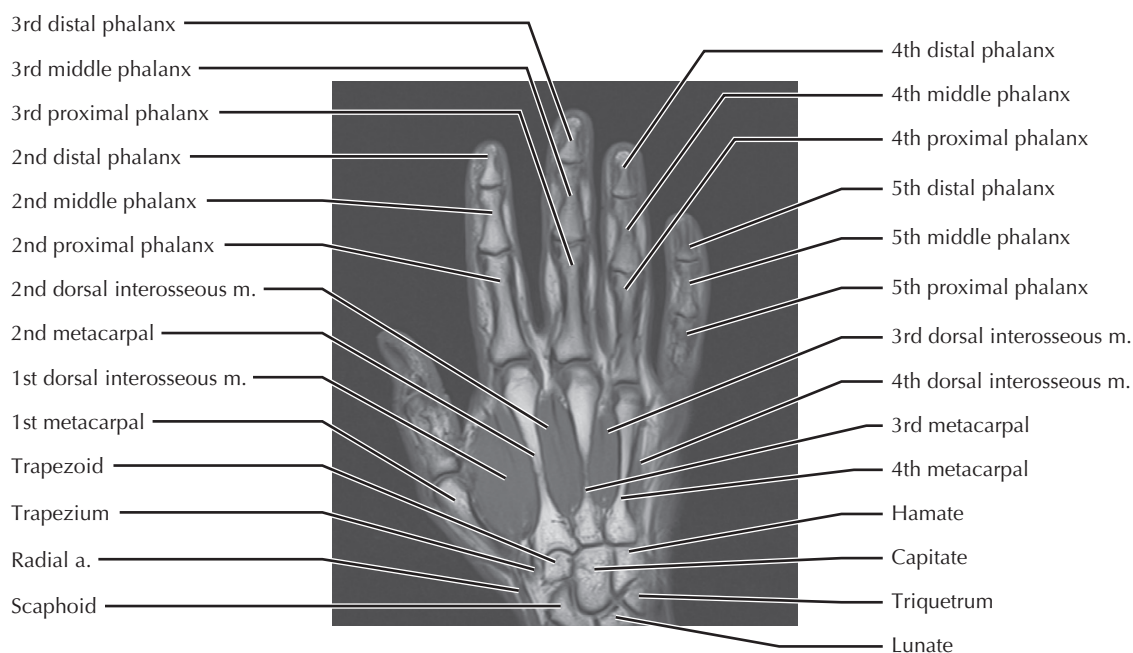
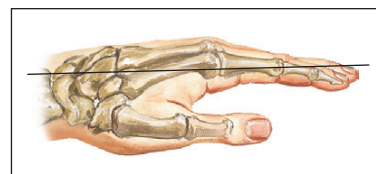


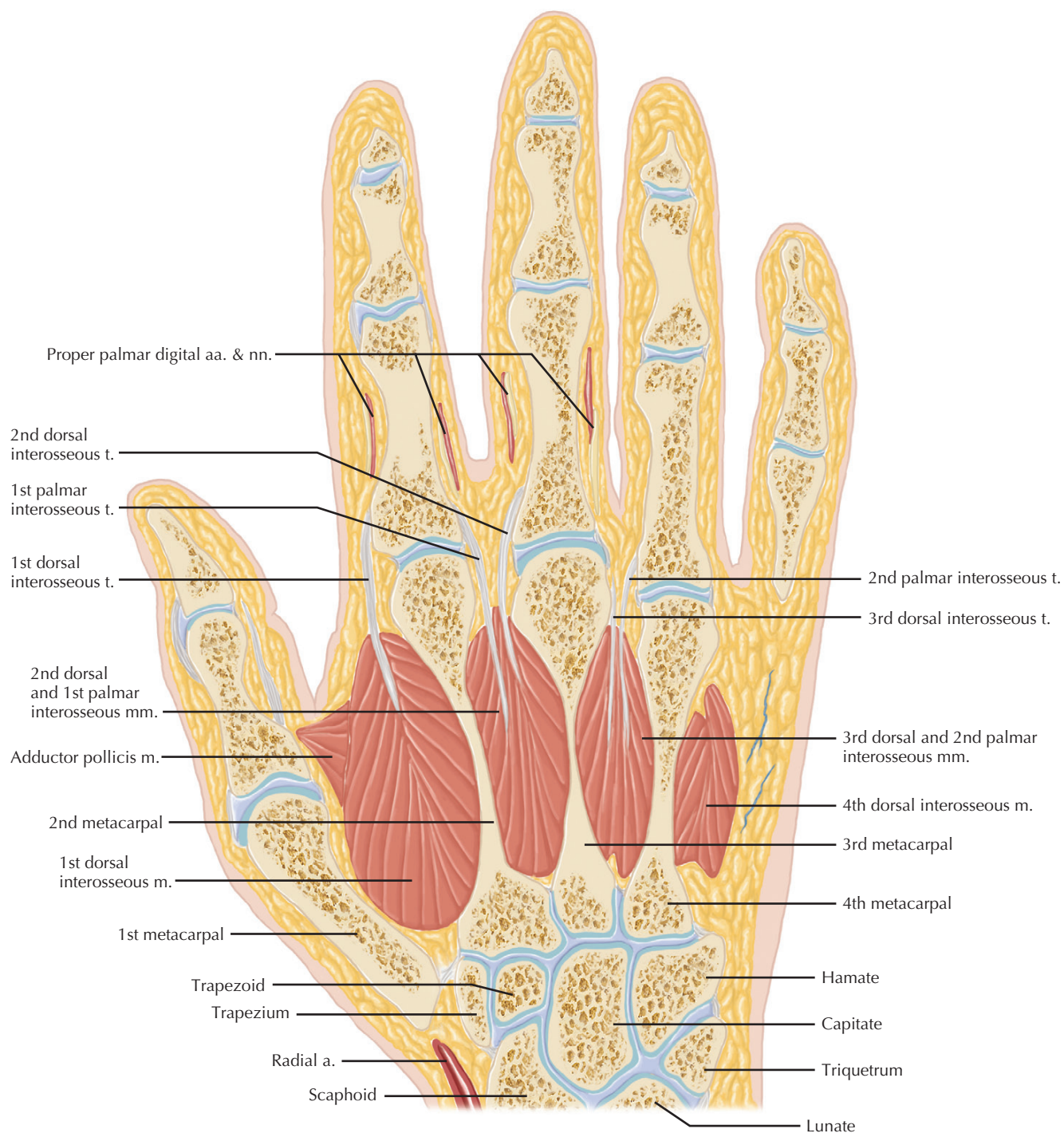
HAND AND FINGER CORONAL 3

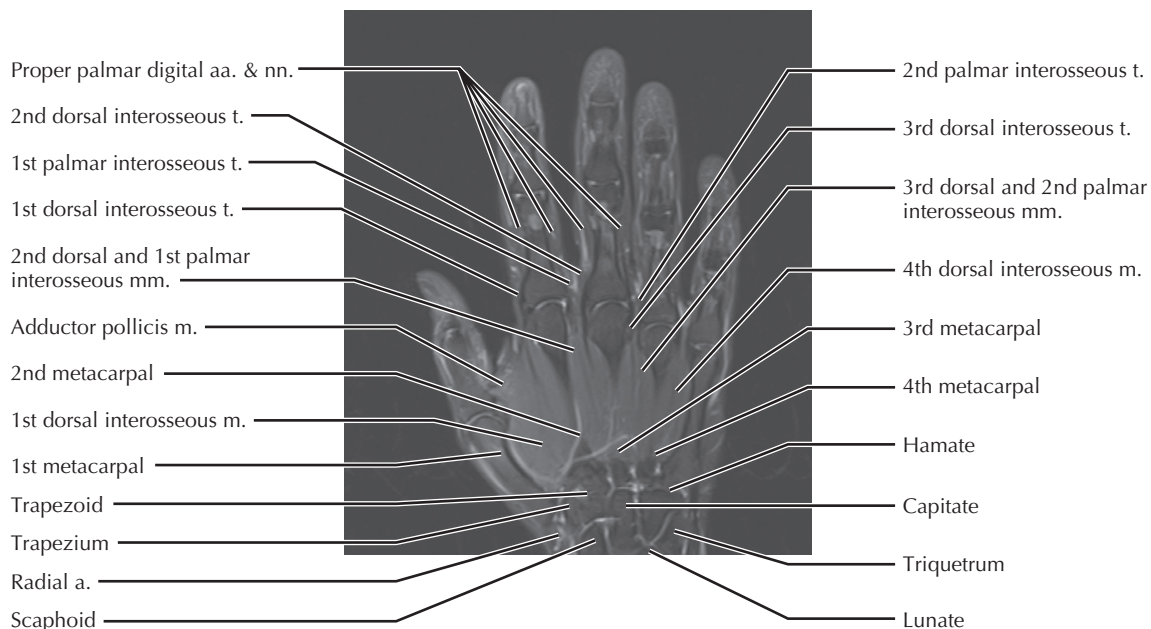
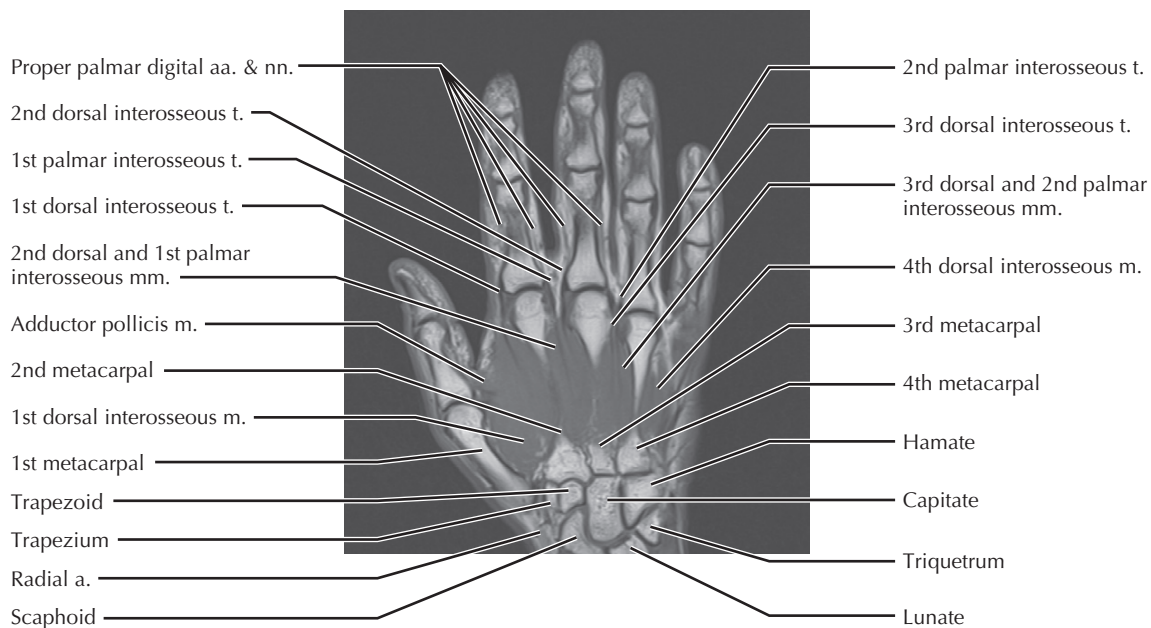
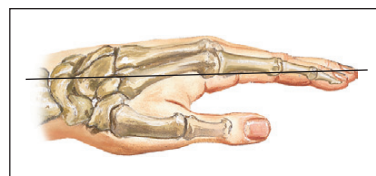


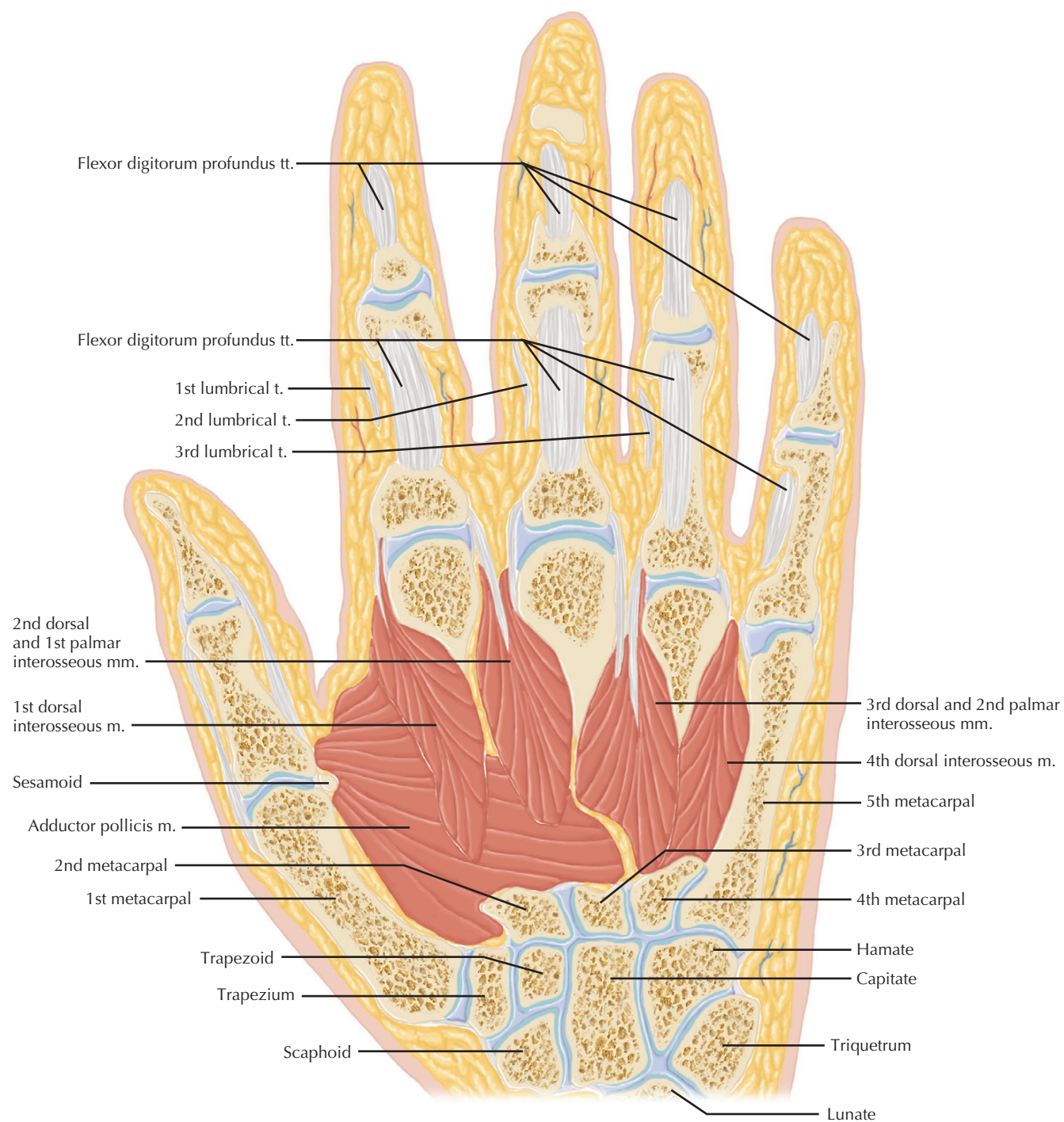
DIAGNOSTIC CONSIDERATION

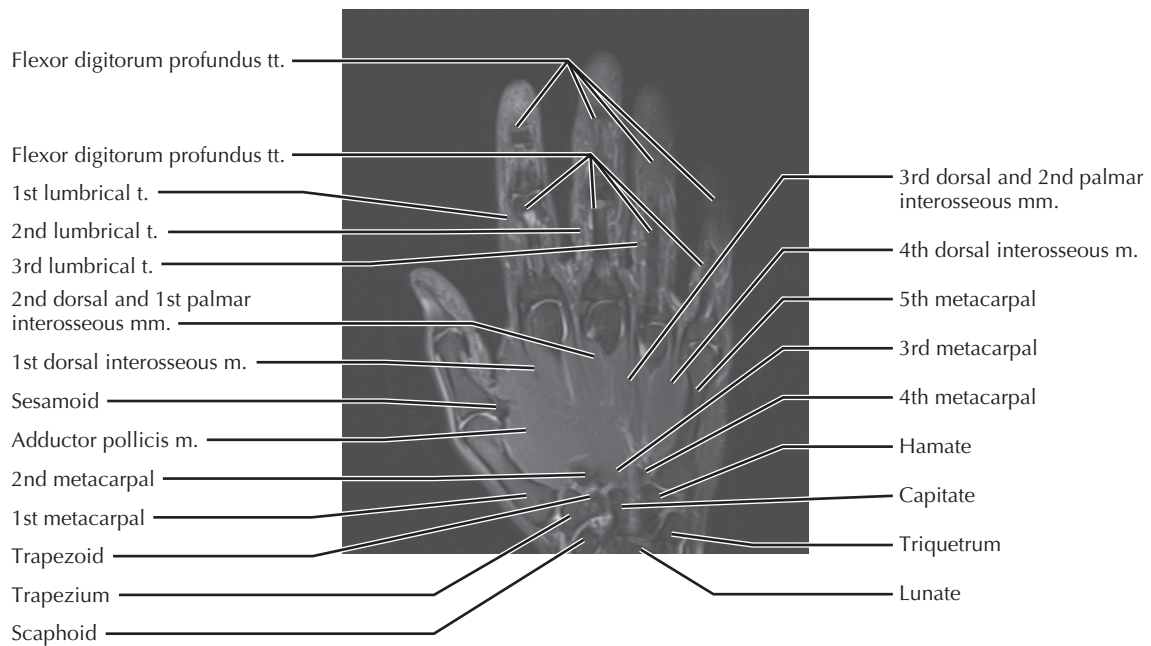
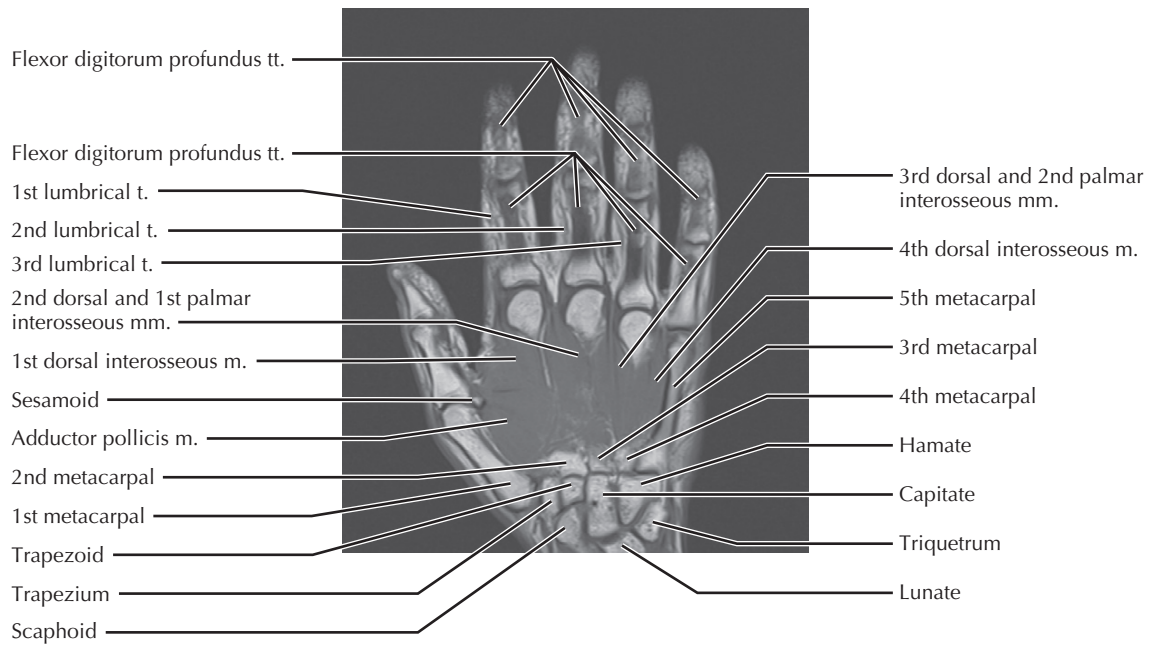
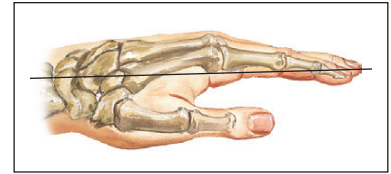
The hand and wrist are often affected by inflammatory, degenerative, and metabolic arthritides. Manifestations of arthritis, including erosions, subchondral cysts, synovitis, and tenosynovitis, are better demonstrated on MRI than on other imaging modalities.

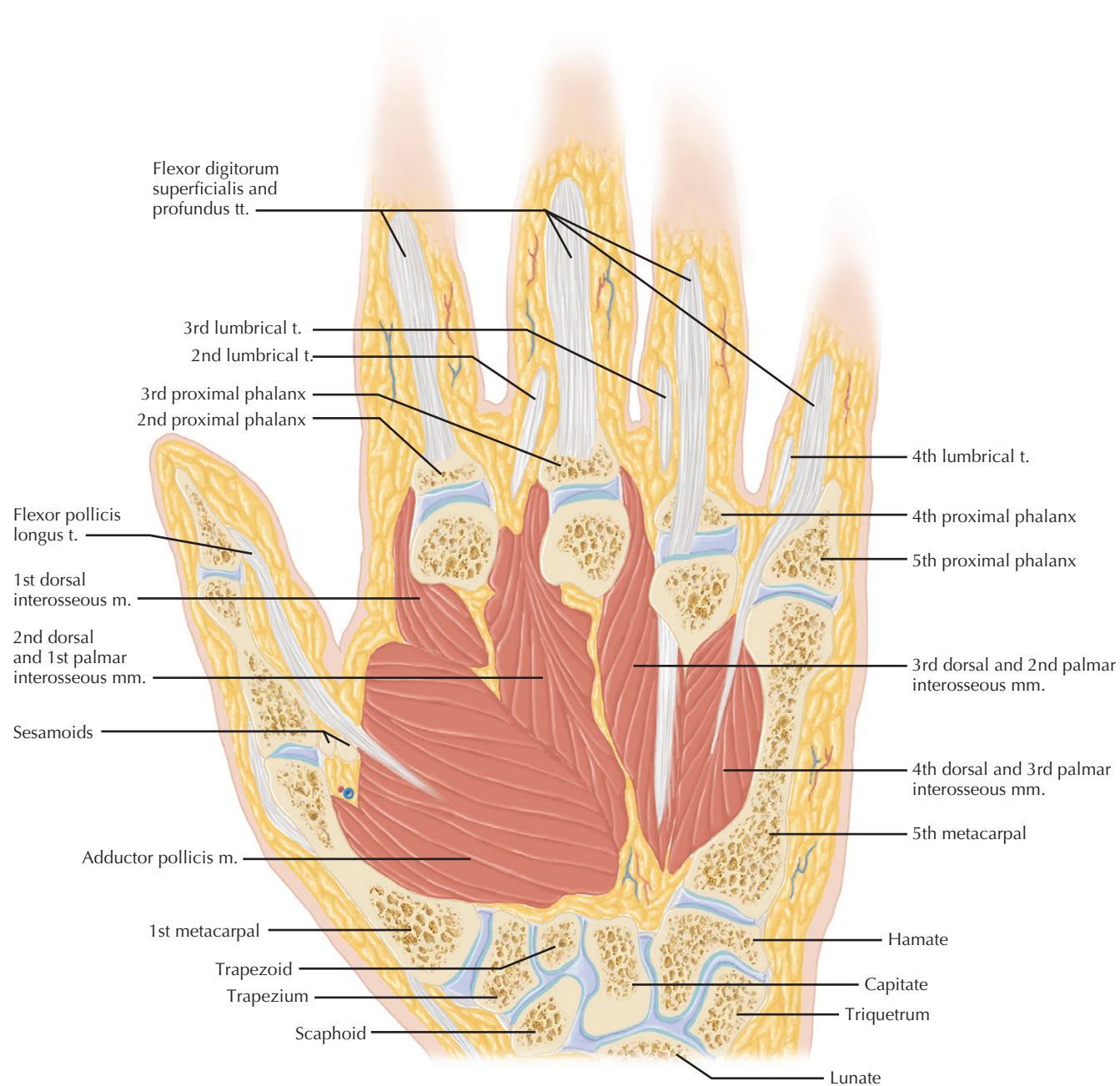


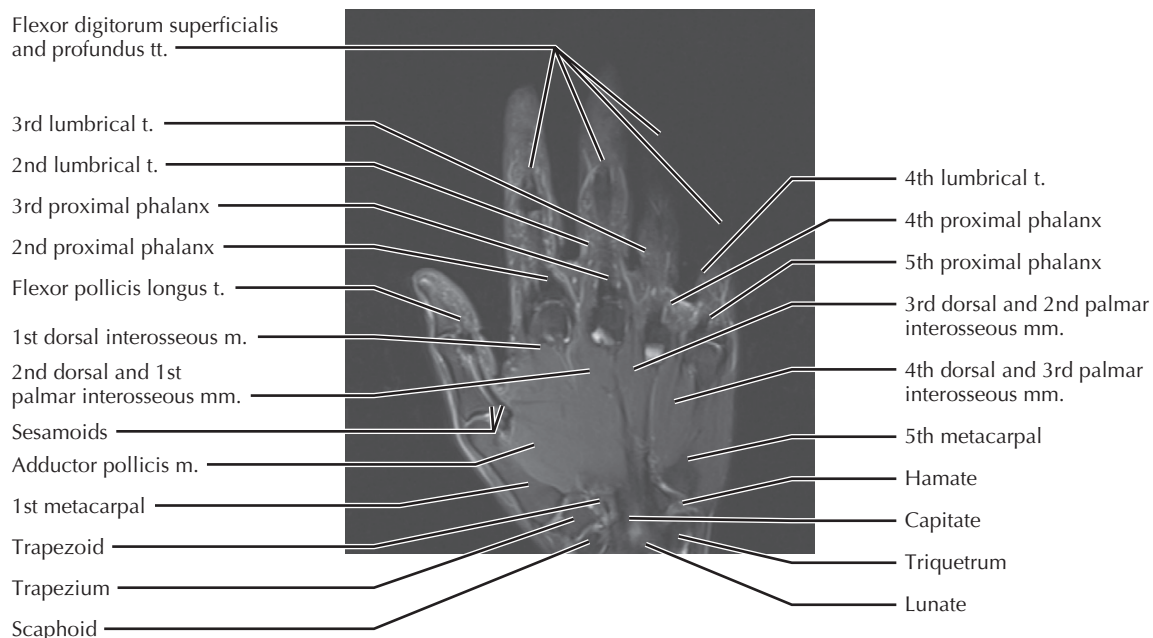
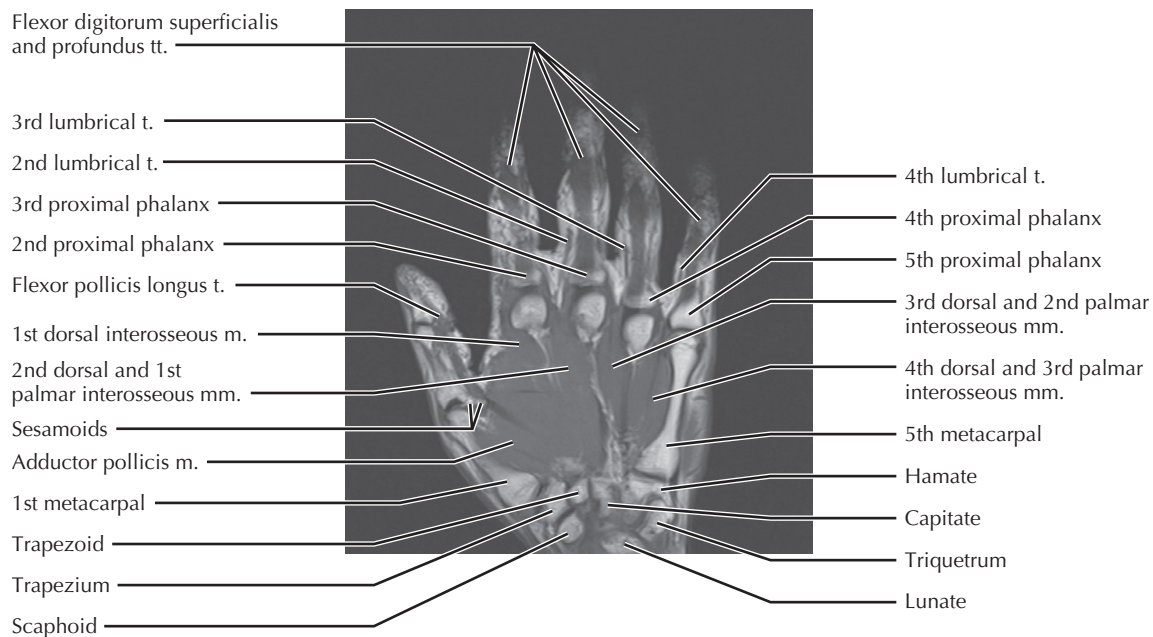
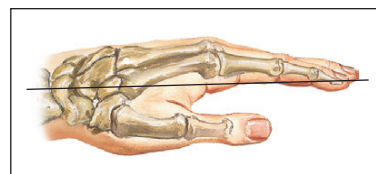


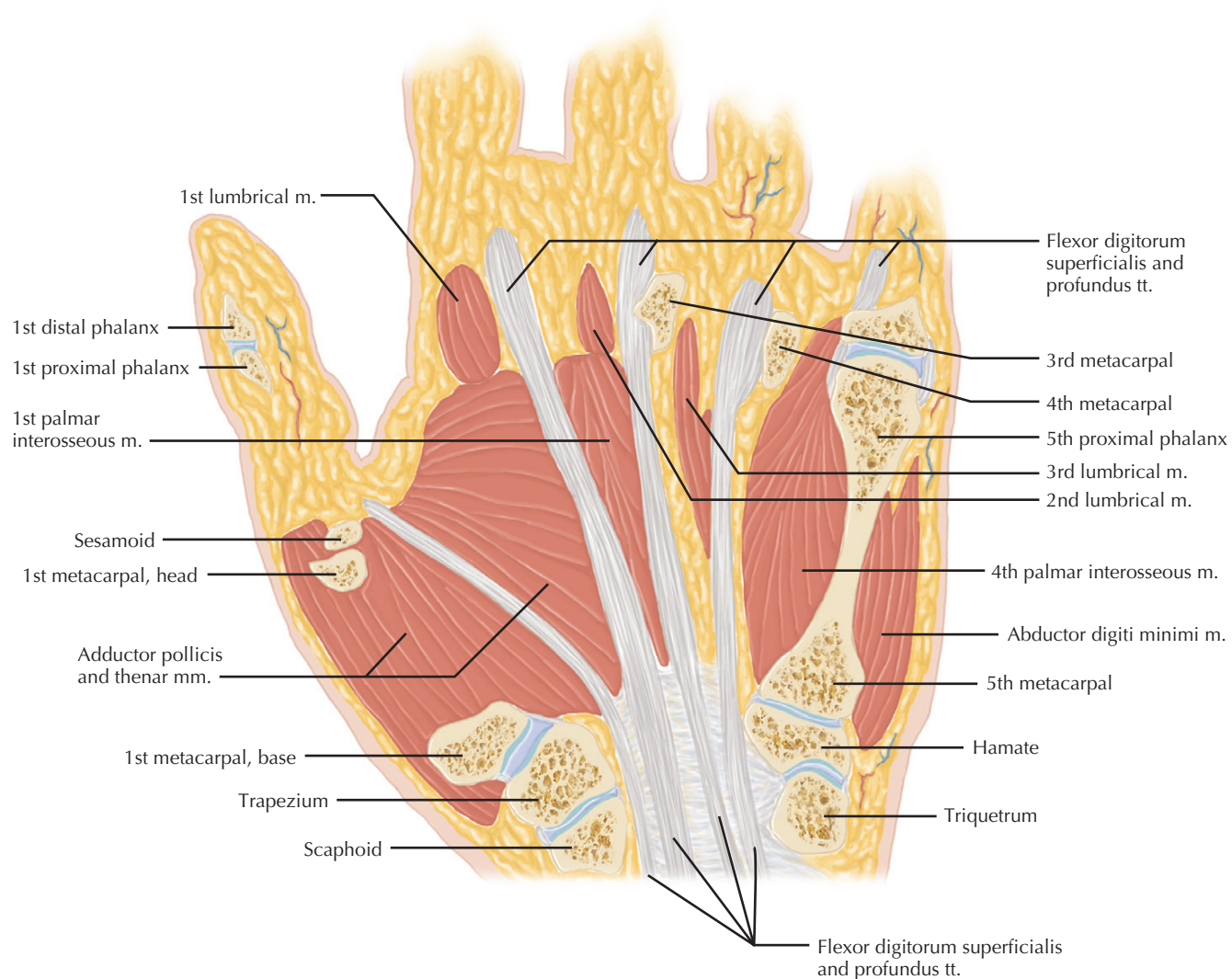


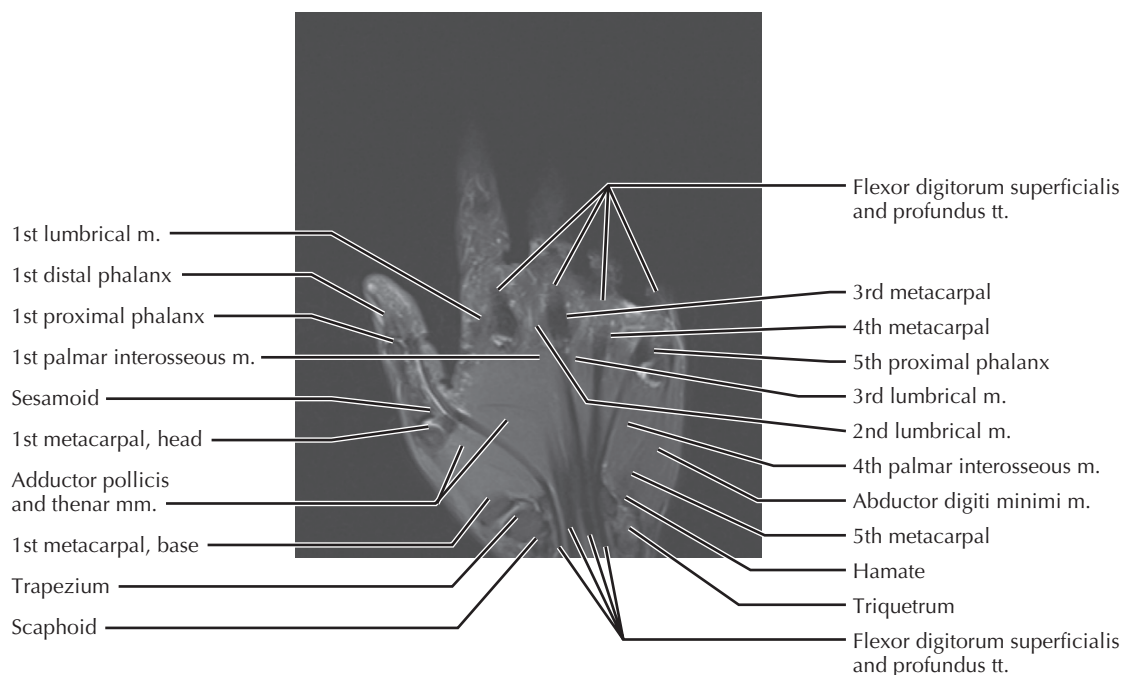
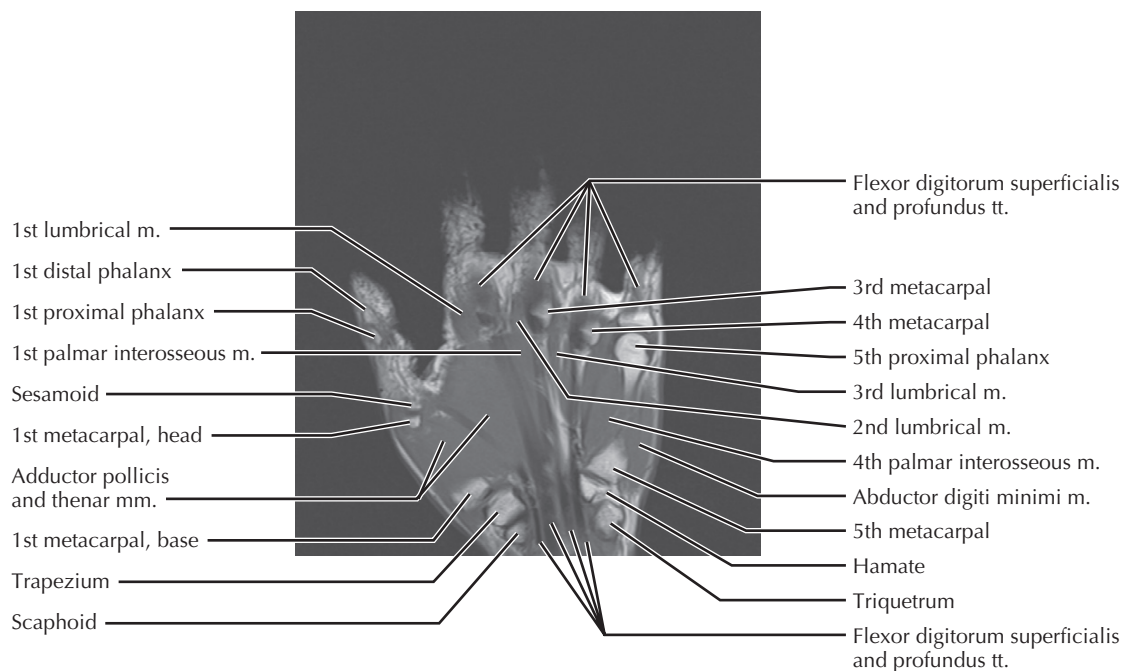
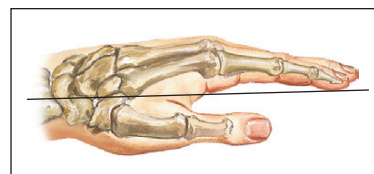


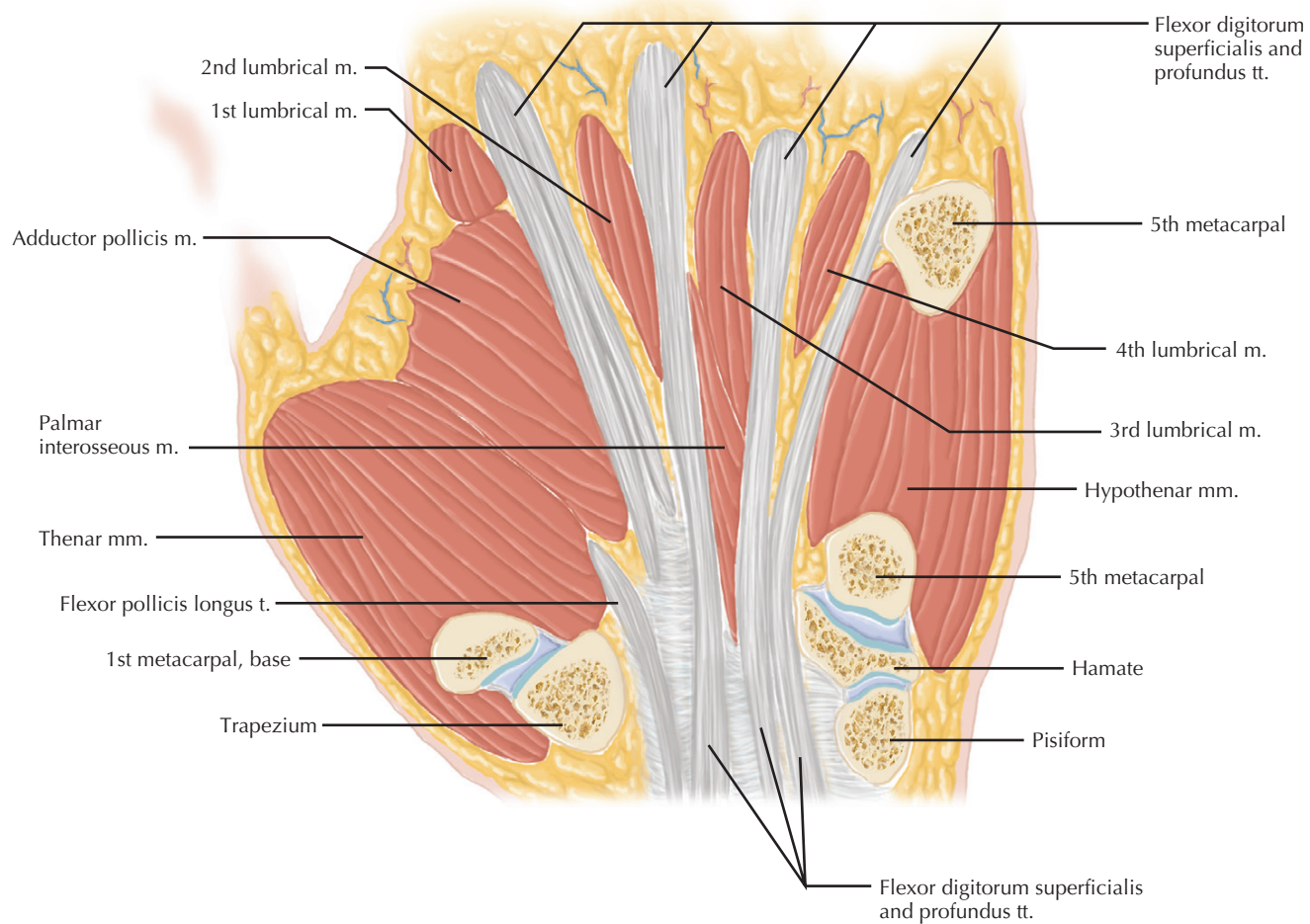


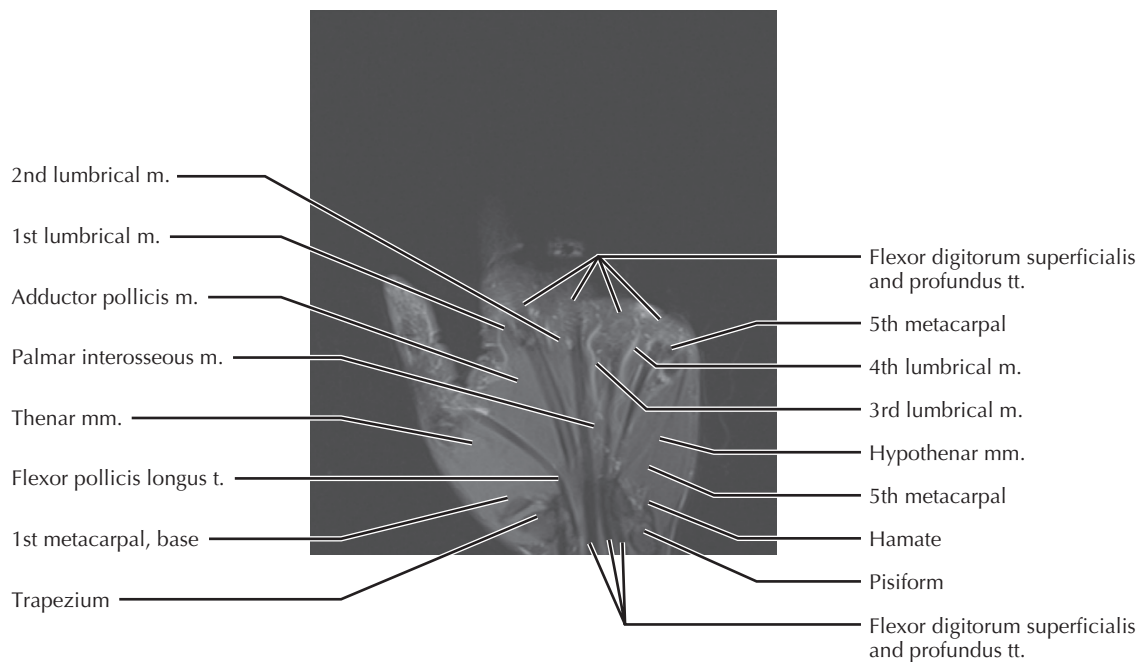
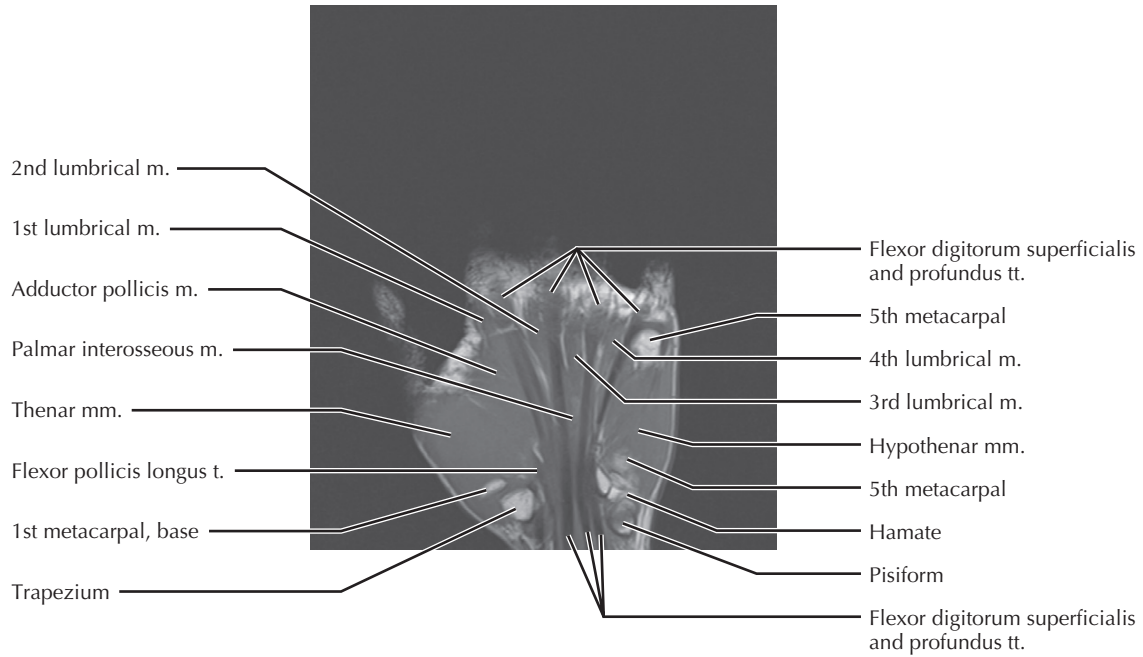
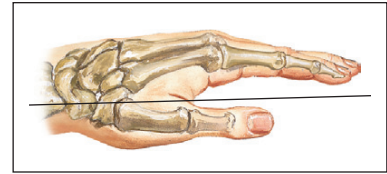


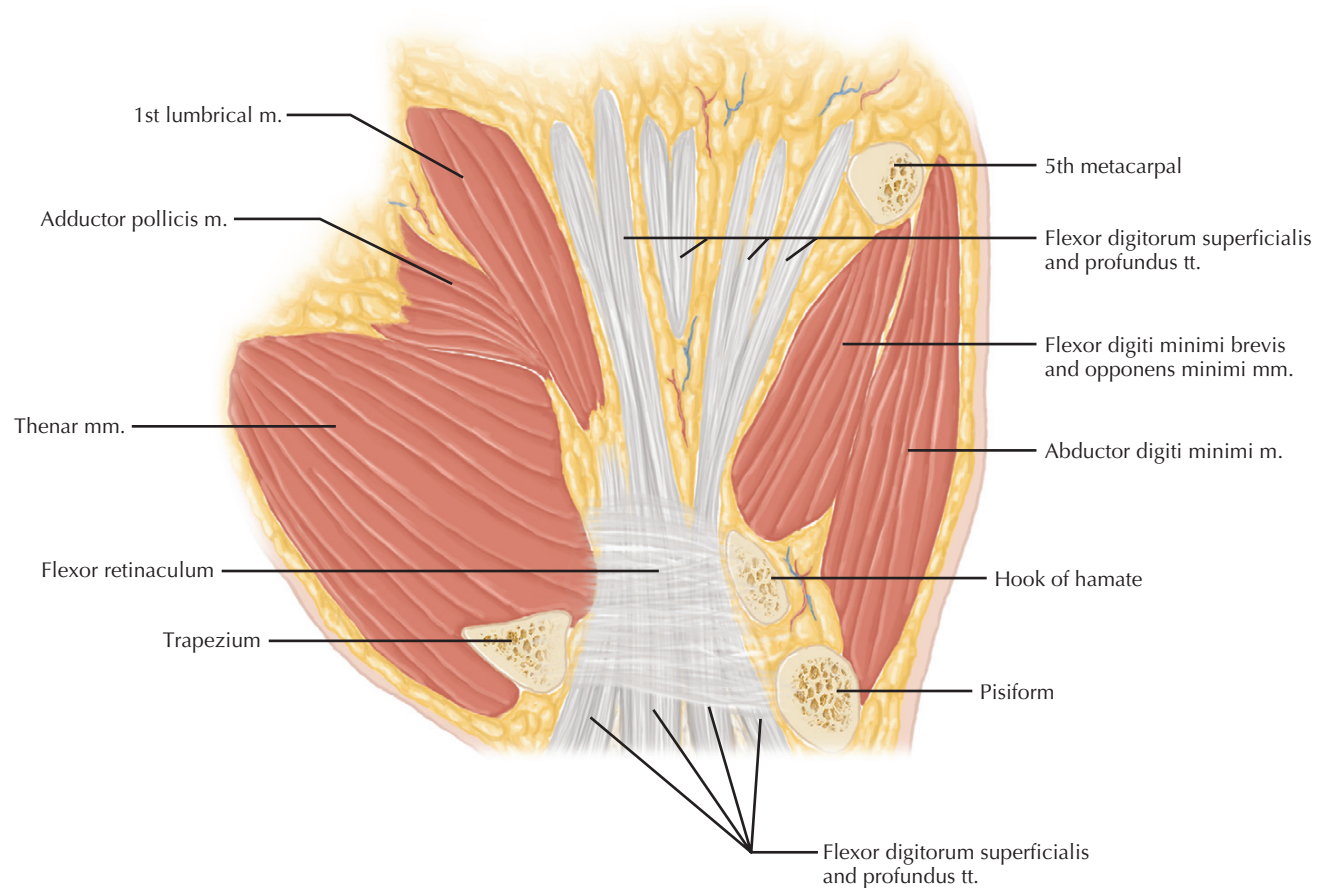


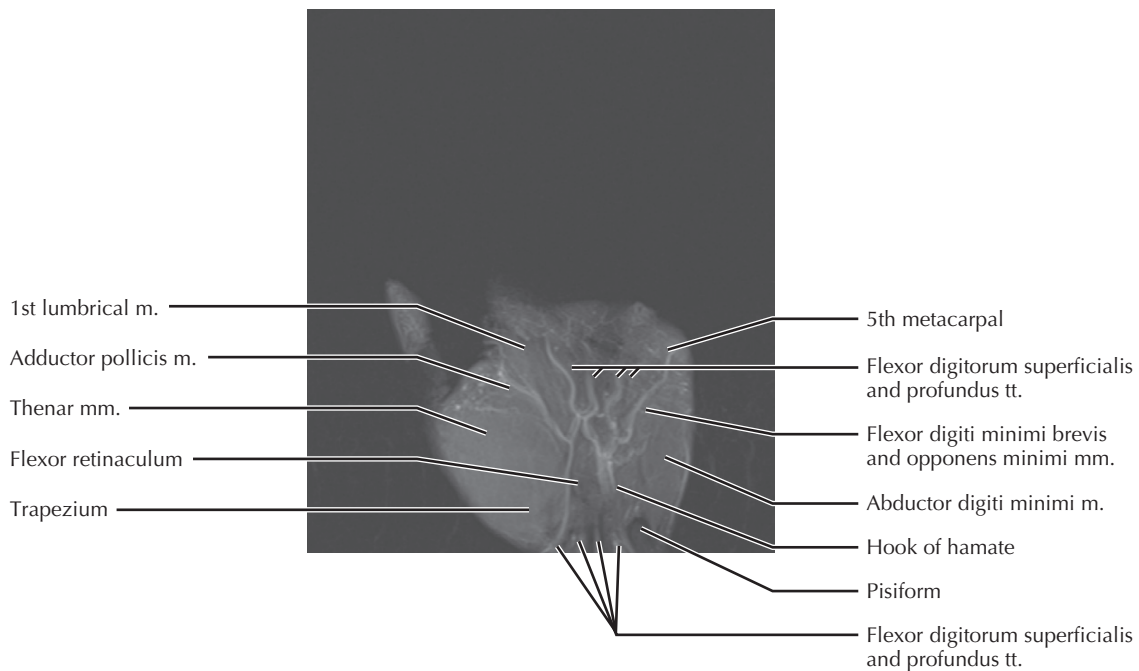
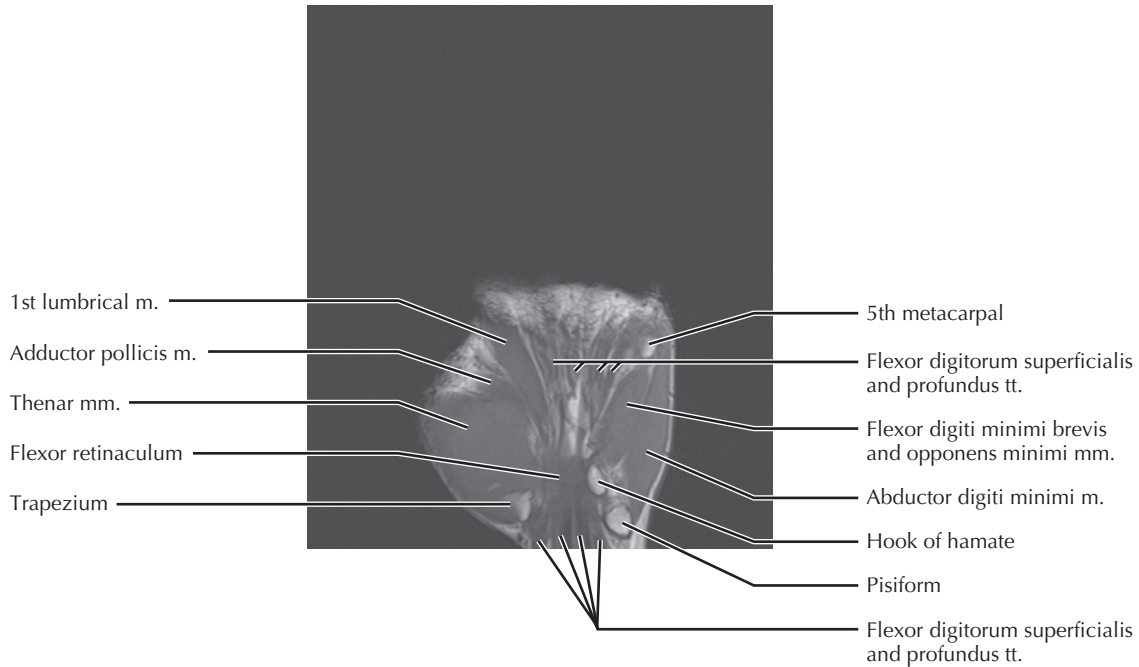
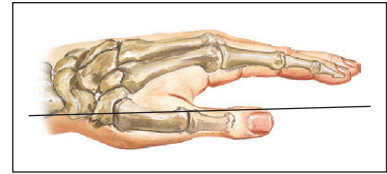


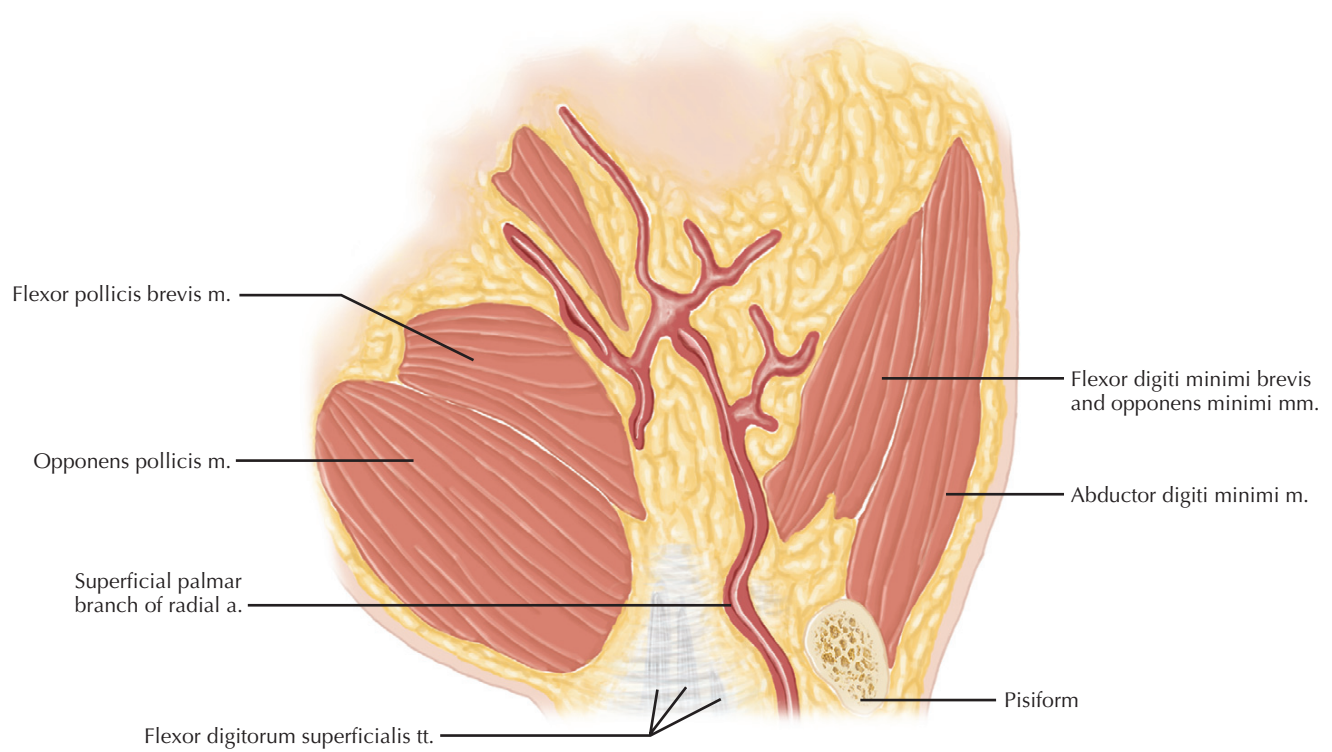


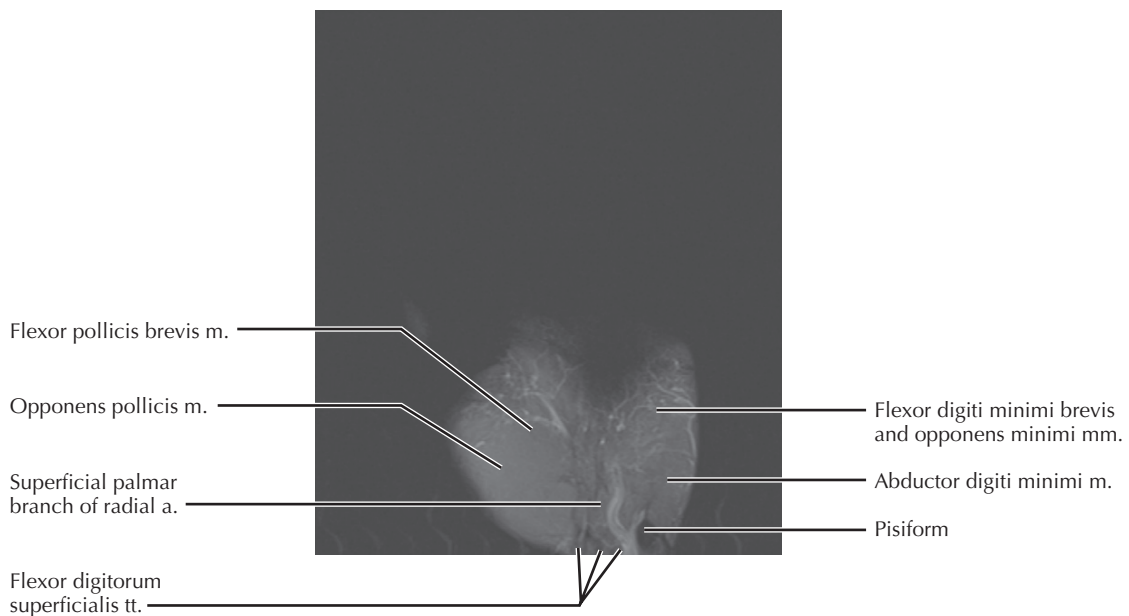
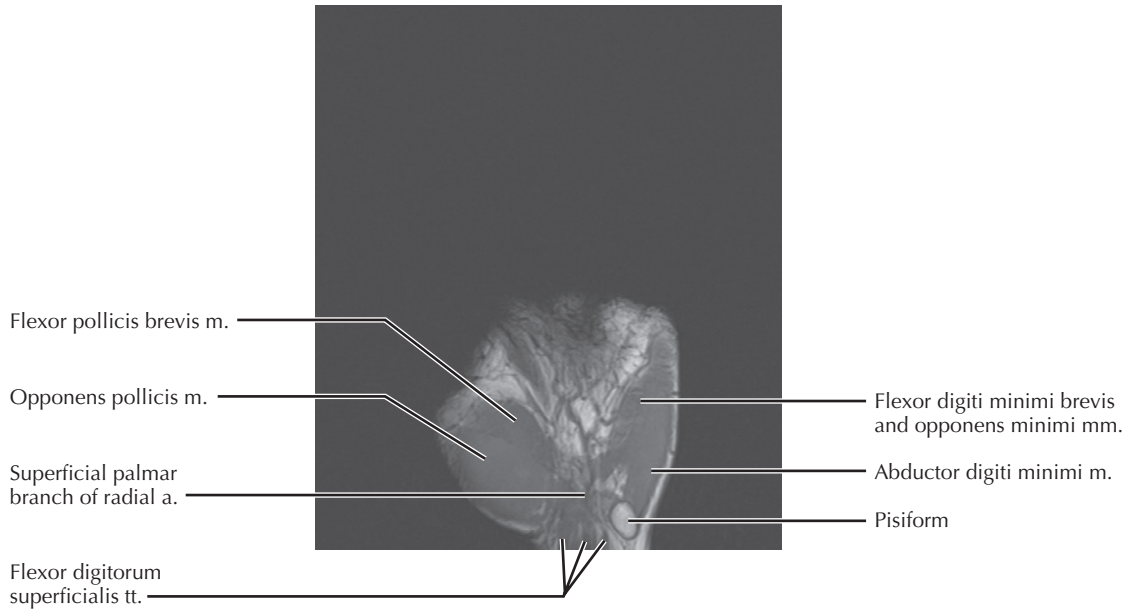
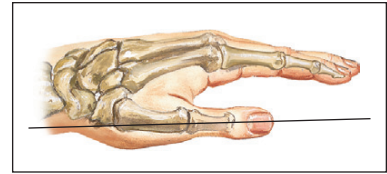


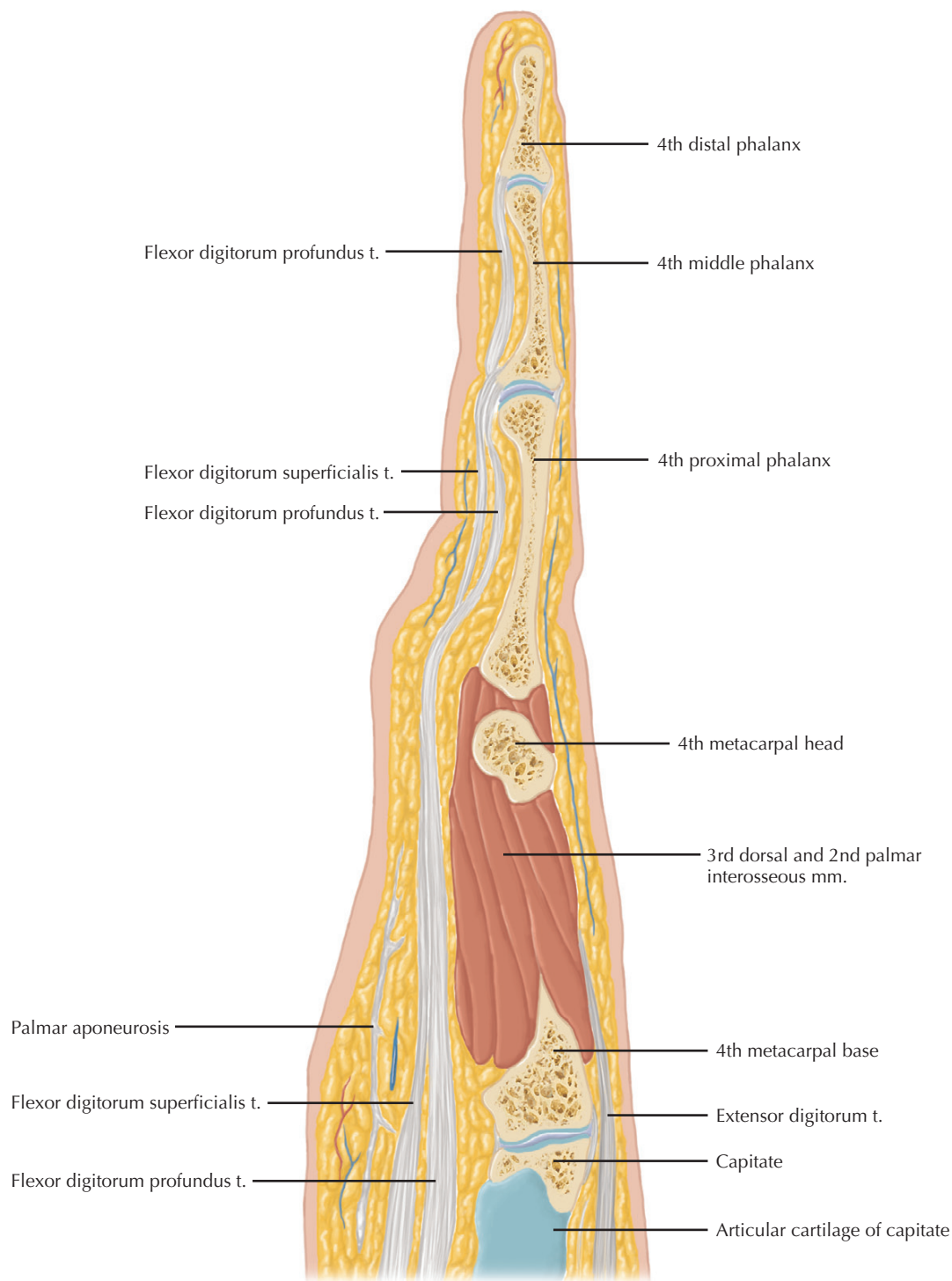


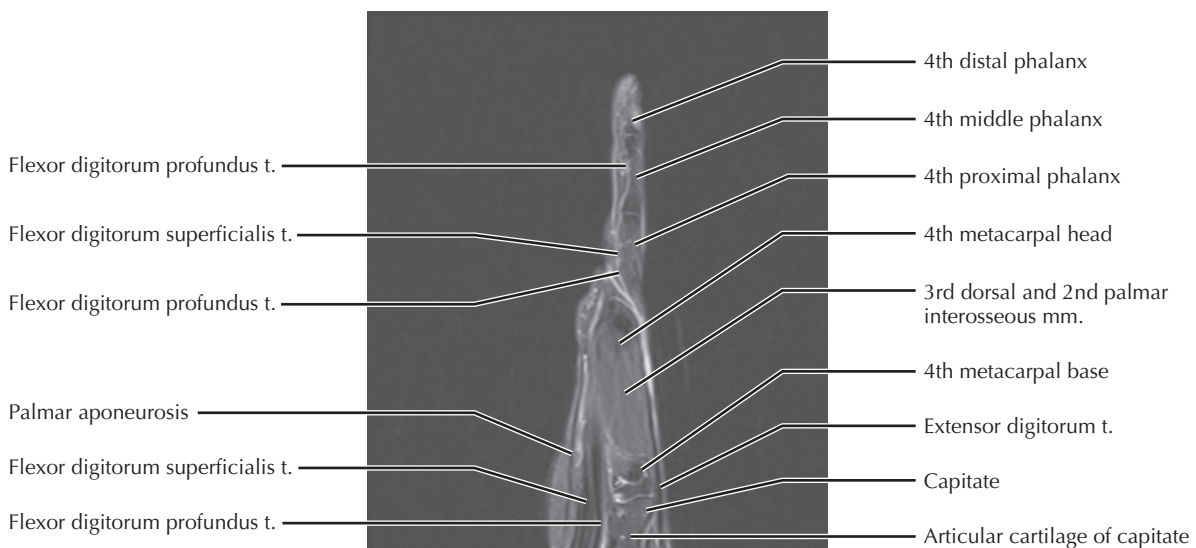
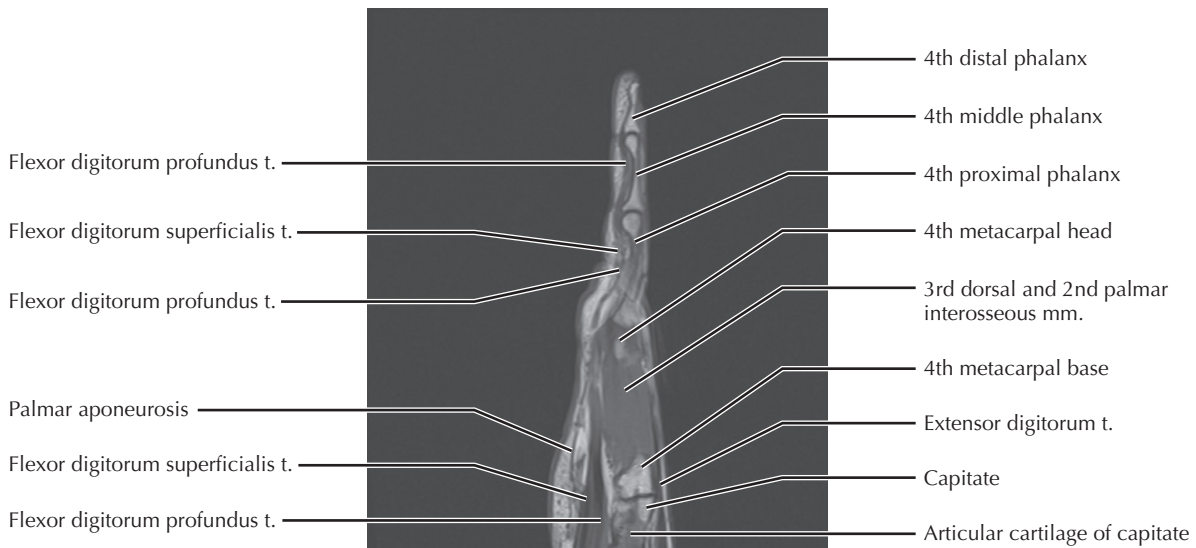
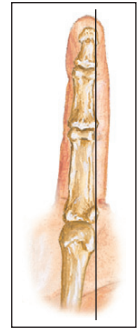


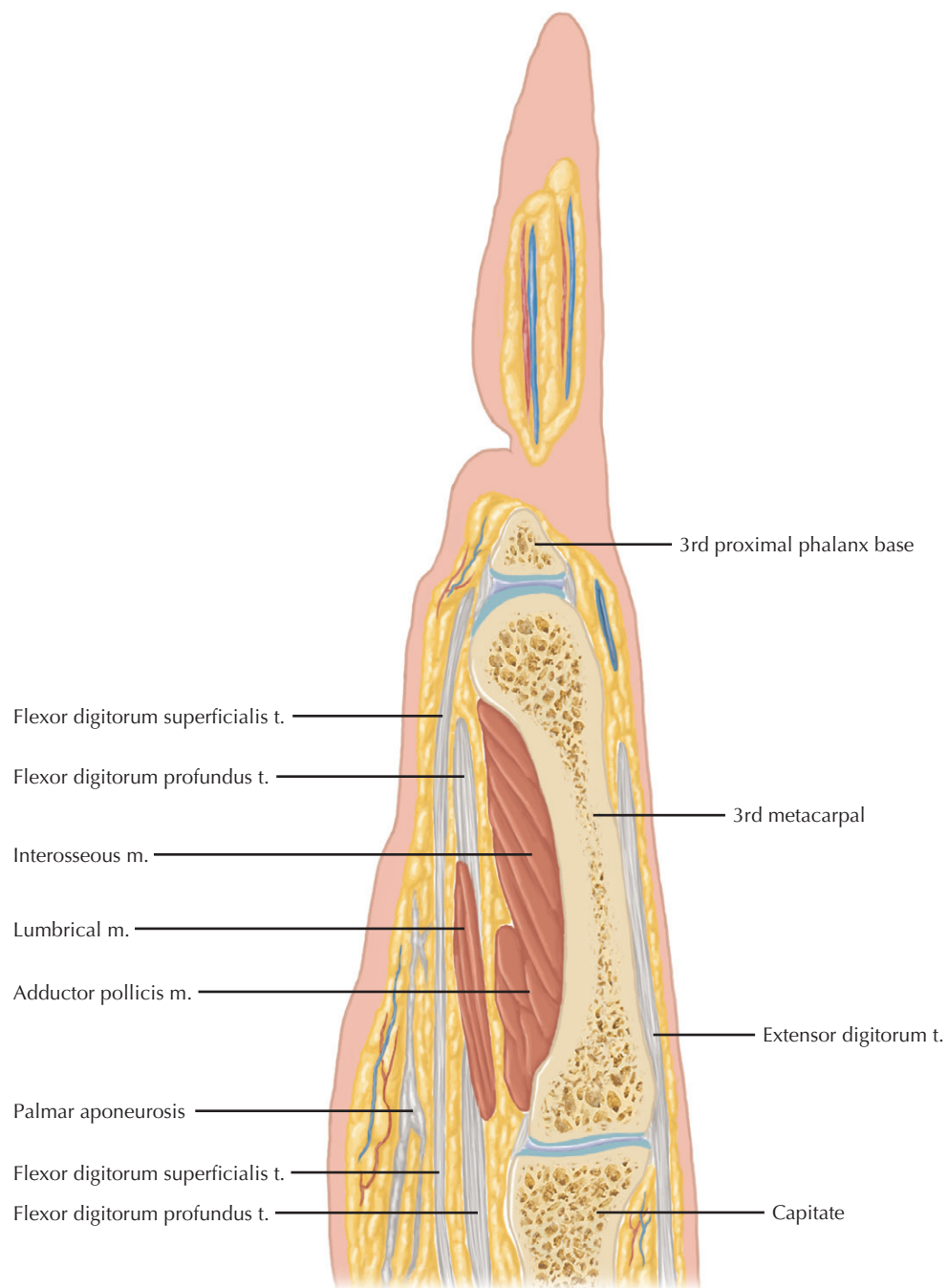


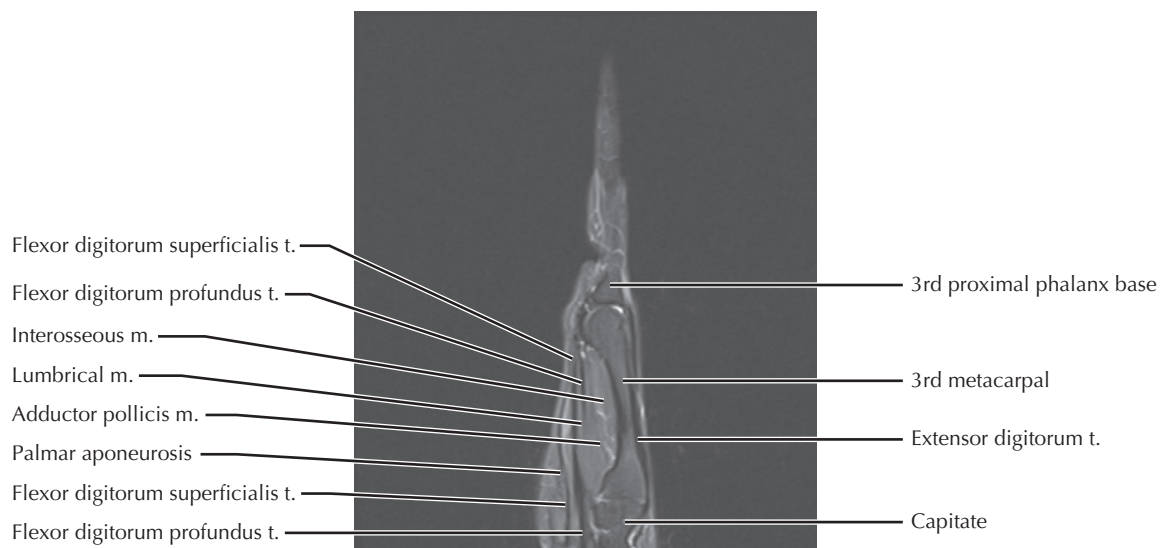
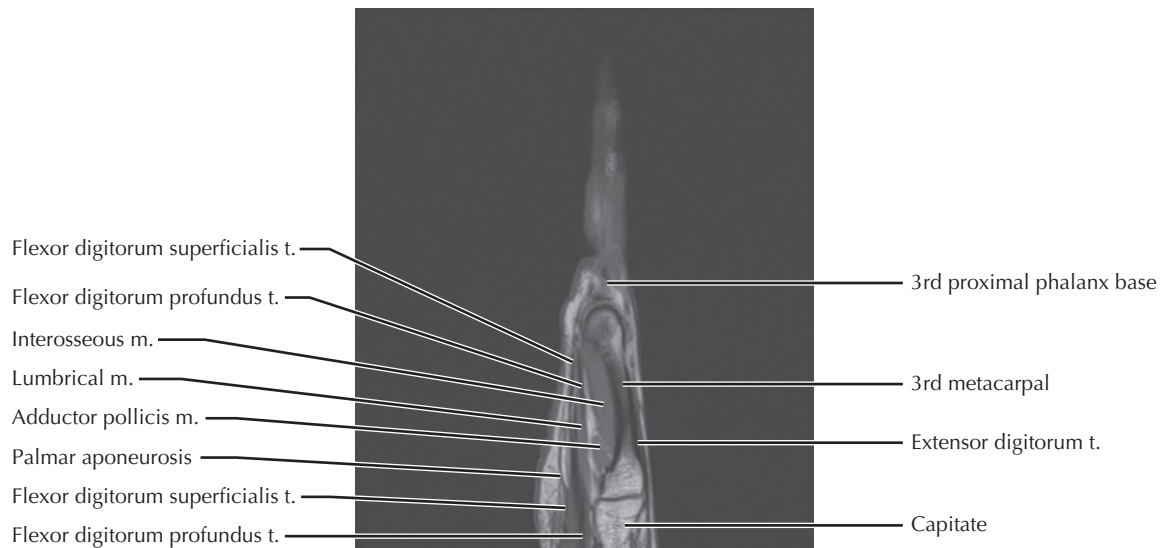
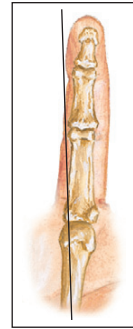


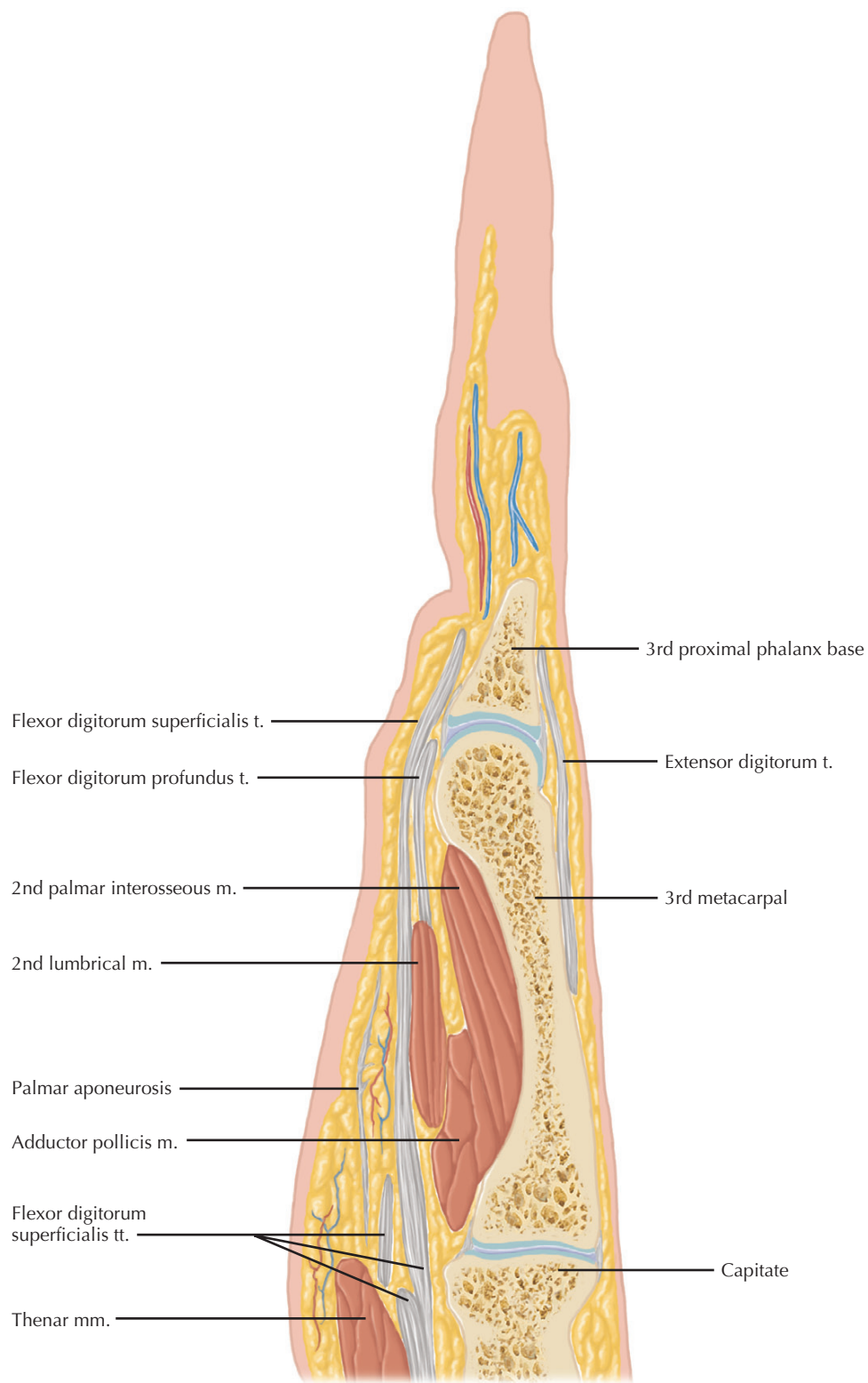


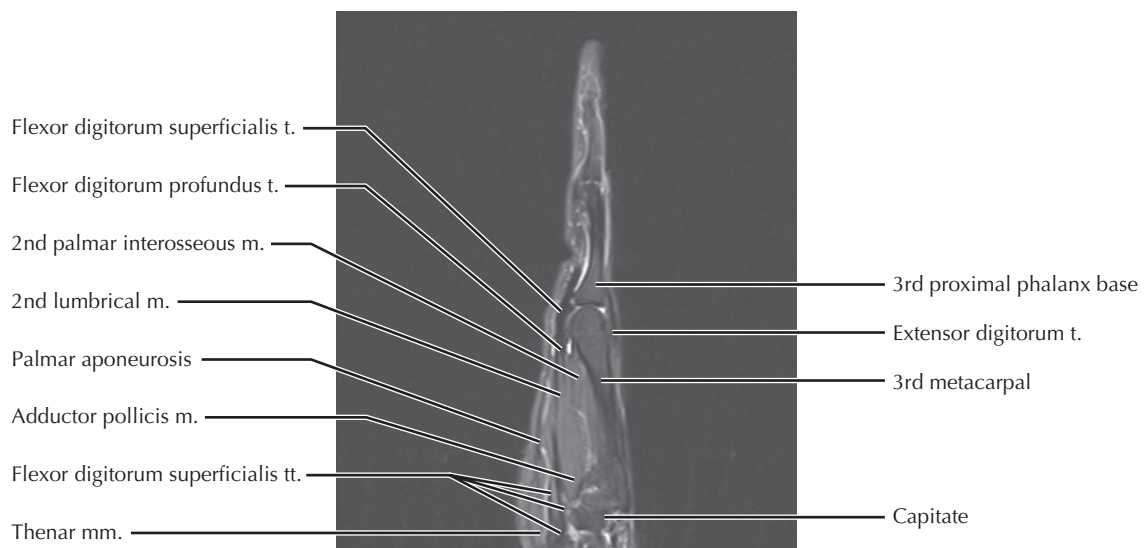
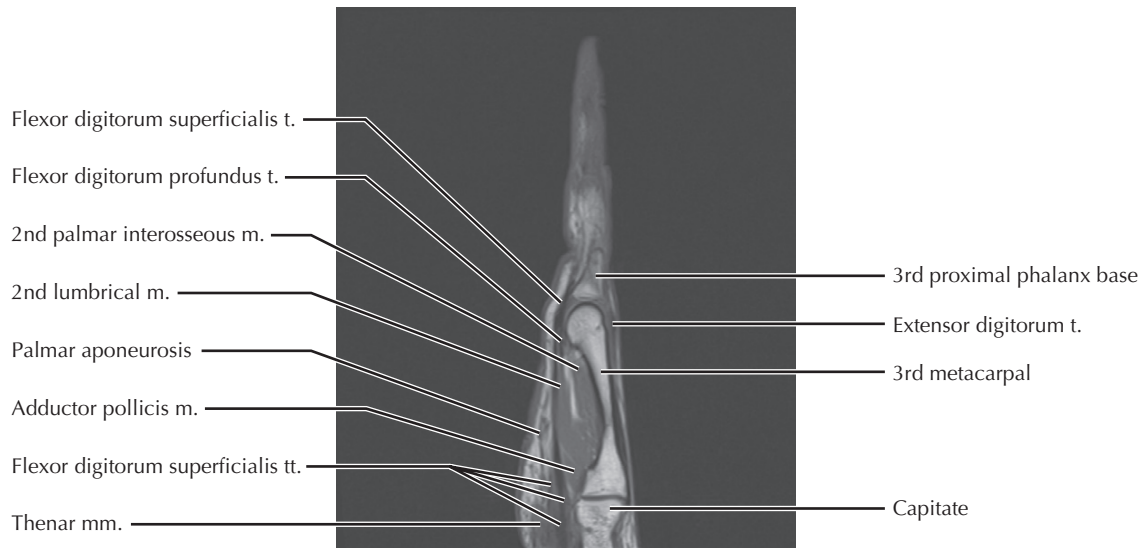
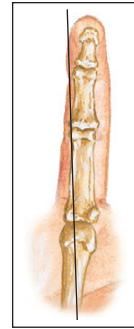


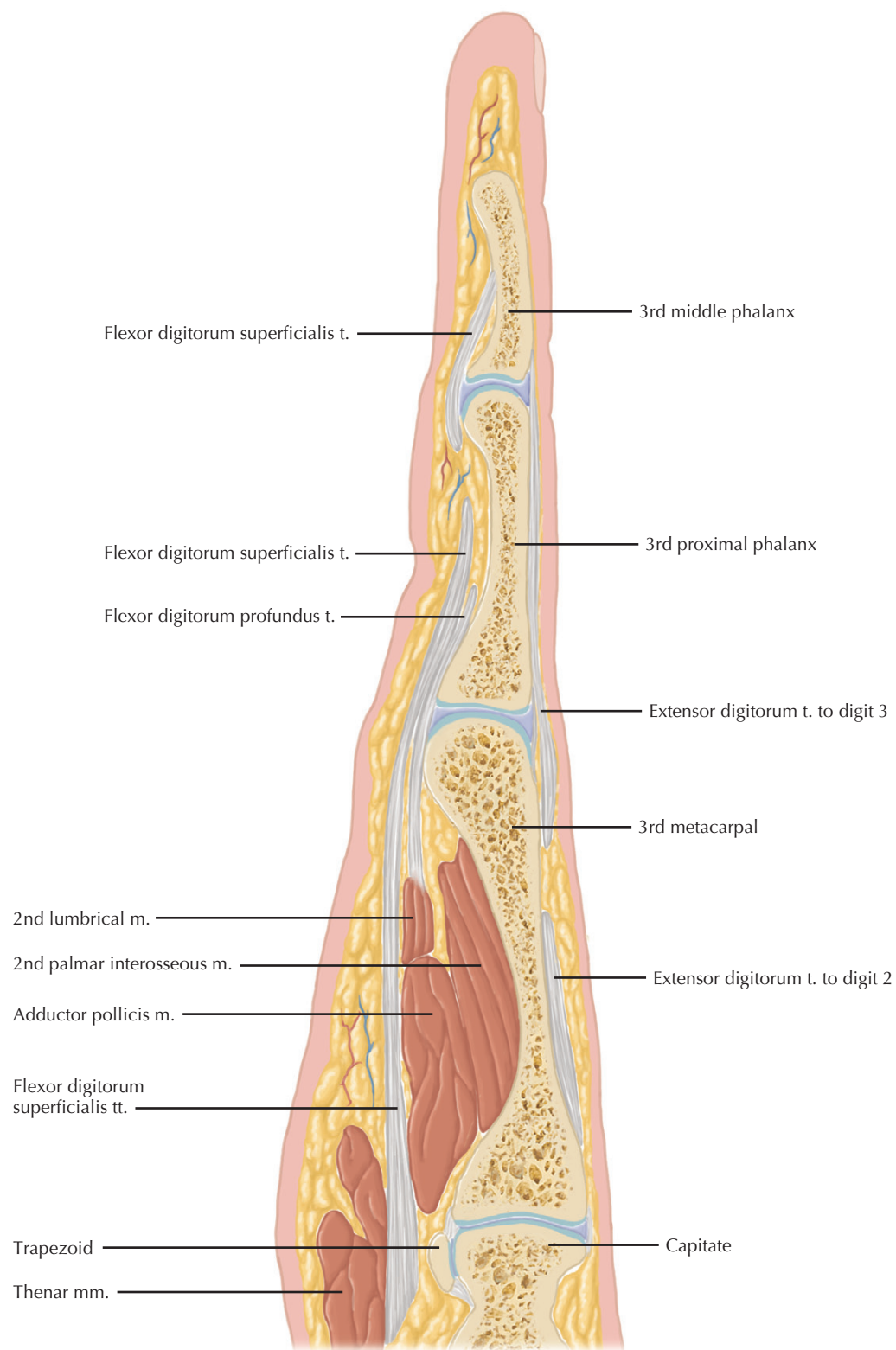


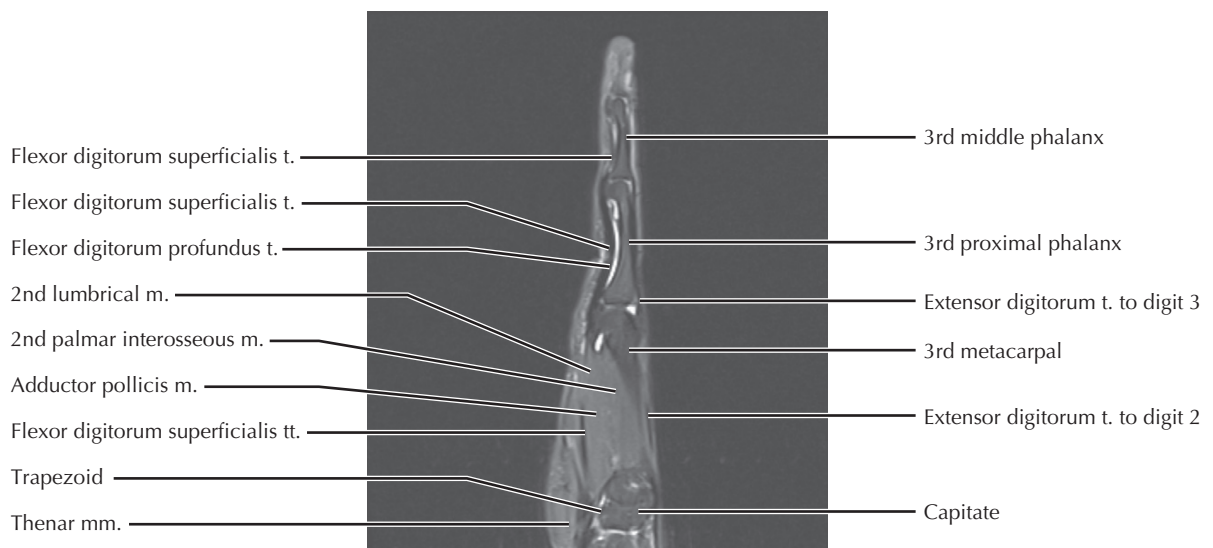
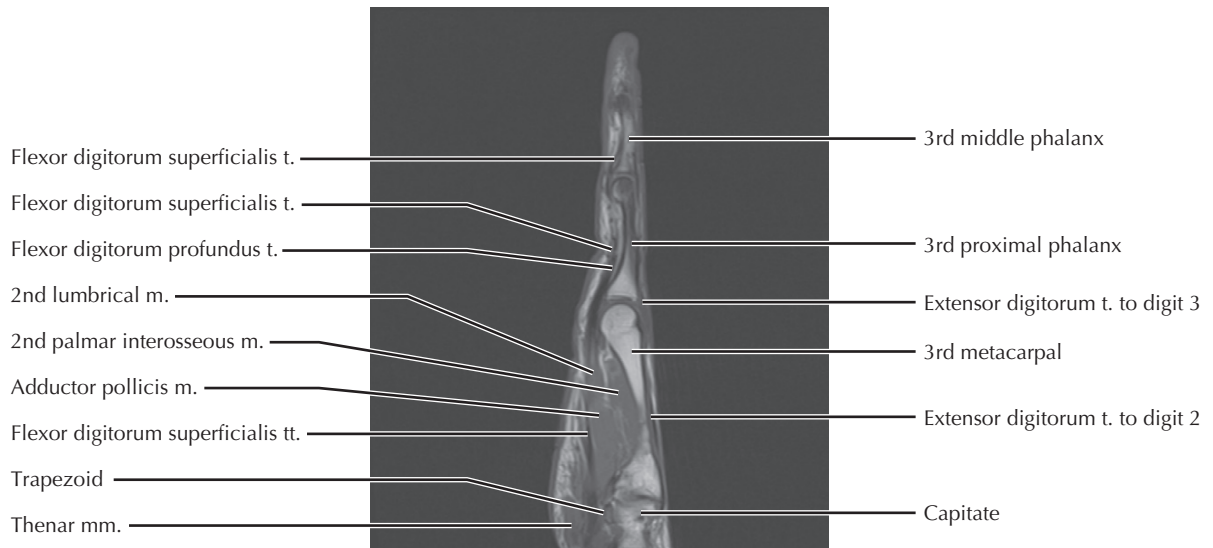
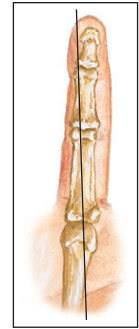


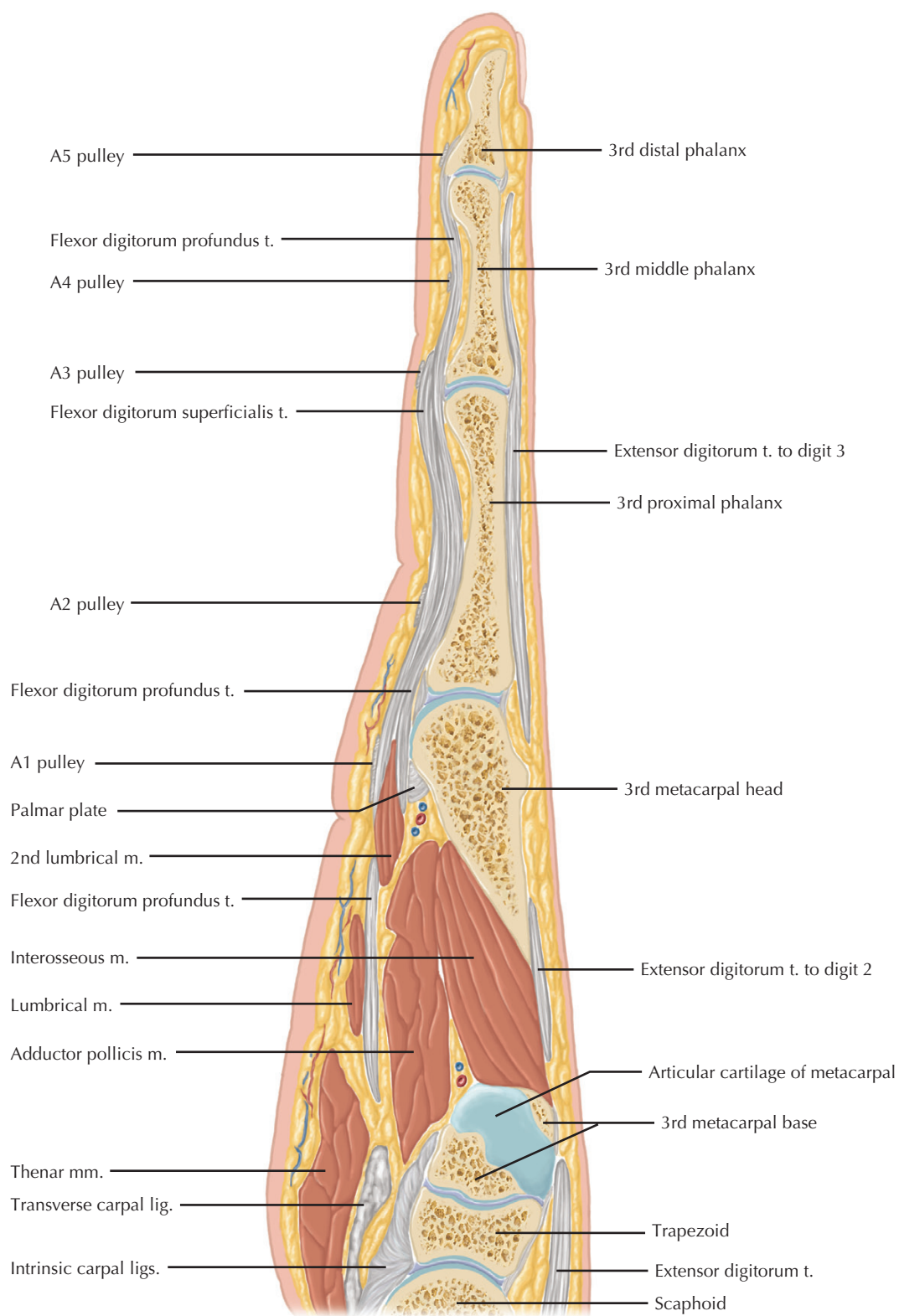


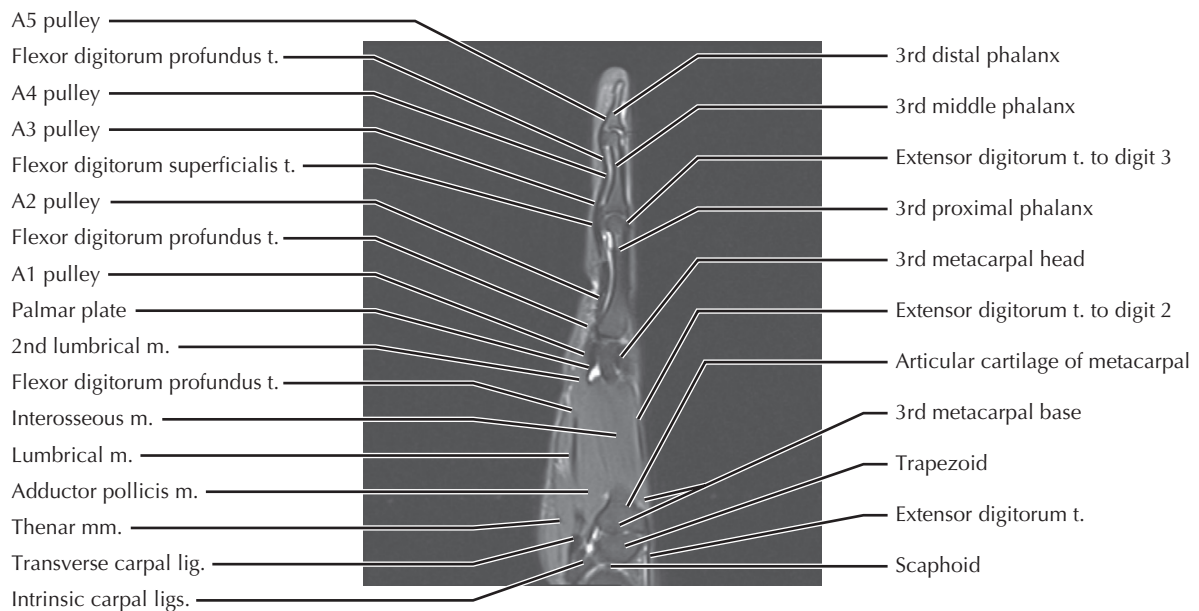
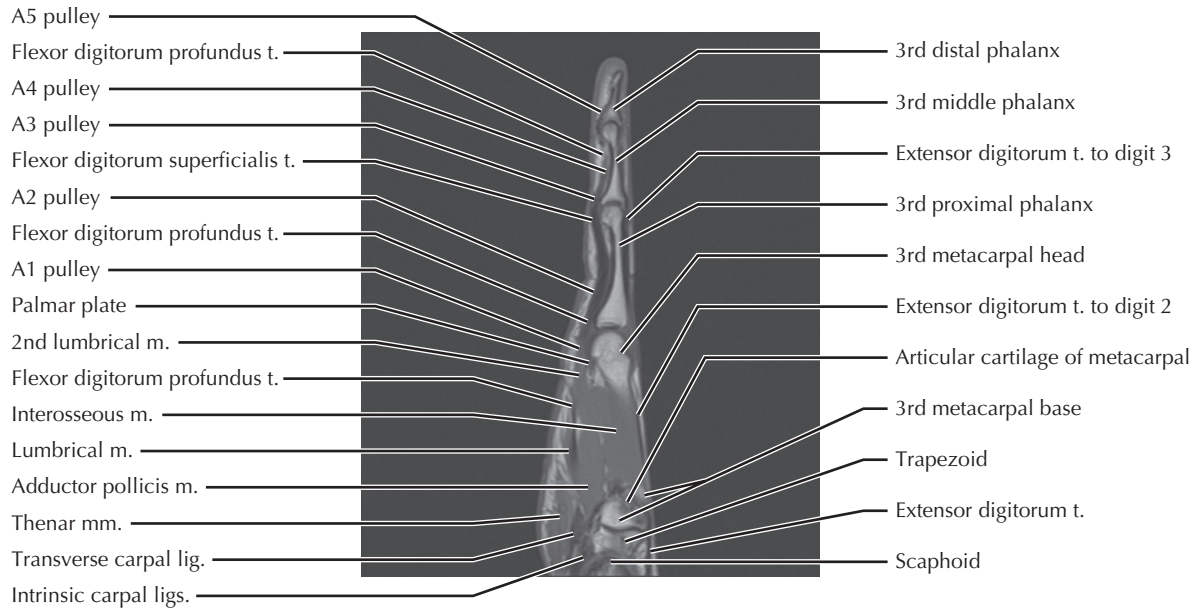
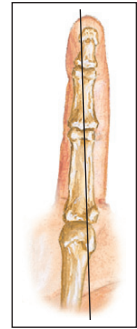


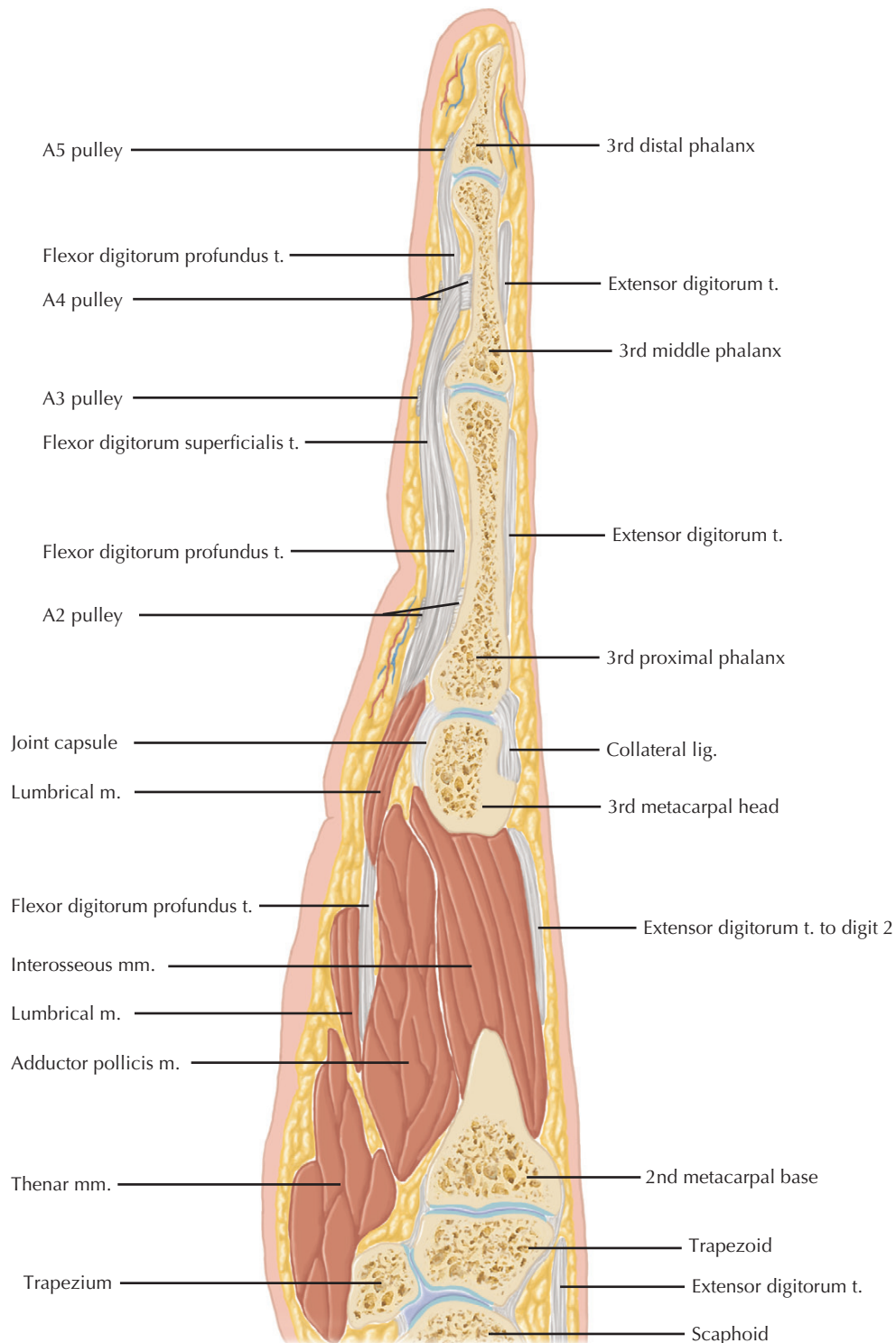








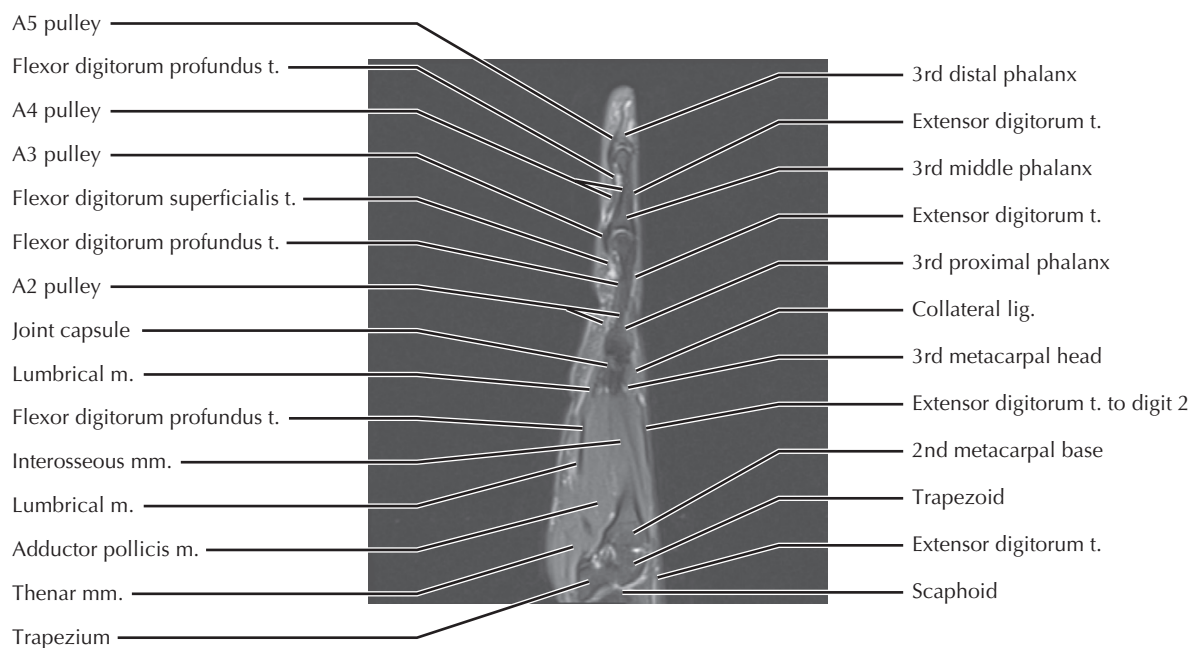
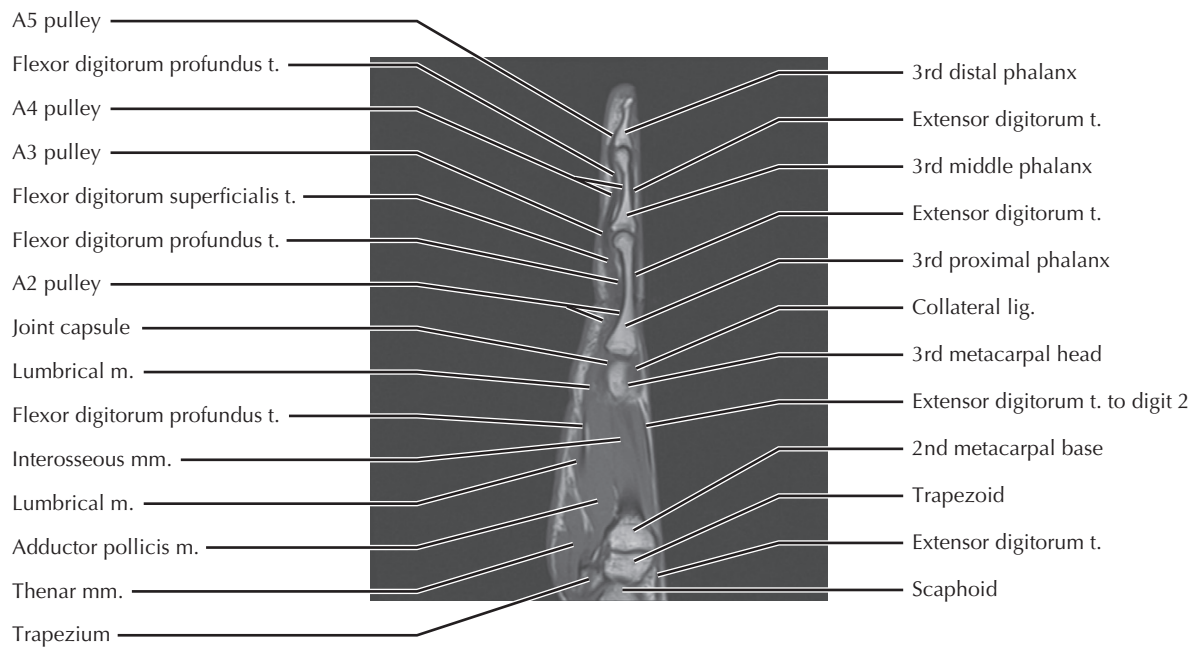
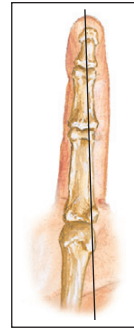


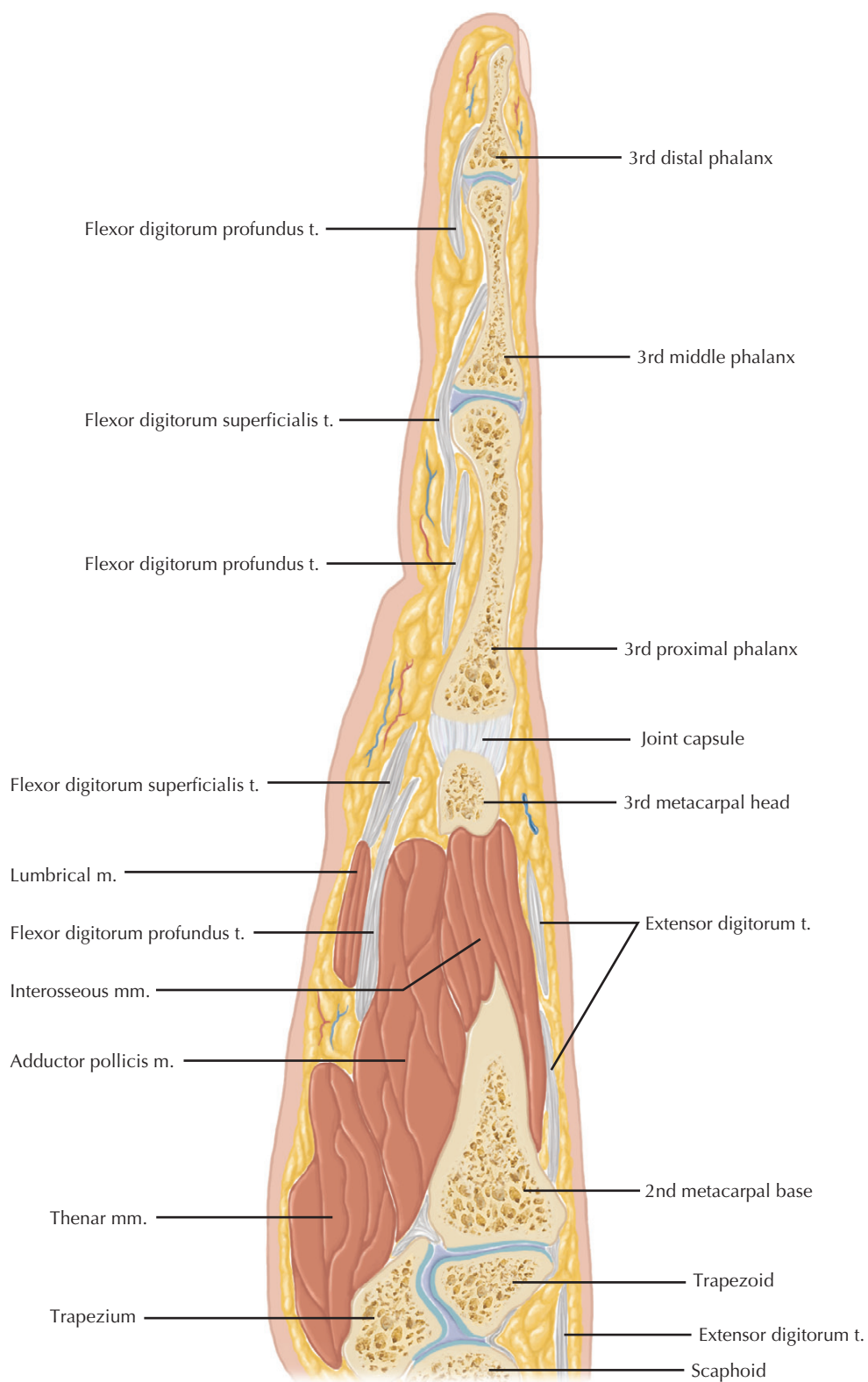


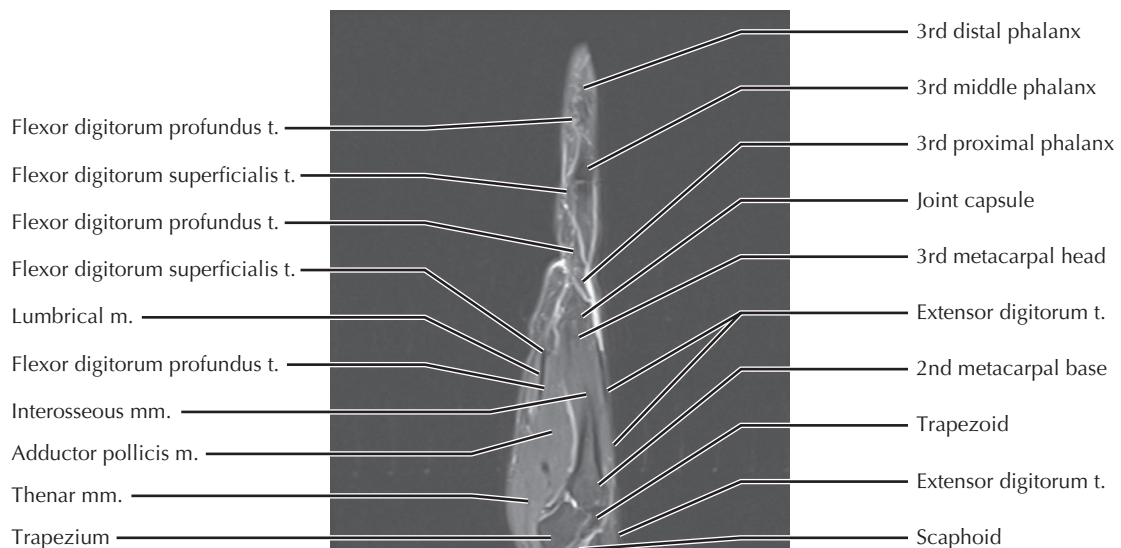
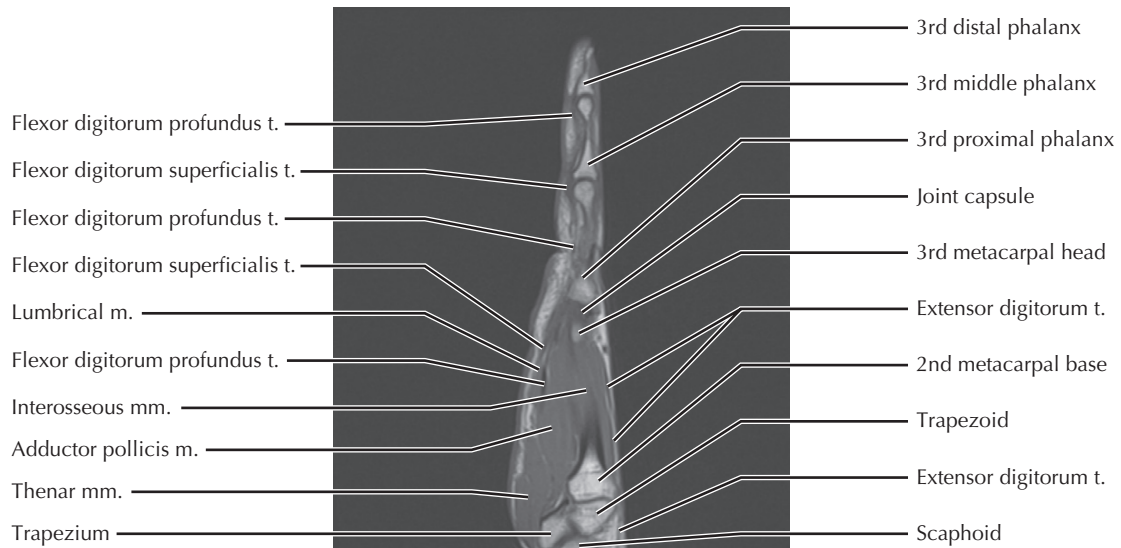
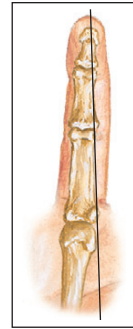
PATHOLOGIC PROCESS

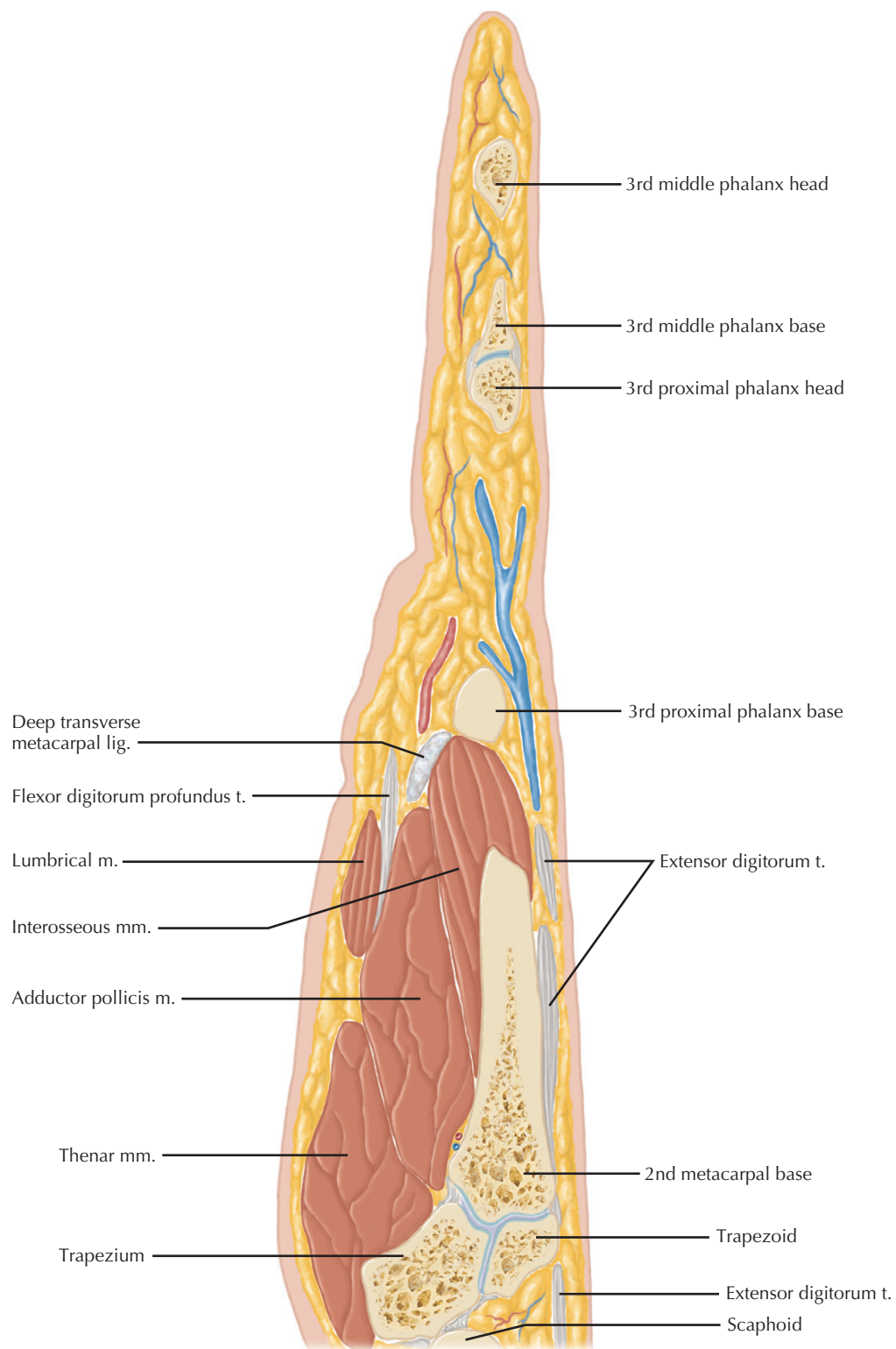
The flexor digitorum tendons are normally closely apposed to the palmar surfaces of the phalanges because they are held in position by pulley ligaments. If the pulley ligaments rupture, the tendons are free to become displaced from the bone, leading to a "bowstring" appearance.

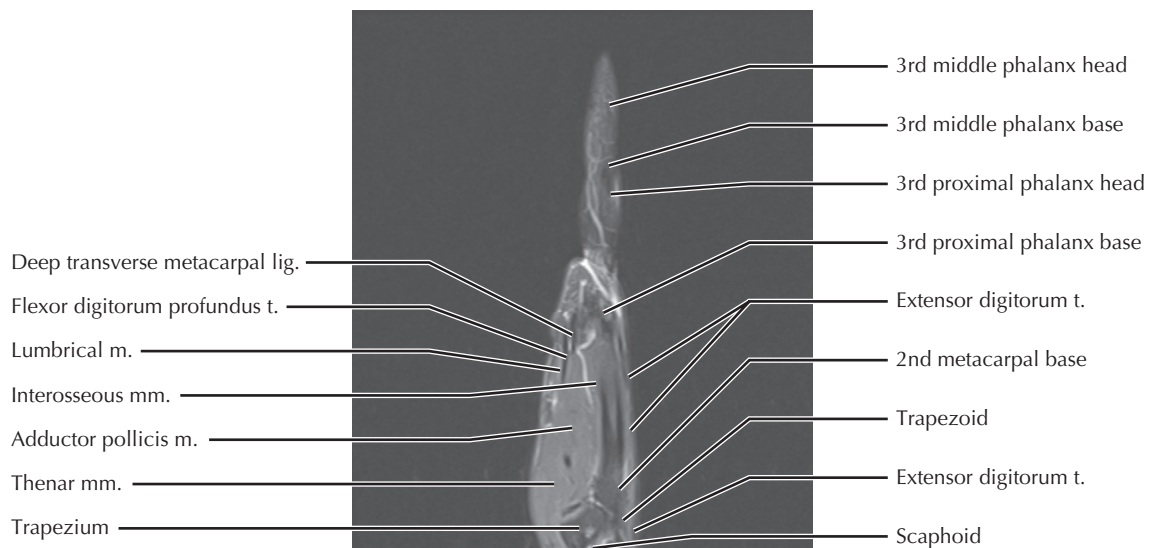
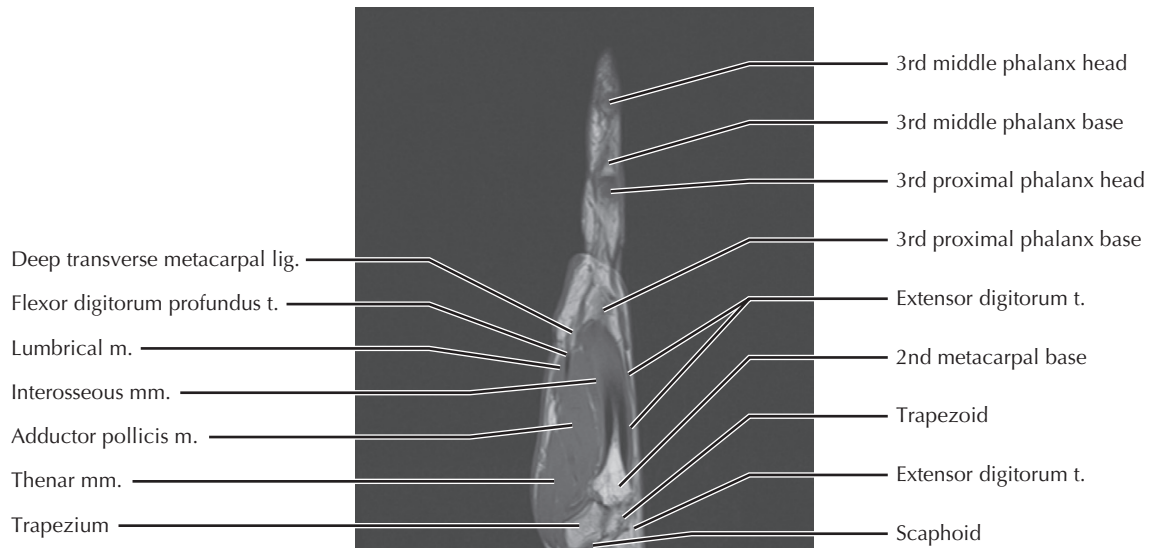
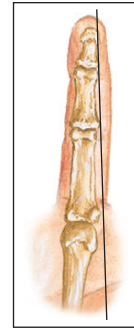
Studies have shown that the A2 pulley is the strongest, followed by the A1 and A4 pulleys. The pattern of injury follows a progressive and predictable course. Disruption begins at the distal part of the A2 pulley and progresses from partial to complete rupture, which is followed by involvement of the A3, A4, and, in rare situations, A1 pulleys.









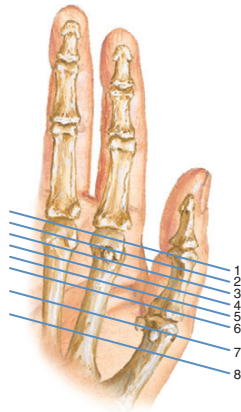


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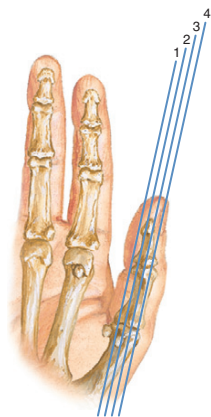
Chapter

8

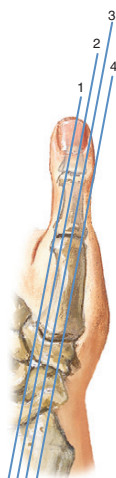
THUMB



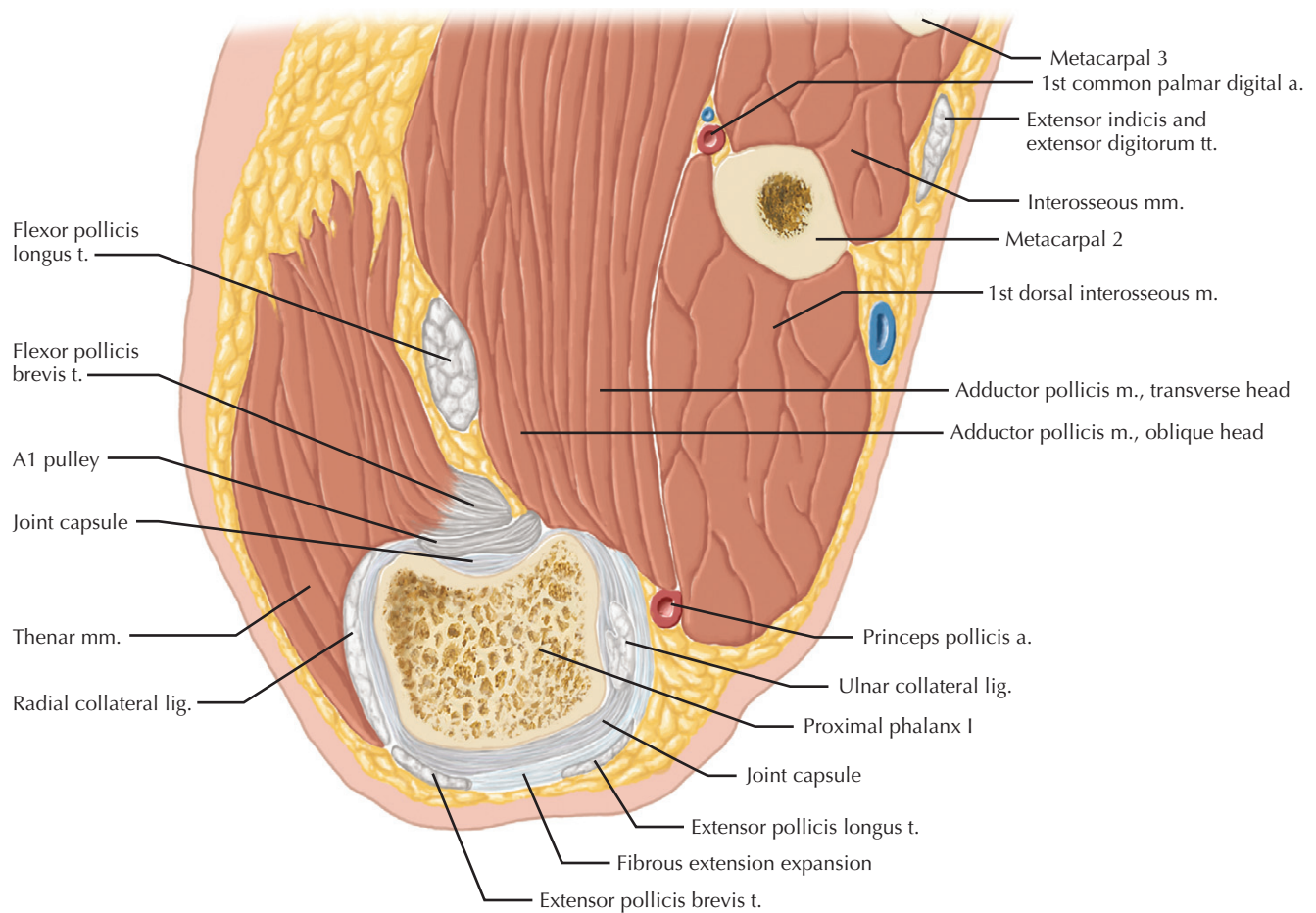
AXIAL 304

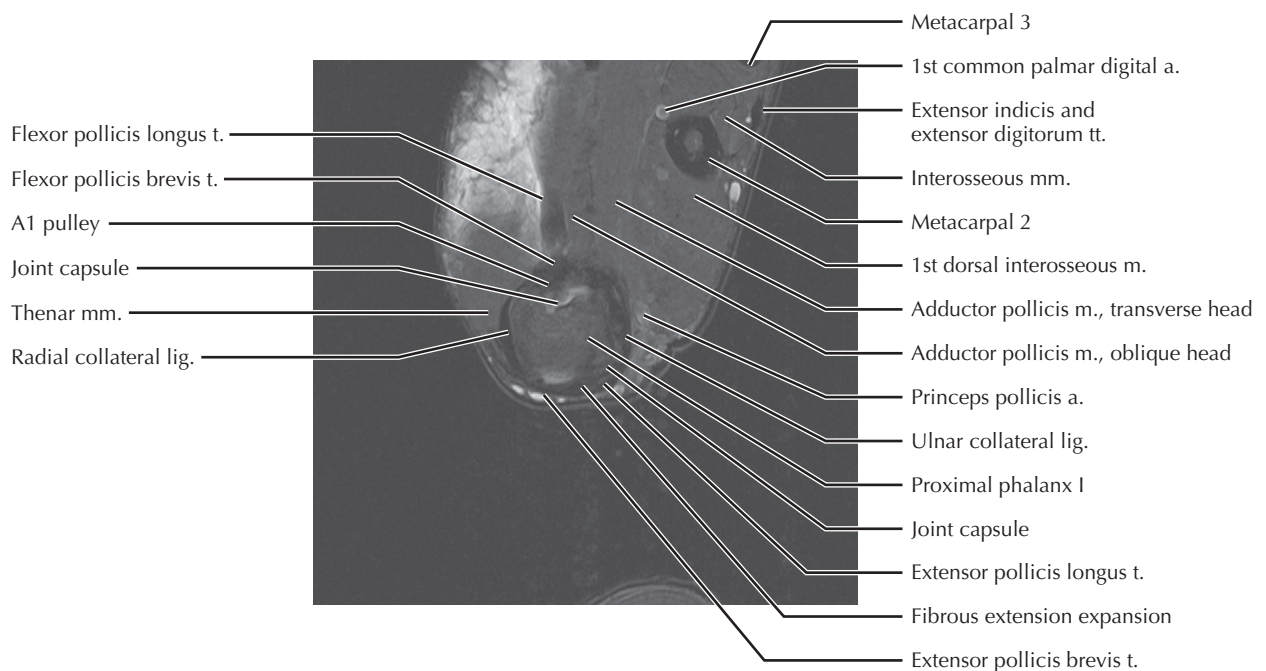
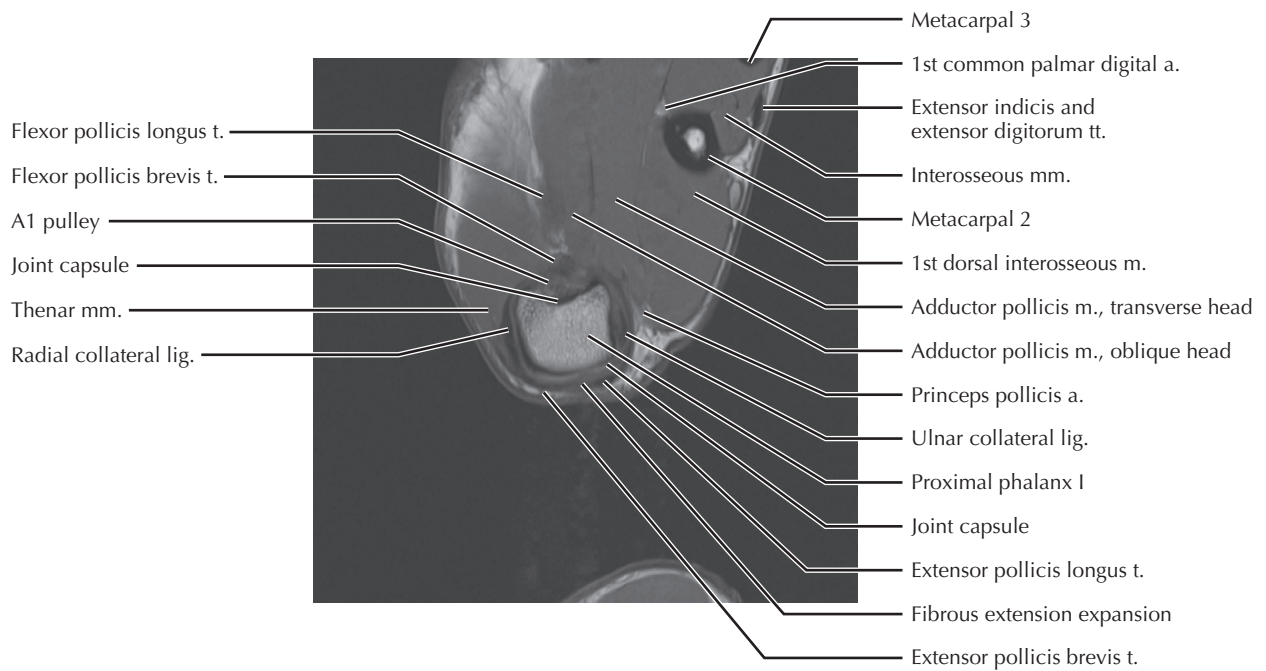
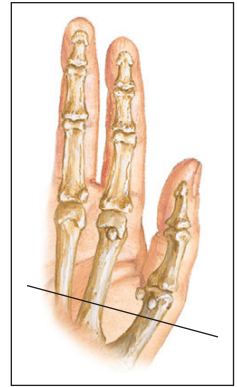


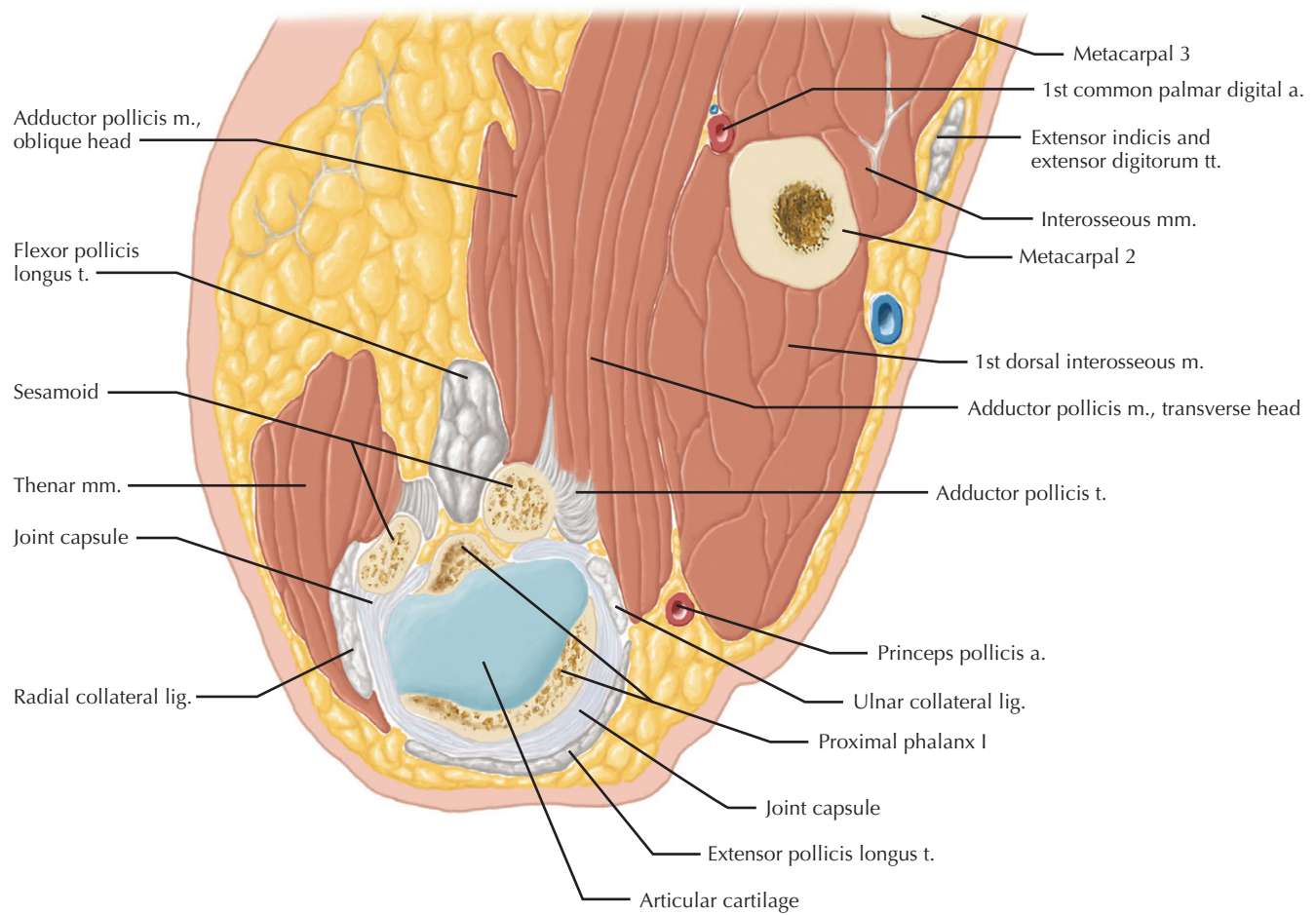
CORONAL 320

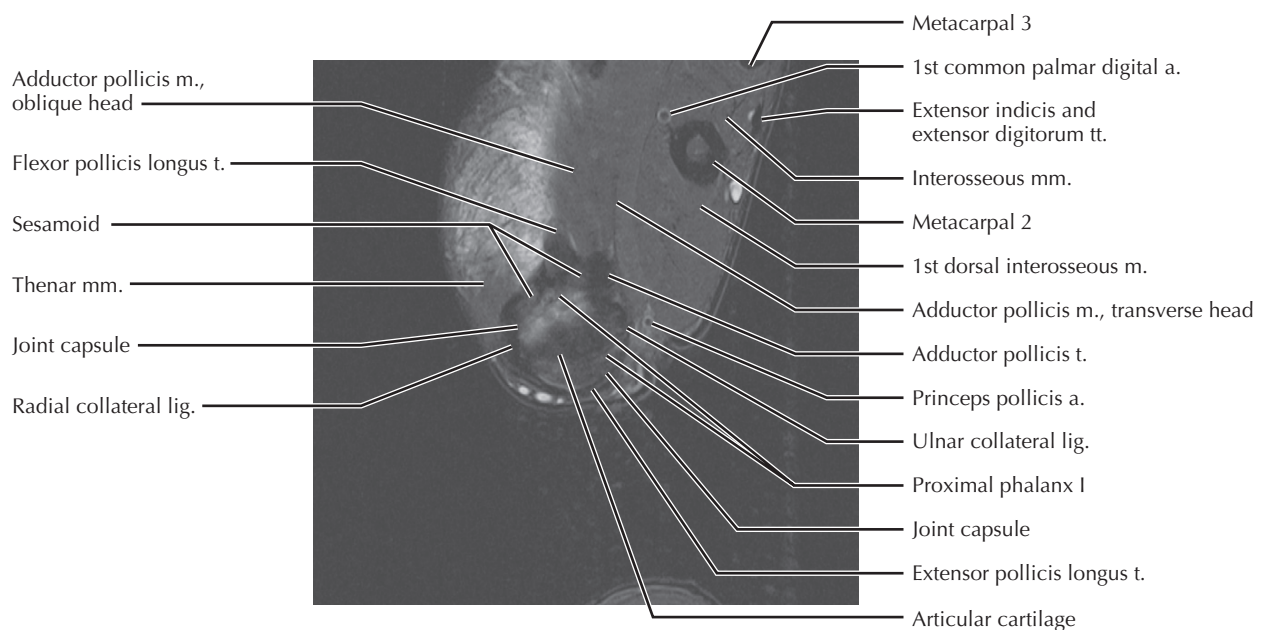
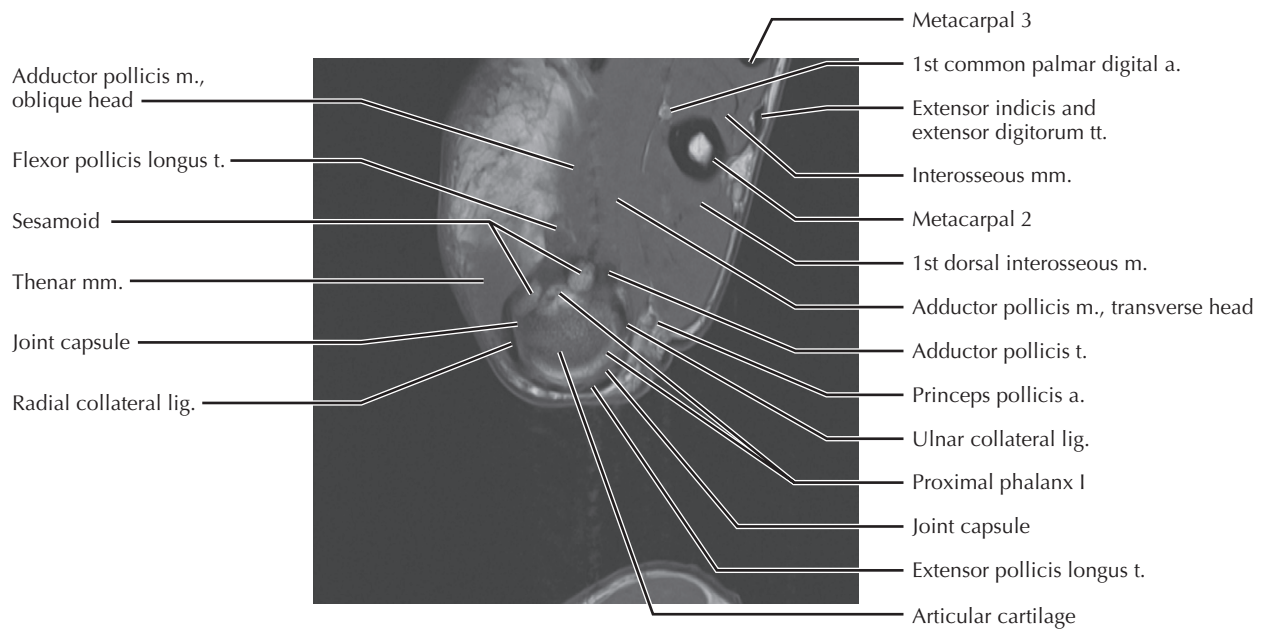
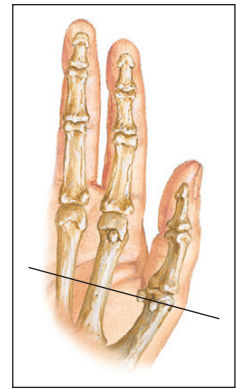


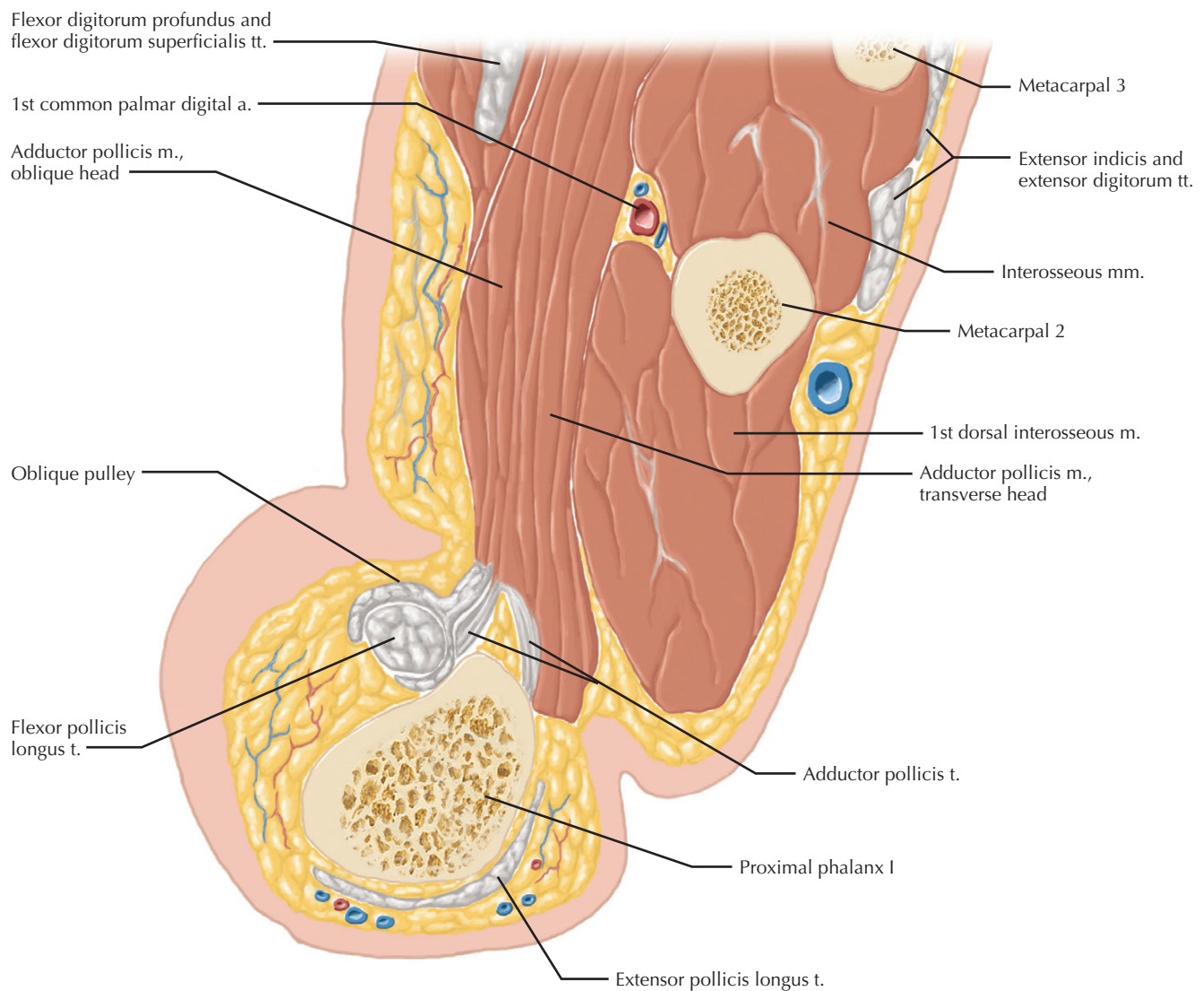
SAGITTAL 328

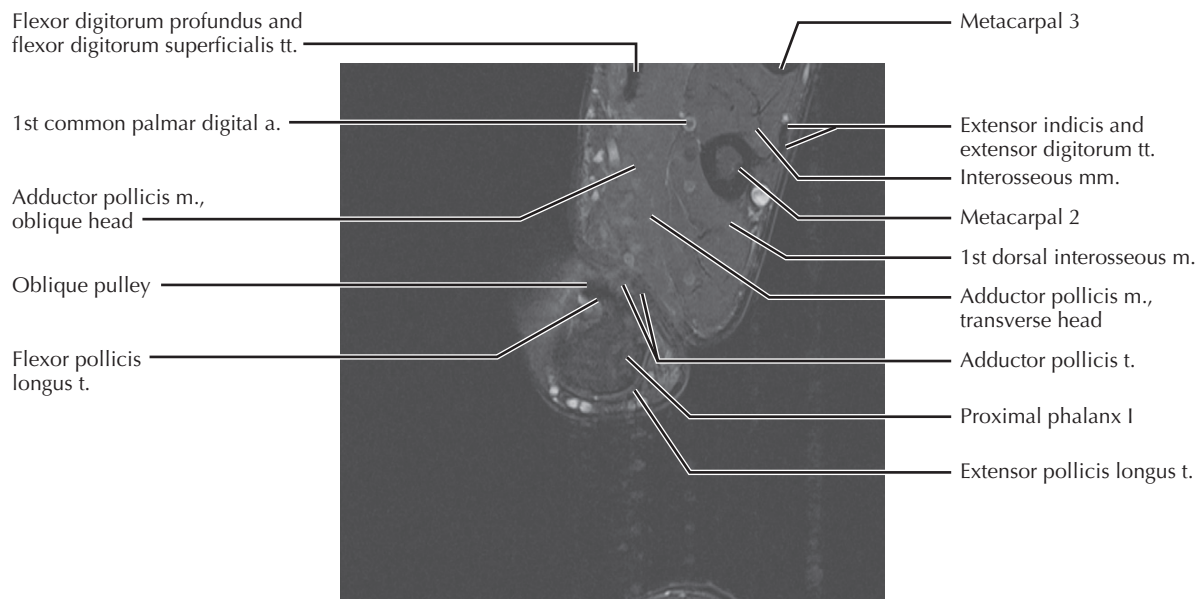
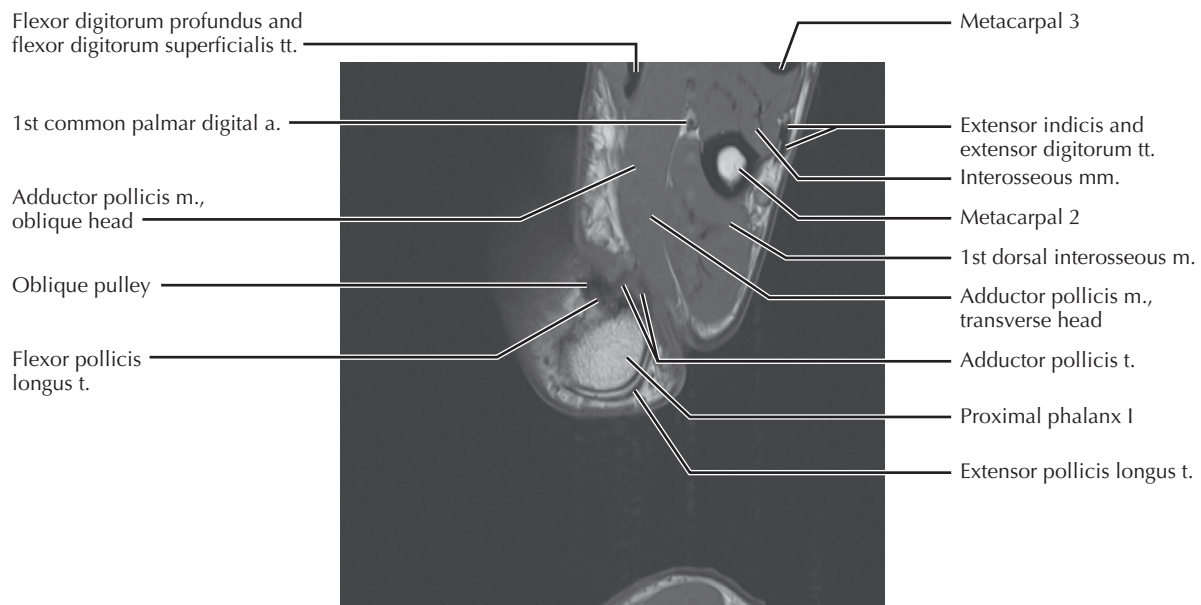
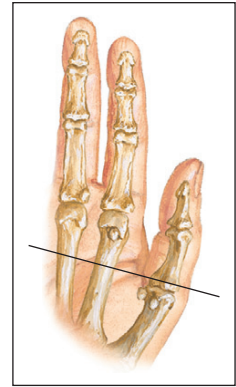


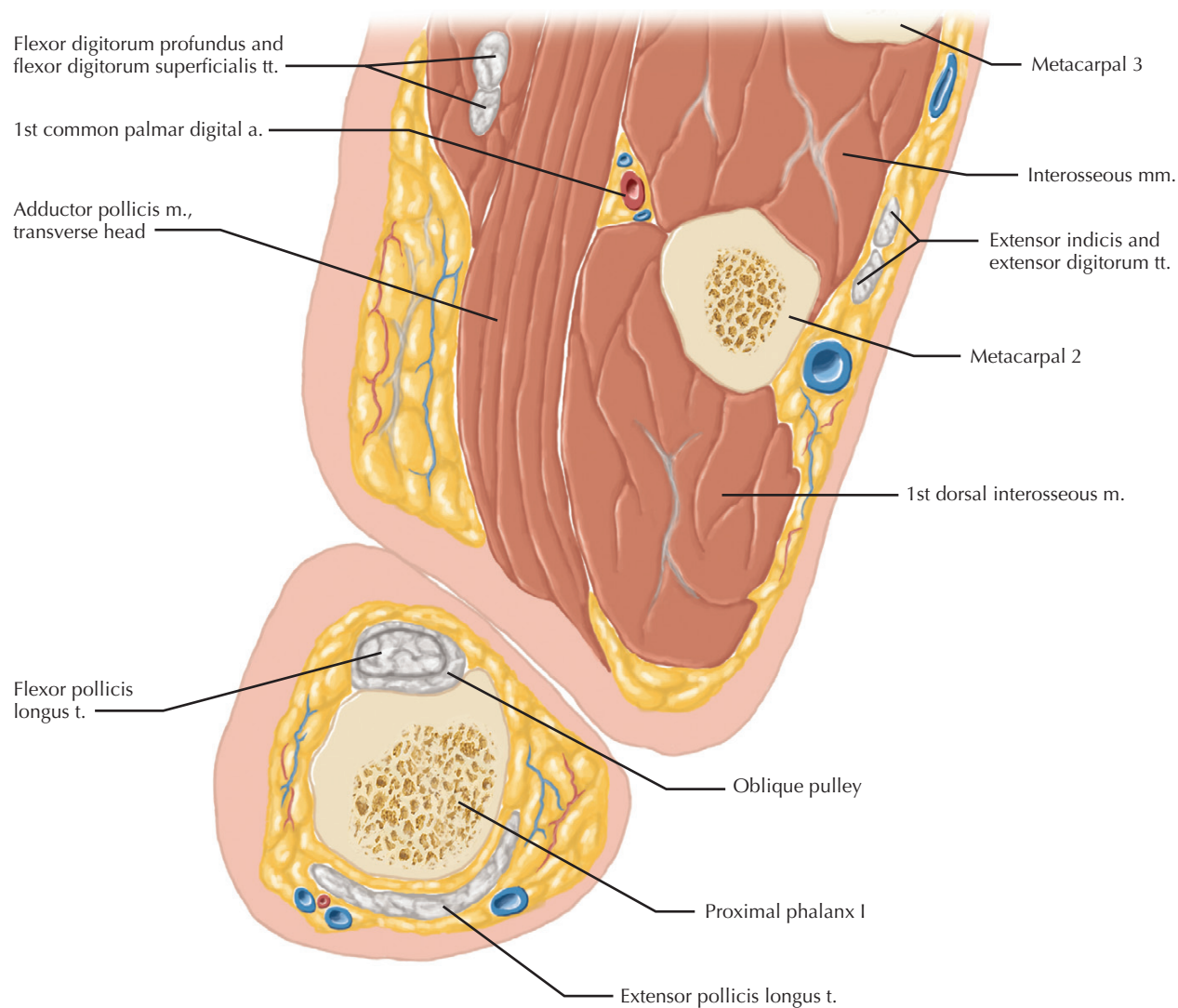


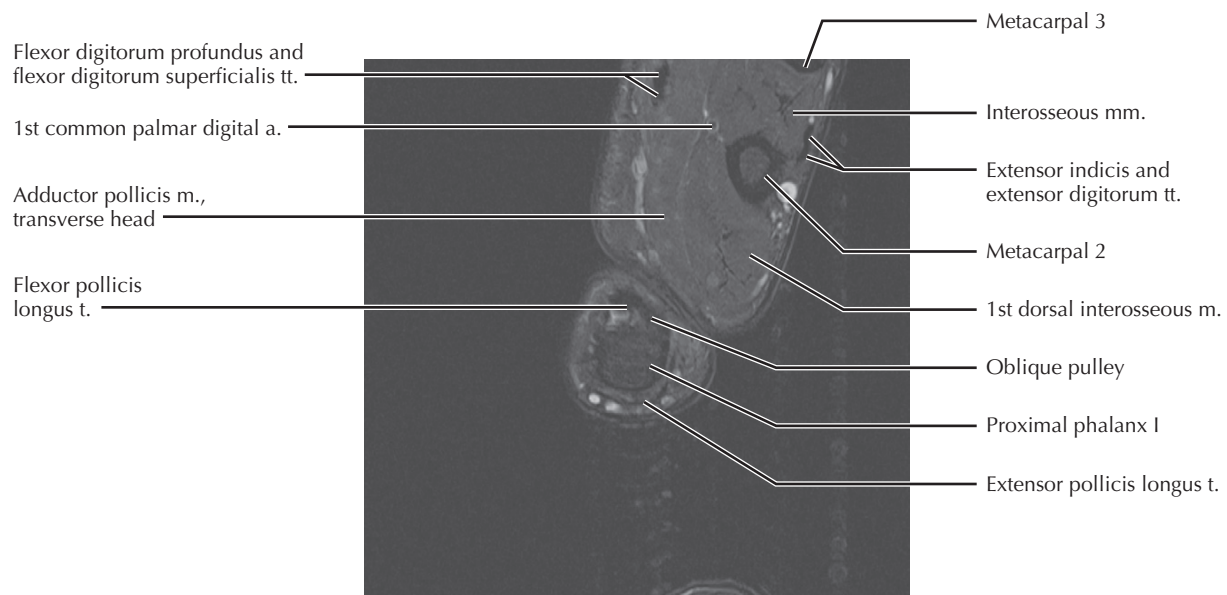
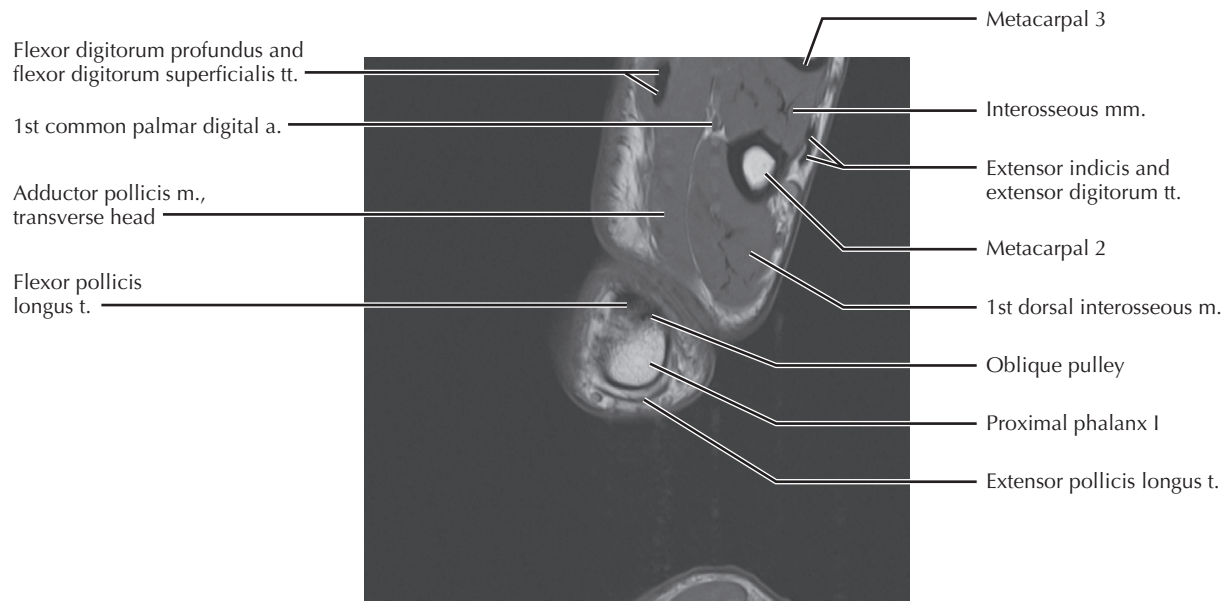
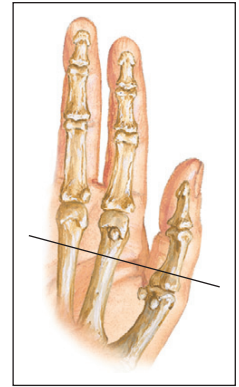


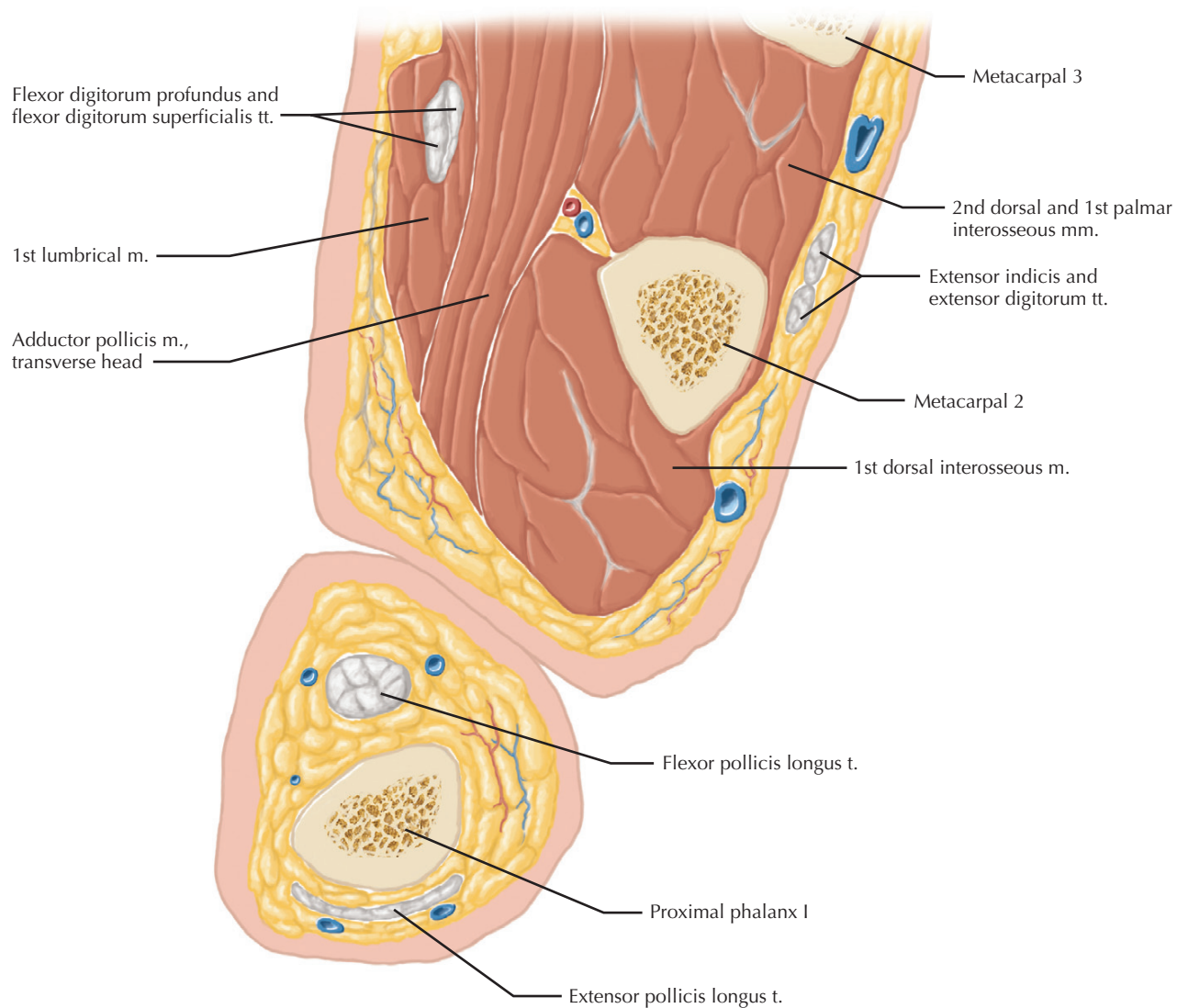


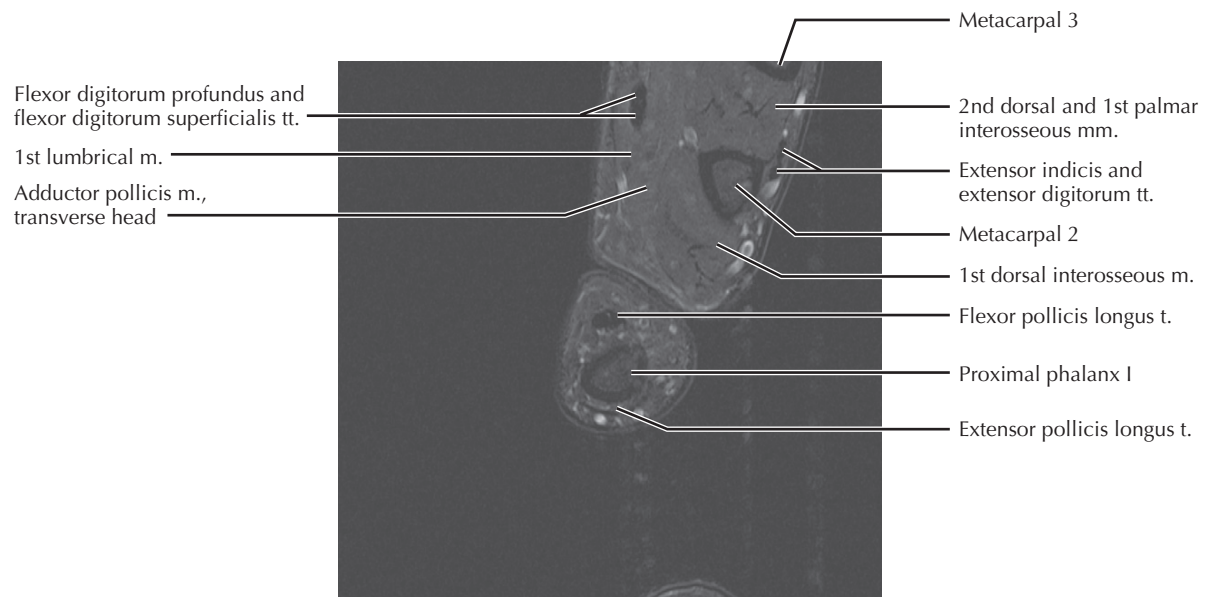
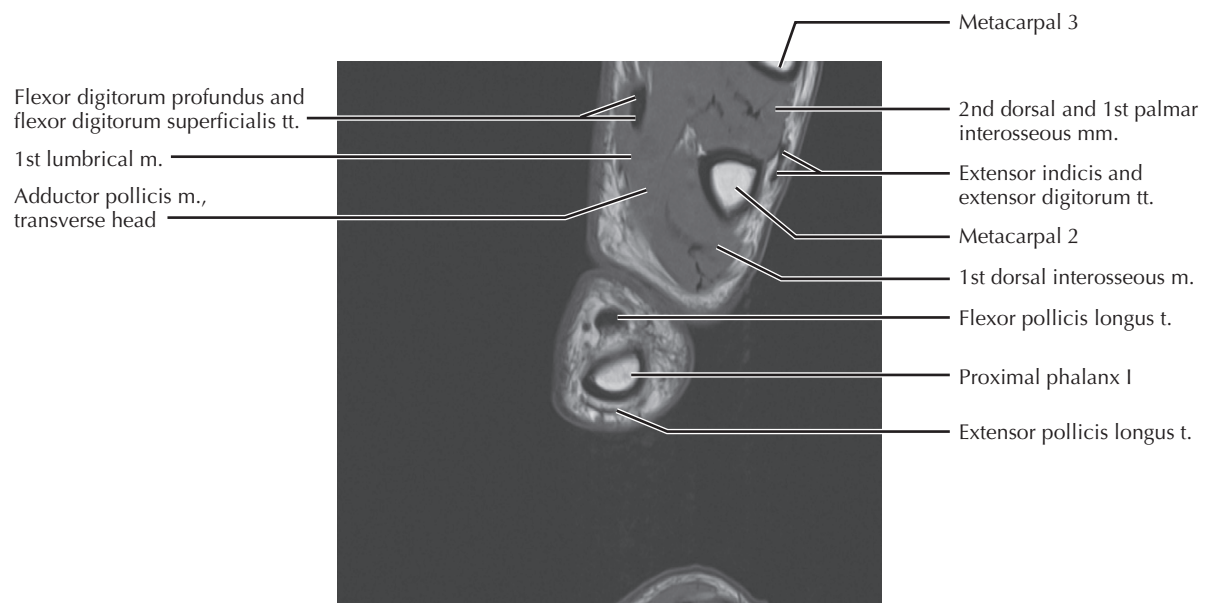
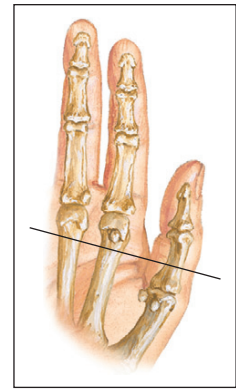


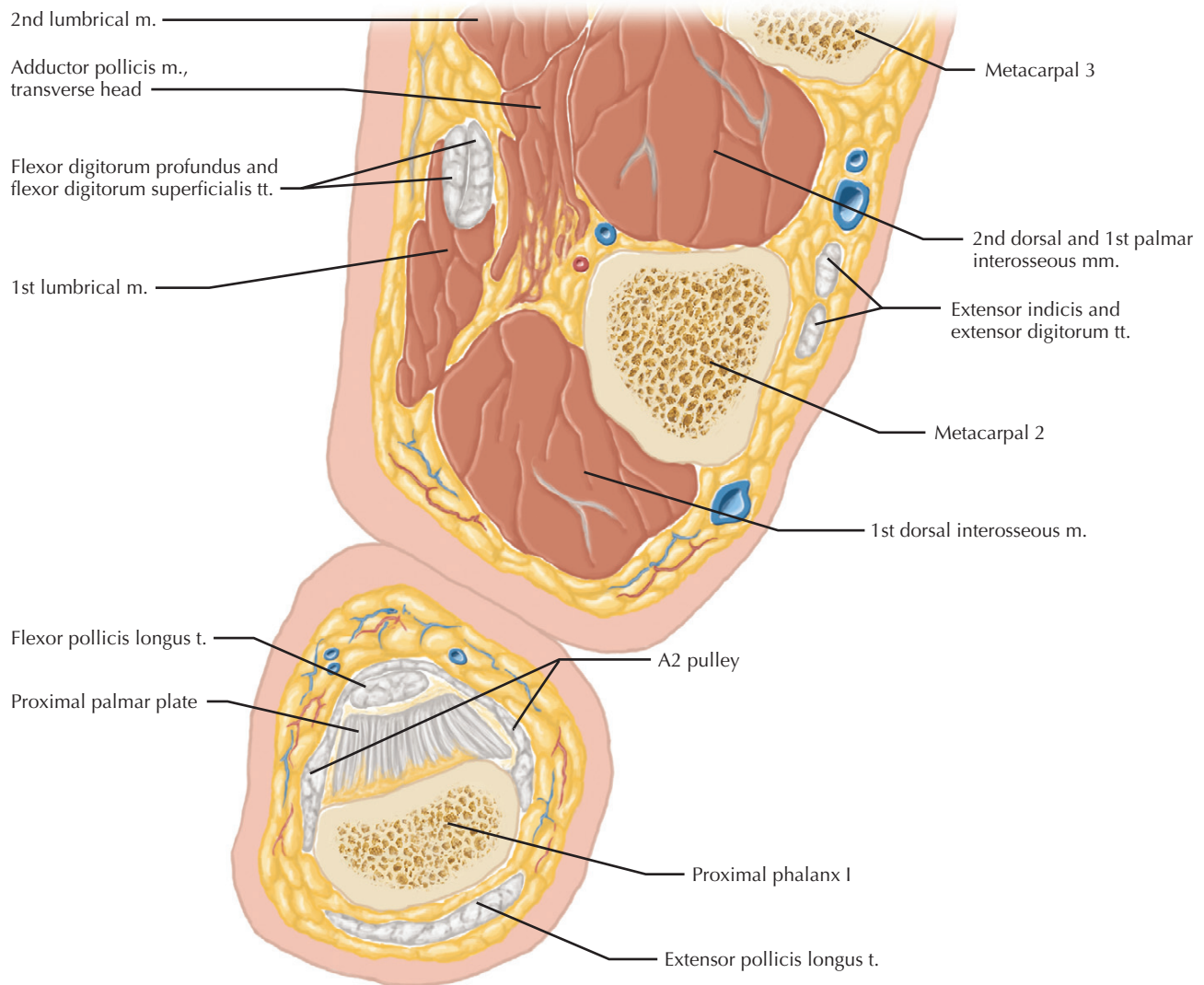


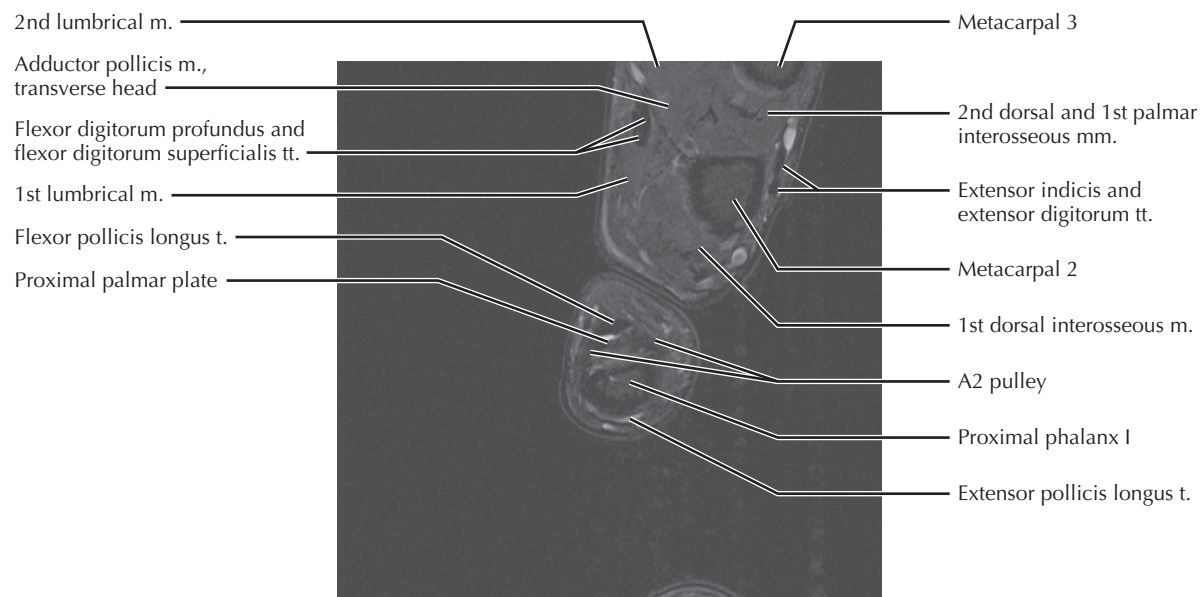
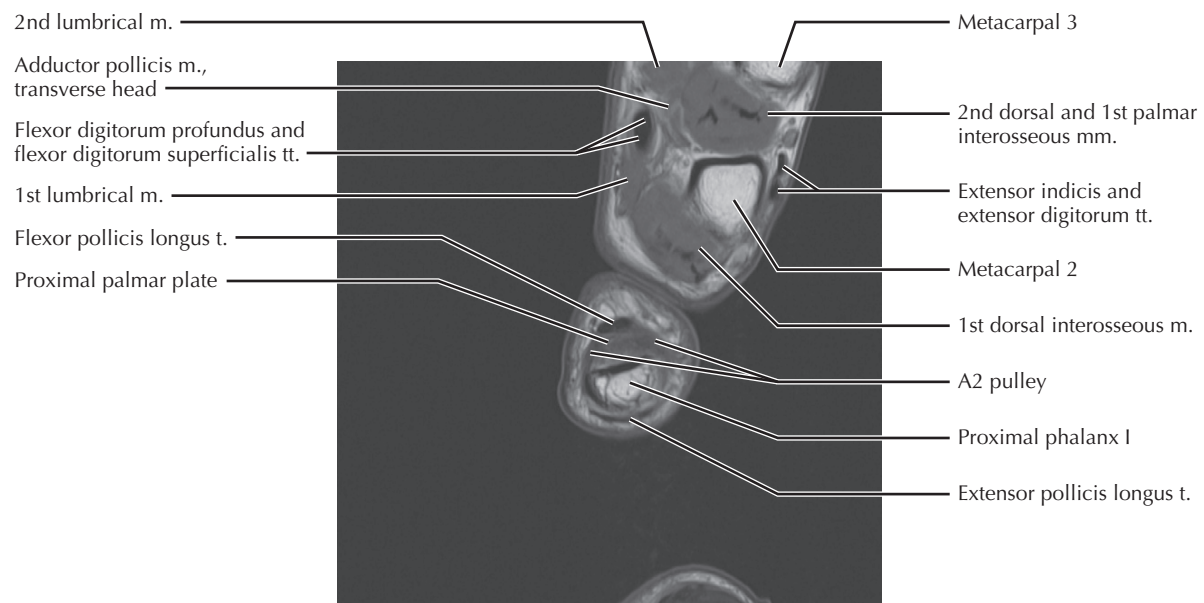
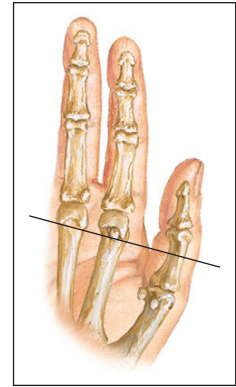


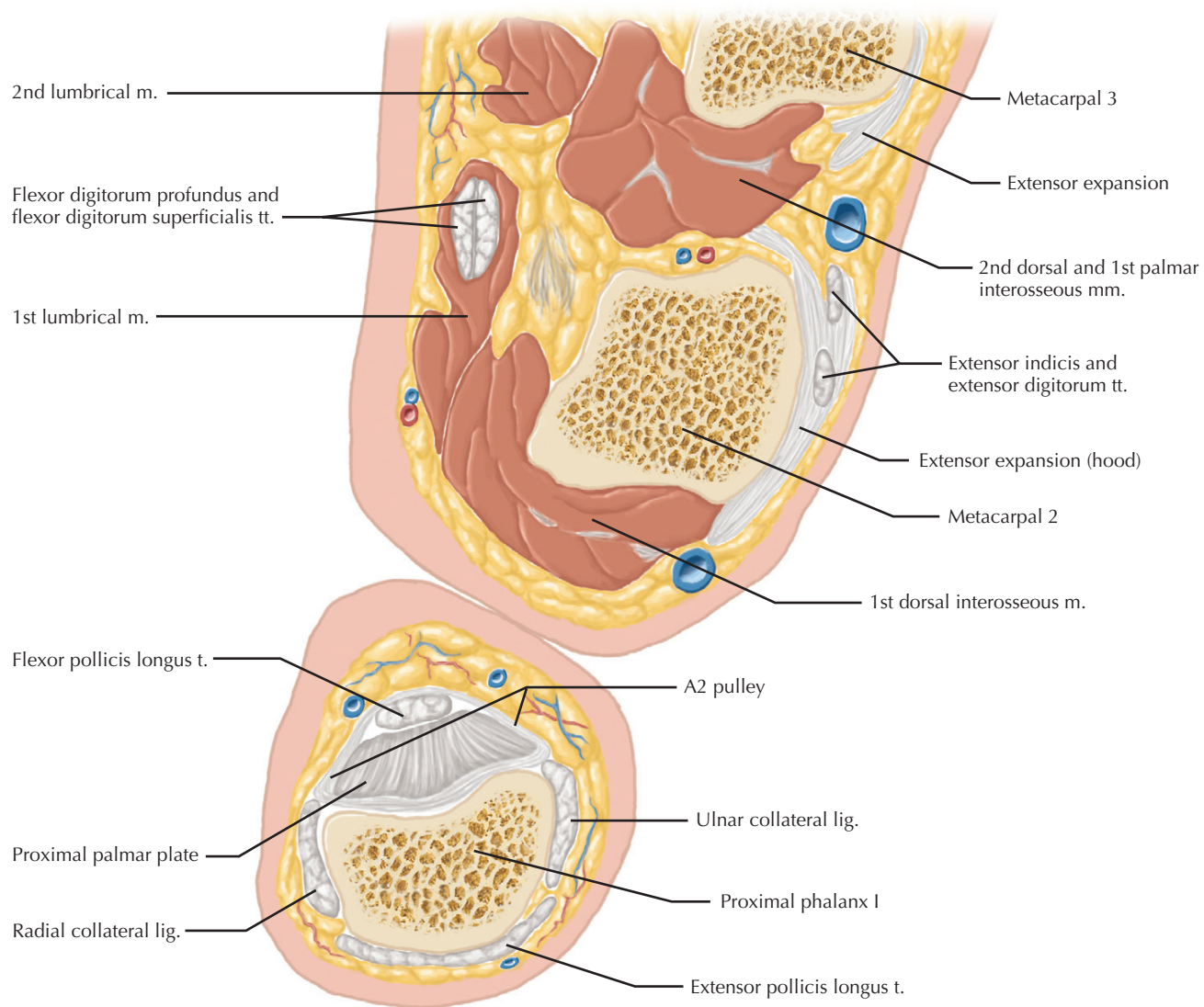


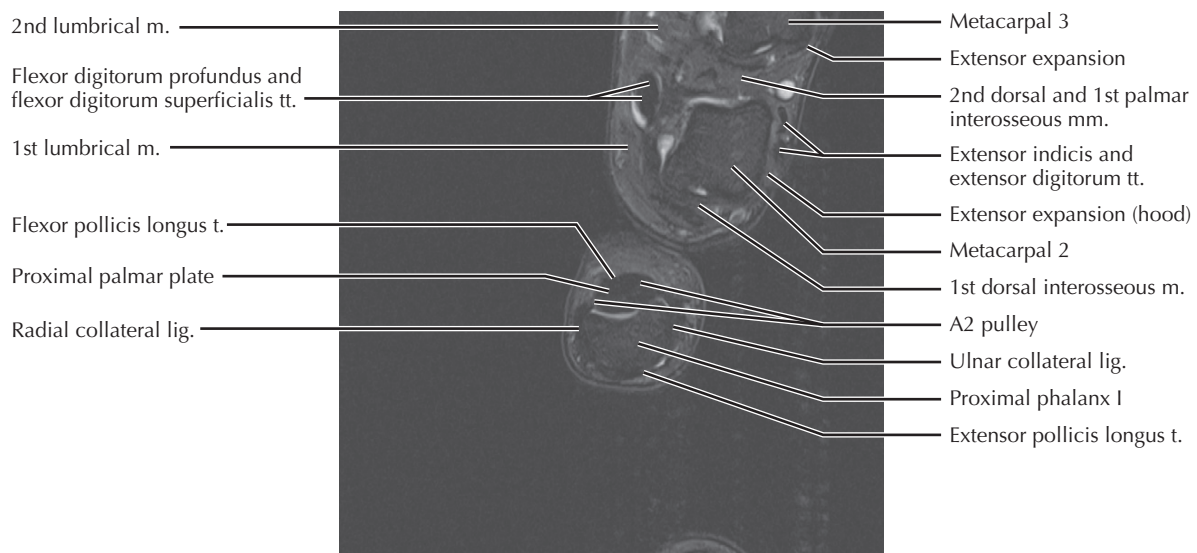
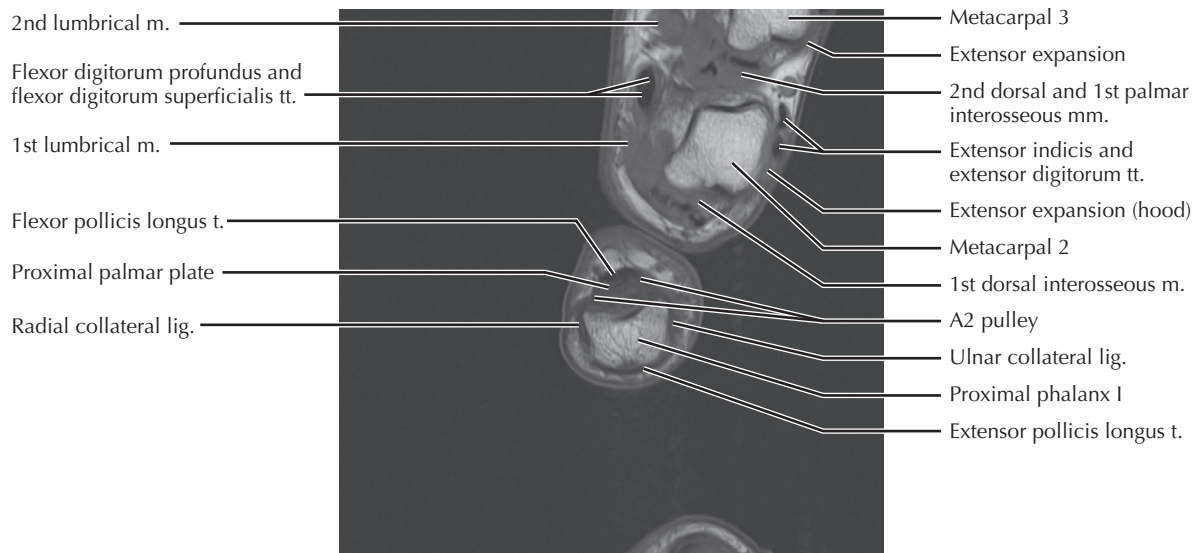
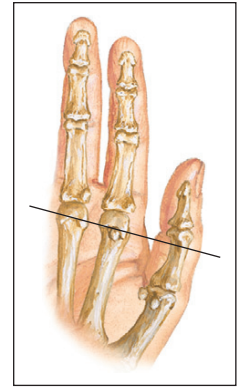


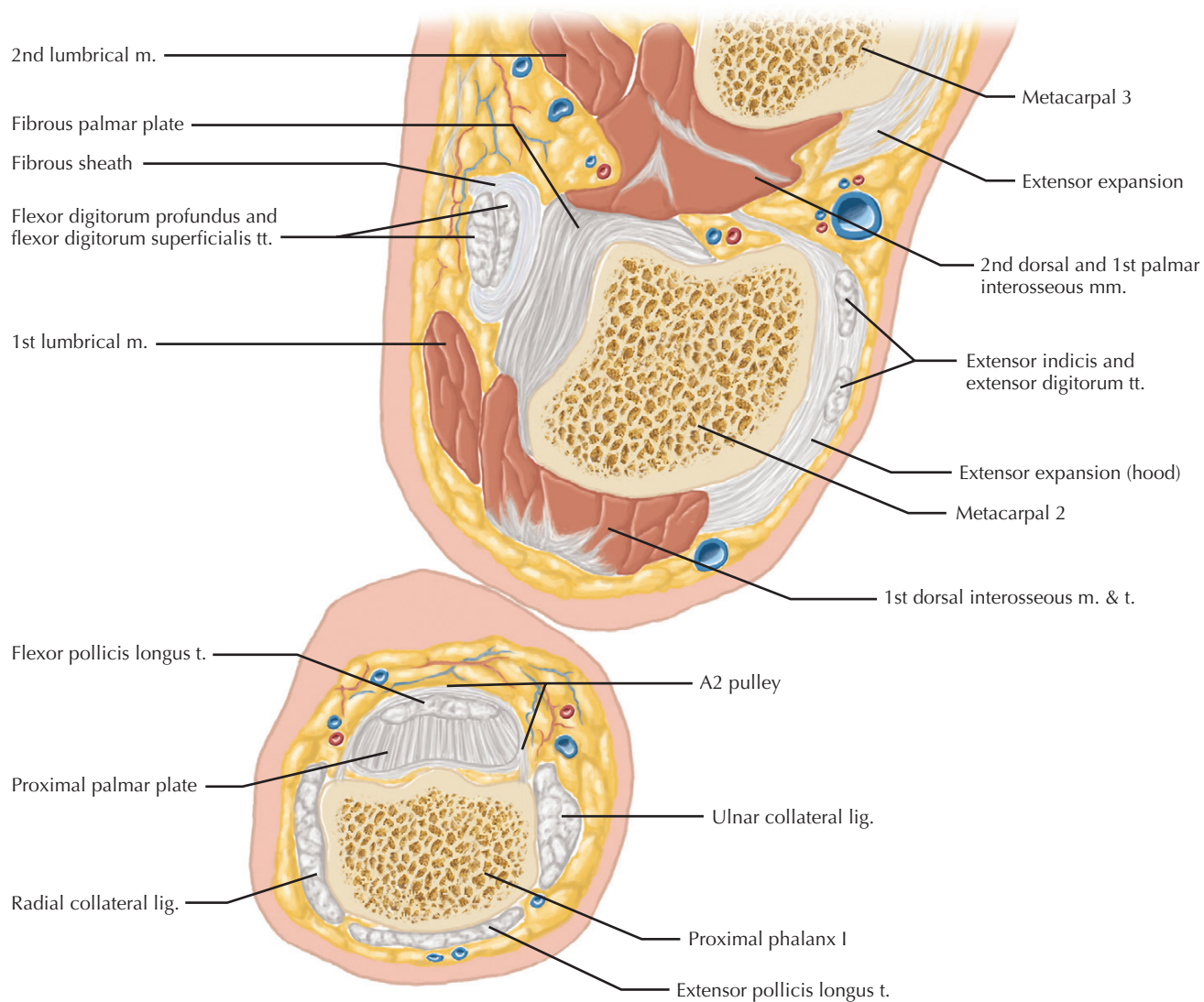


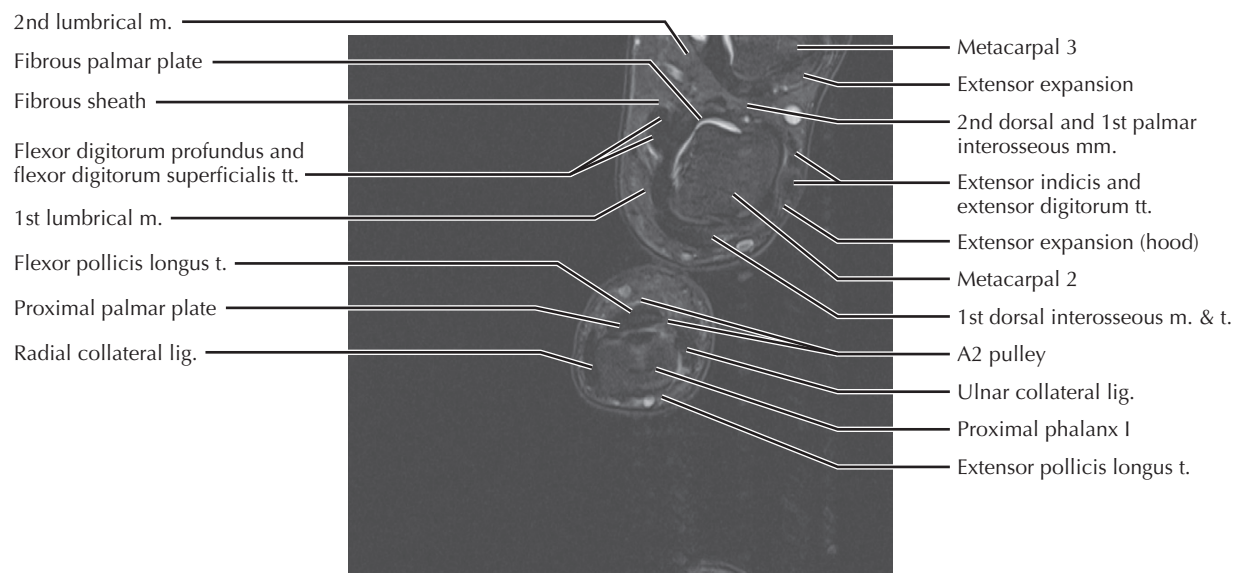
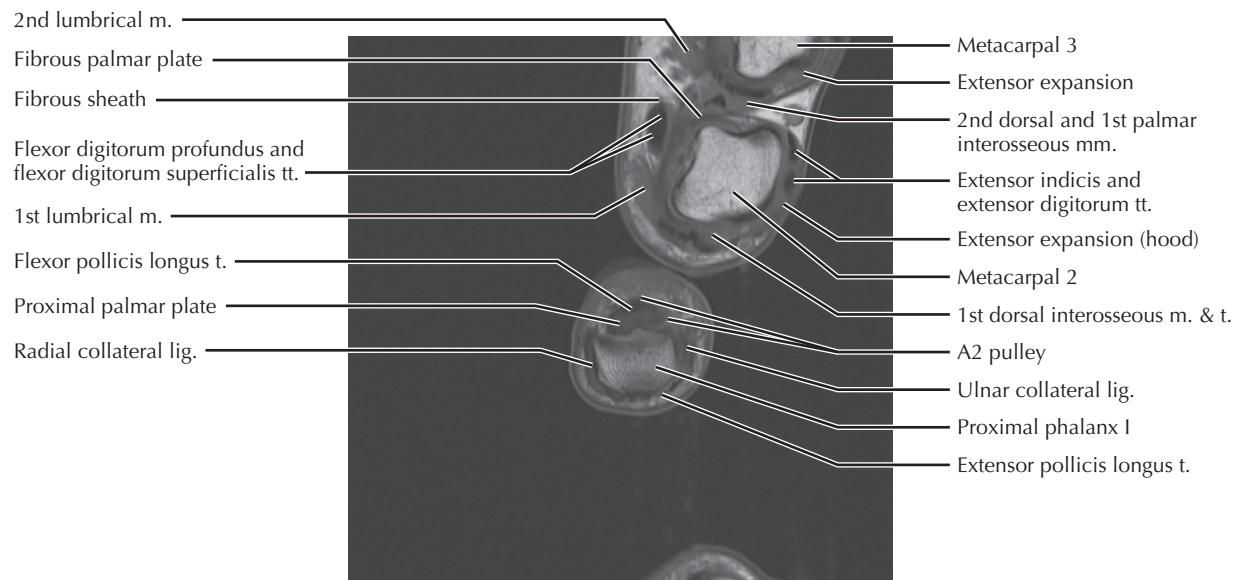
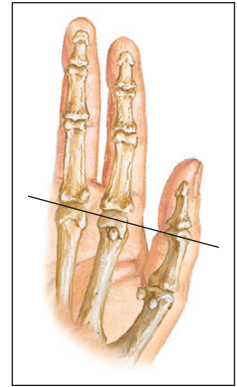


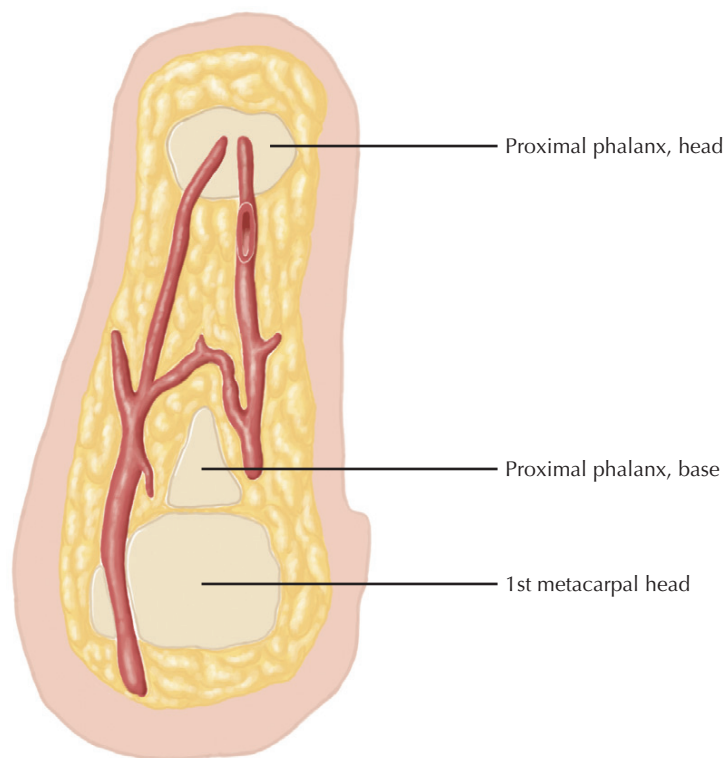


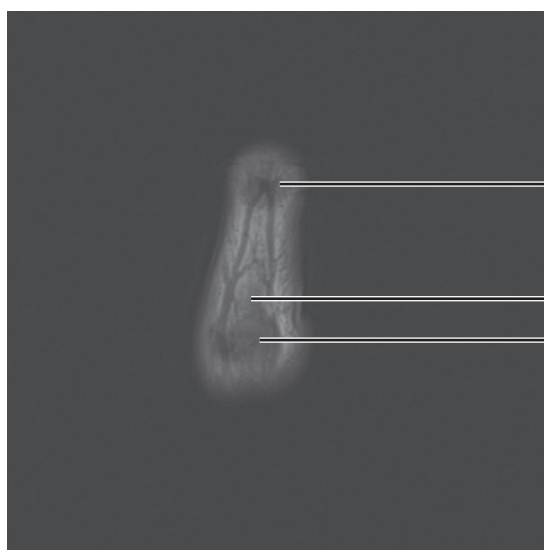
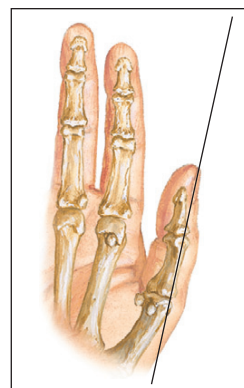








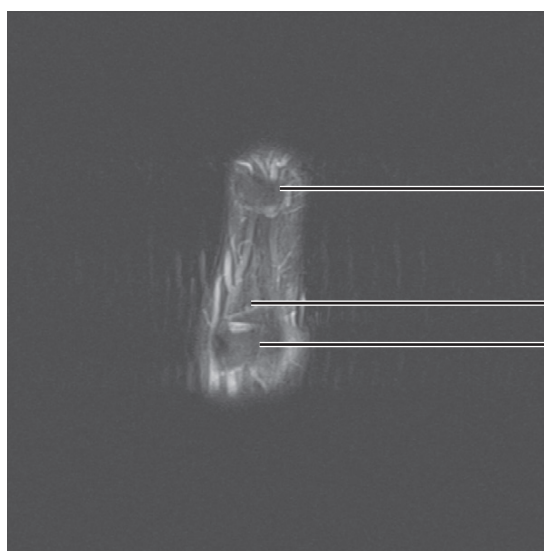




Proximal phalanx, head

Proximal phalanx, base

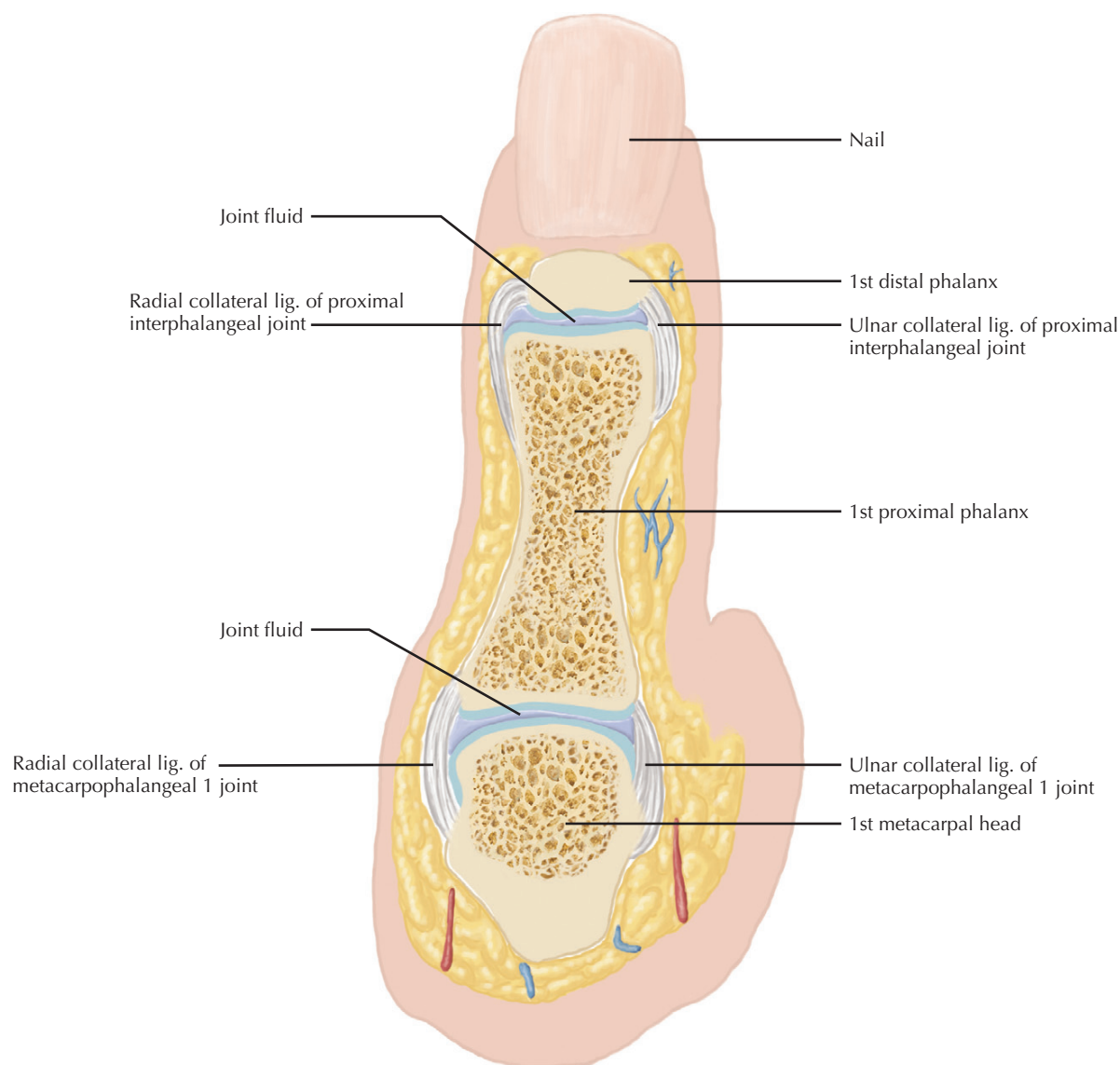
1st metacarpal head



Proximal phalanx, head

Proximal phalanx, base

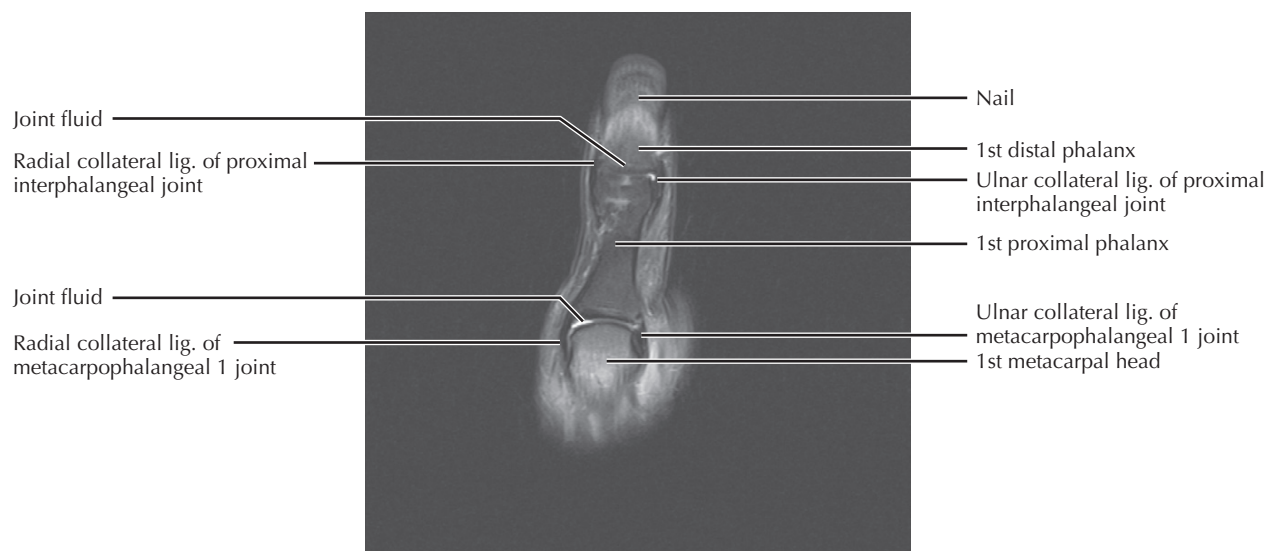
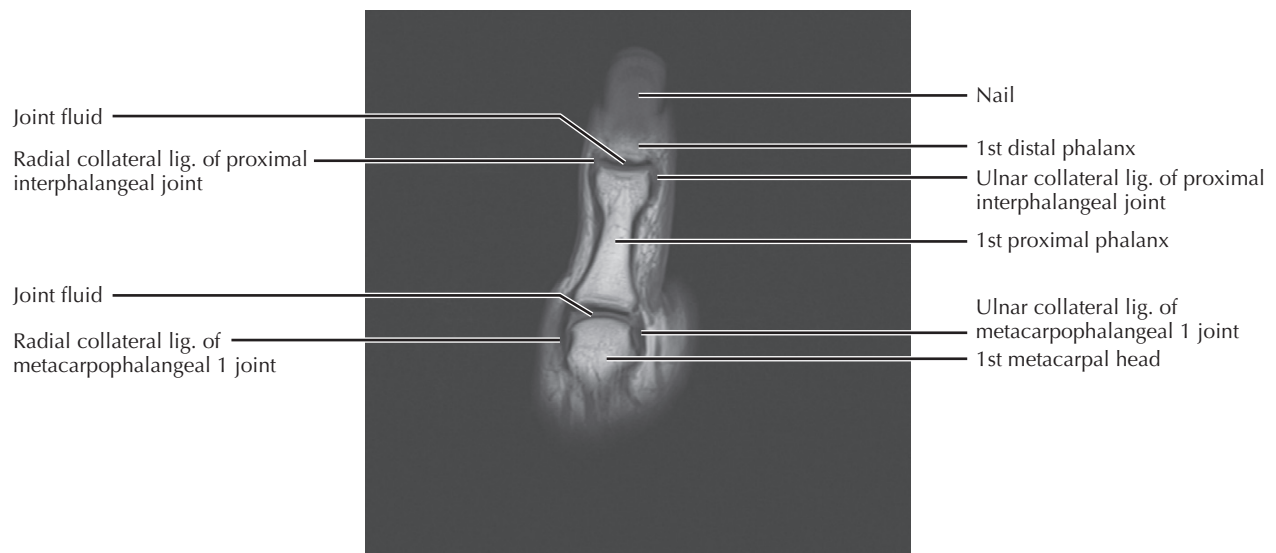
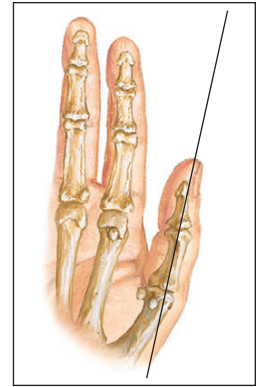
1st metacarpal head

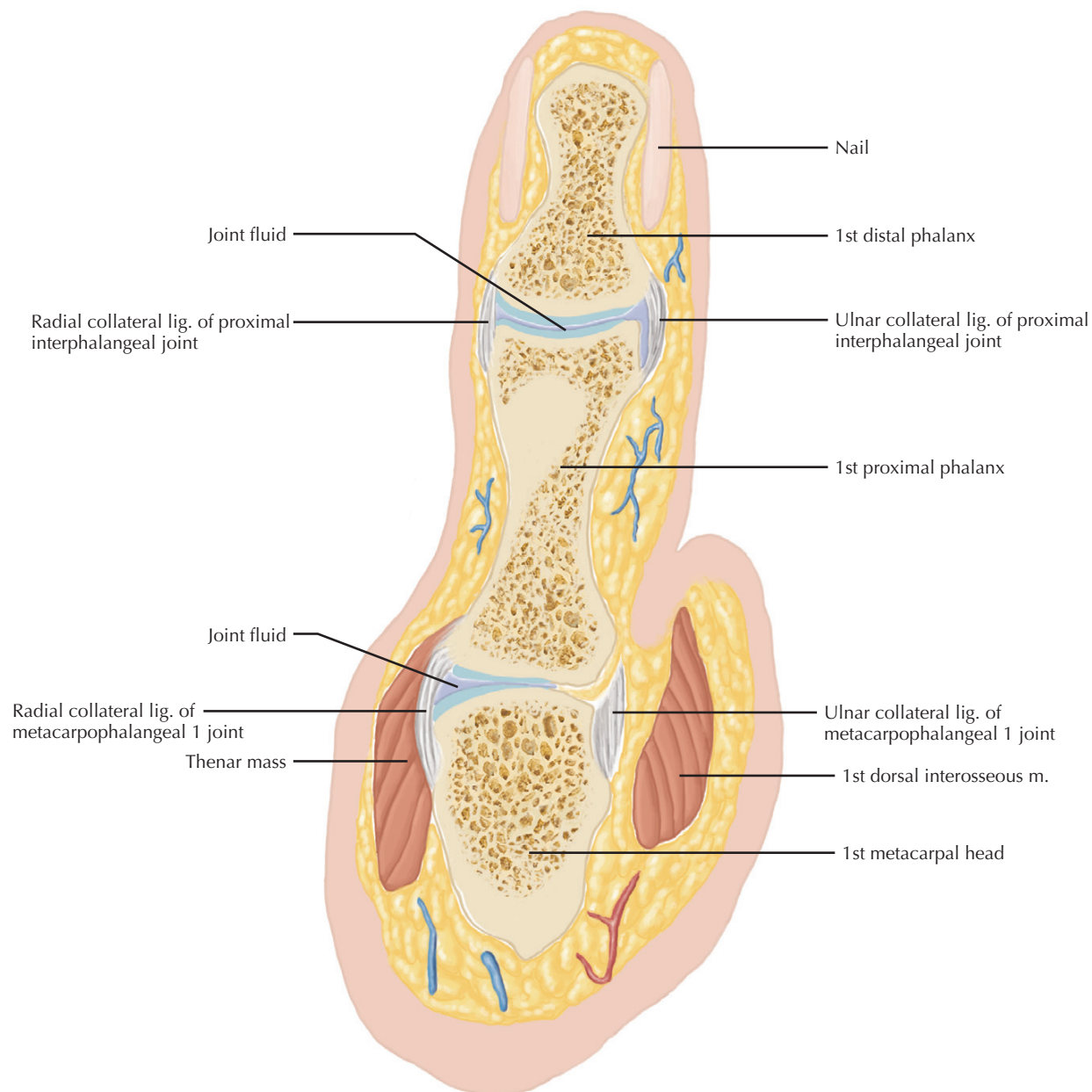


PATHOLOGIC PROCESS

In a gamekeeper's injury, the ulnar collateral ligament (UCL) is torn off from its insertion but does not pull back over the aponeurosis of the adductor pollicis muscle. In this injury the UCL can heal without intervention.

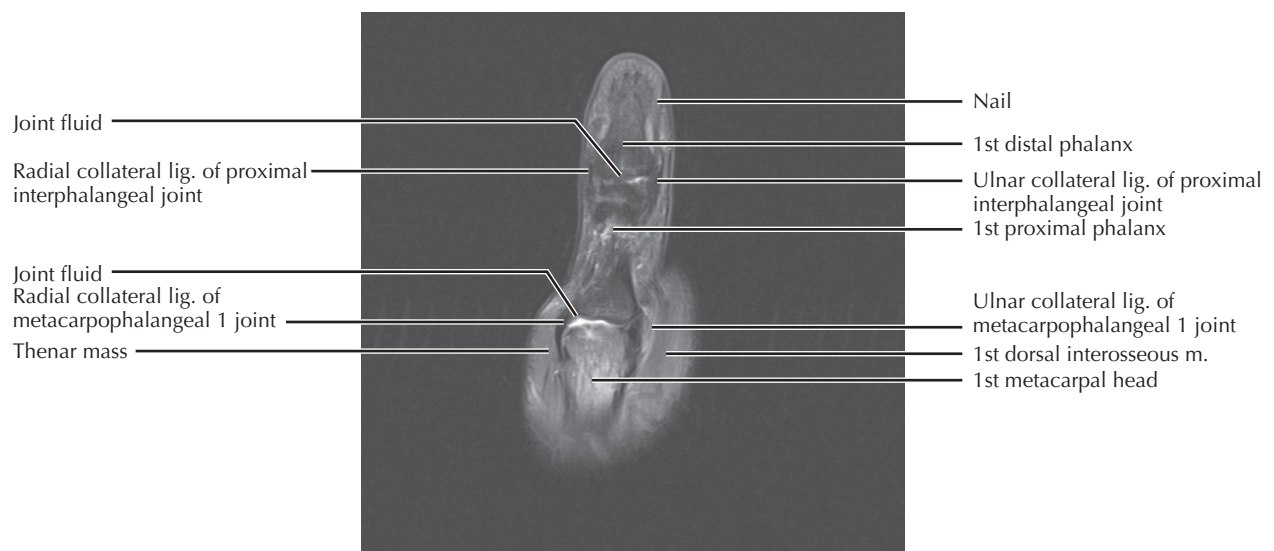
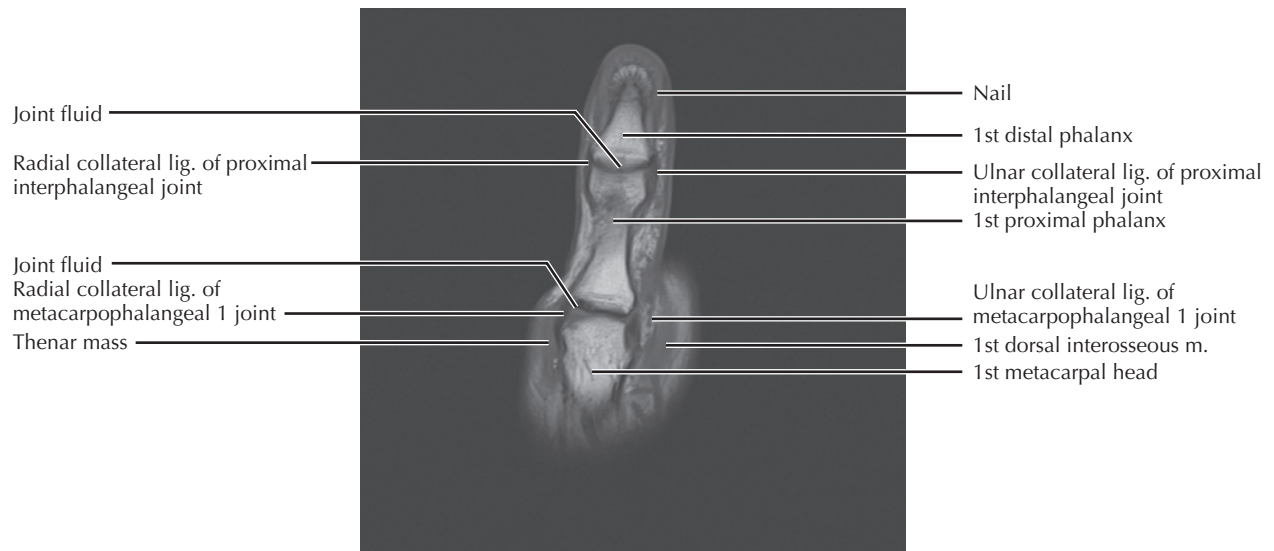
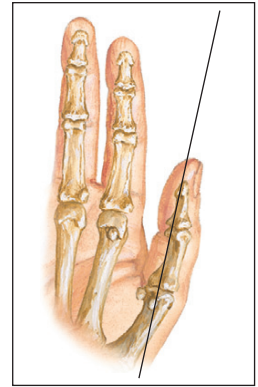
In a Stener lesion the UCL tears off the bone and retracts over the adductor pollicis aponeurosis. This injury cannot heal without intervention because the tendon and insertion site are no longer approximated.

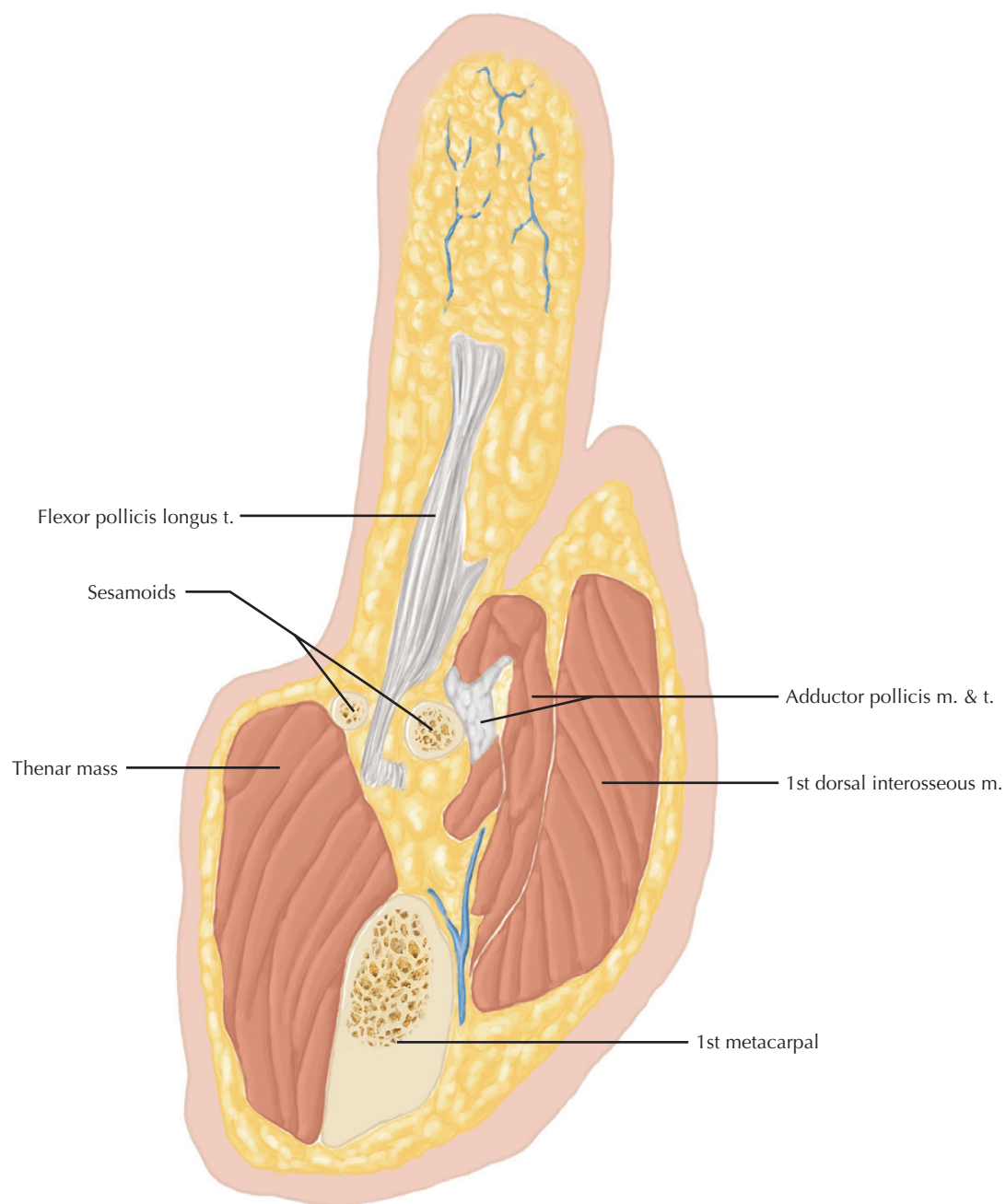


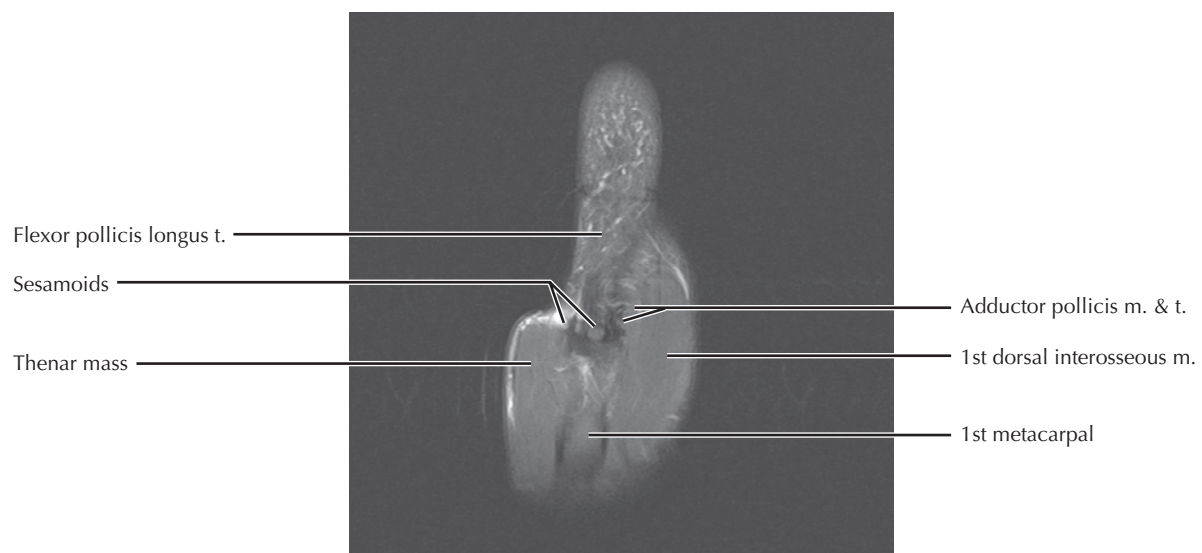
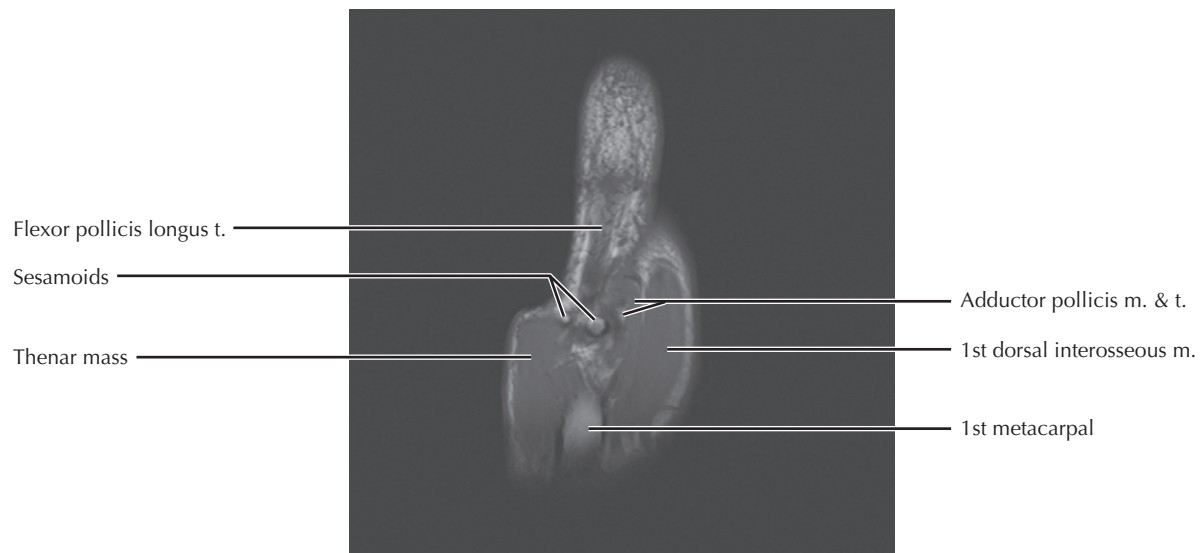
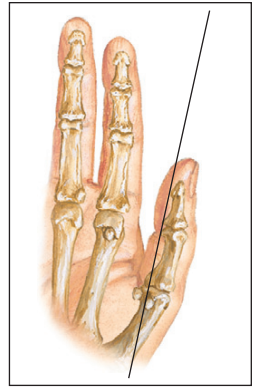


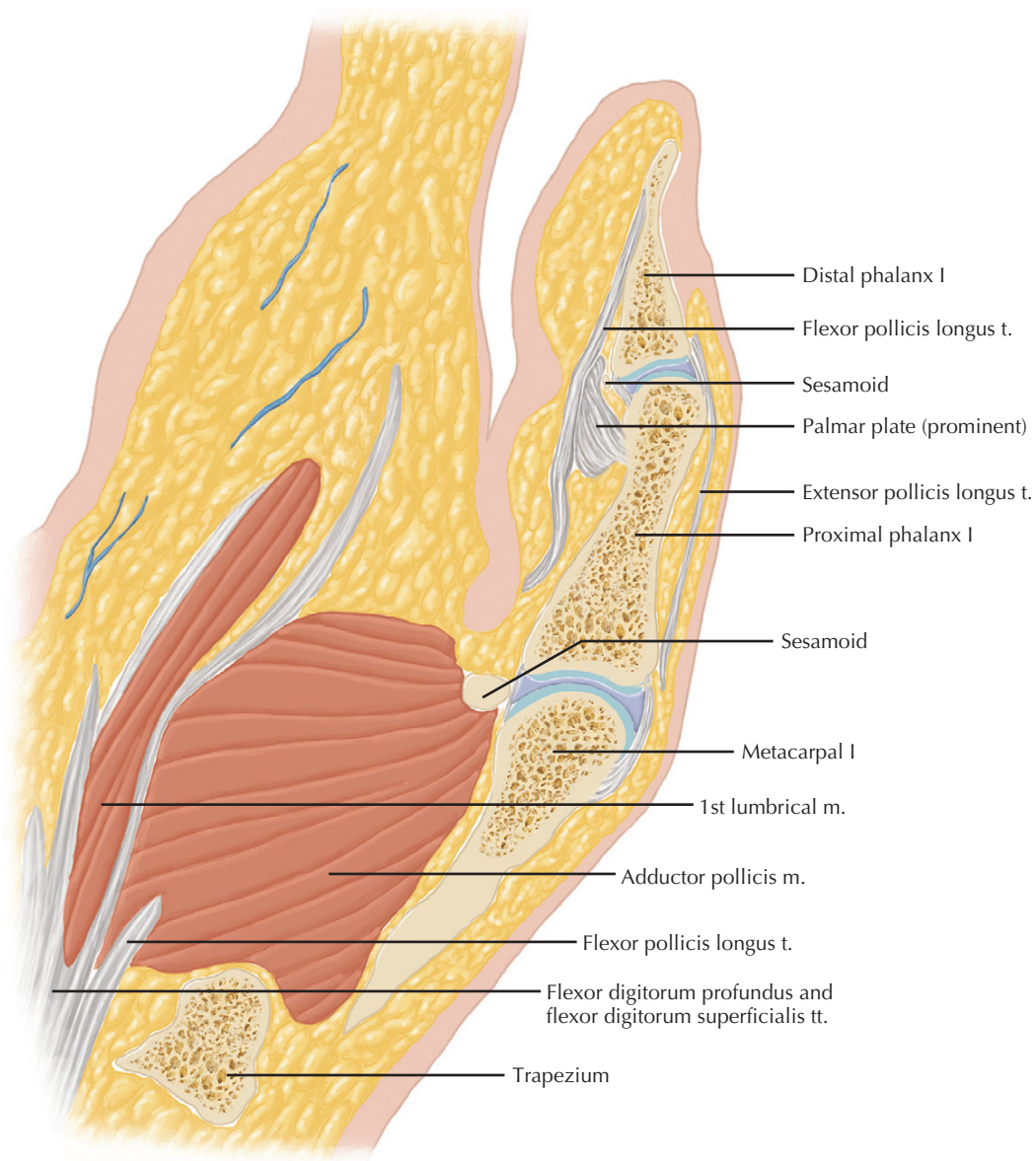
DIAGNOSTIC CONSIDERATION

The thumb should be scanned independently from the rest of the hand, such that the coronal plane lies parallel to the thumbnail. A coronal section of the entire hand yields an oblique sagittal section through the thumb, which does not allow proper examination for ulnar collateral ligament injuries.



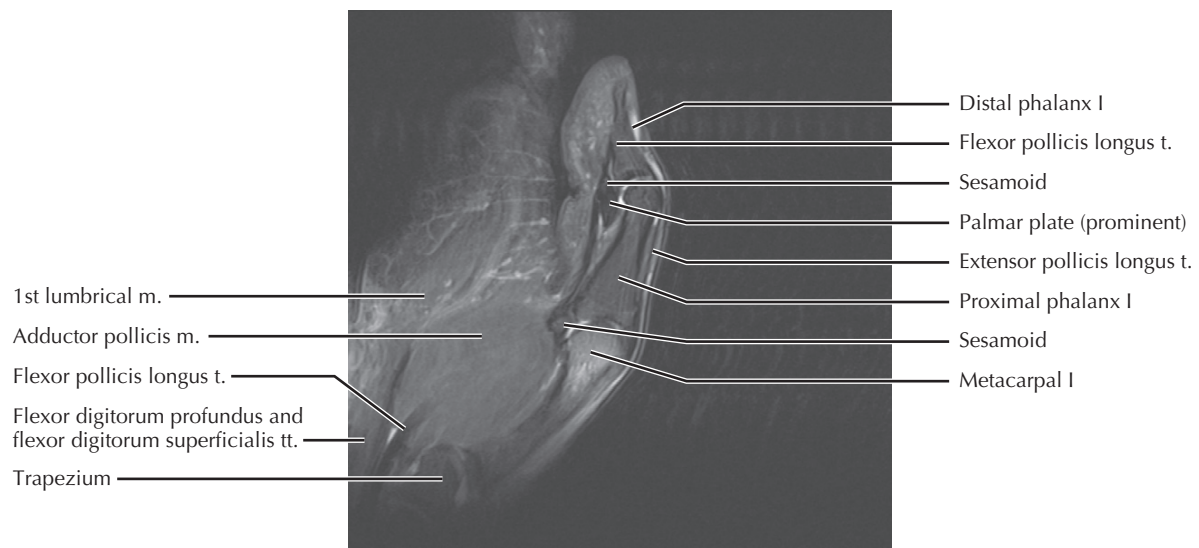
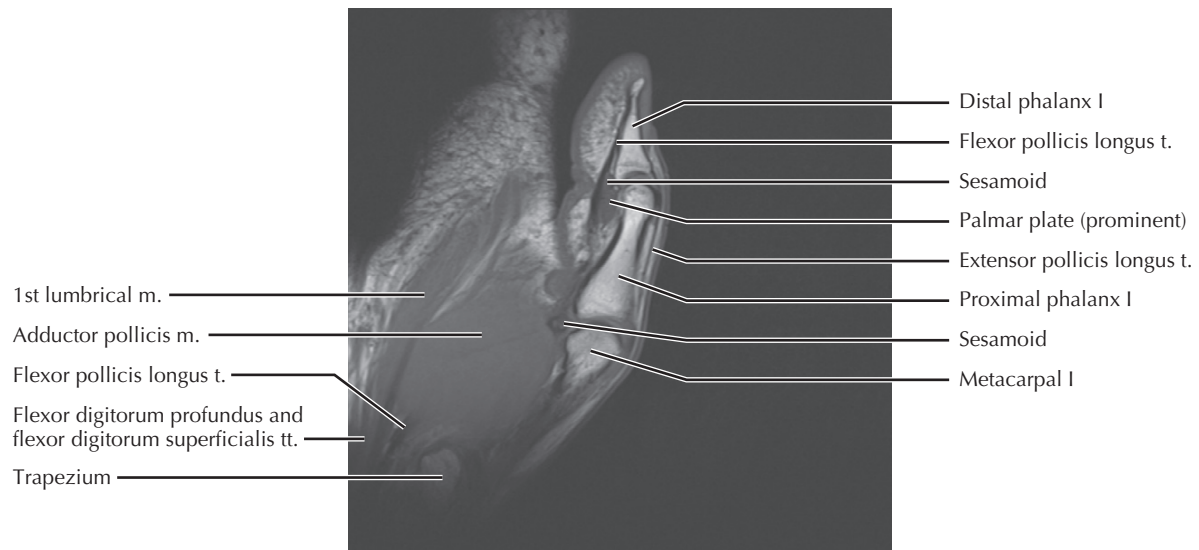
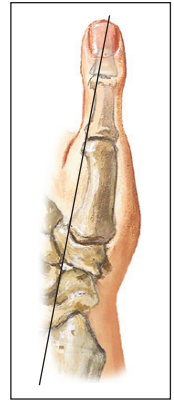


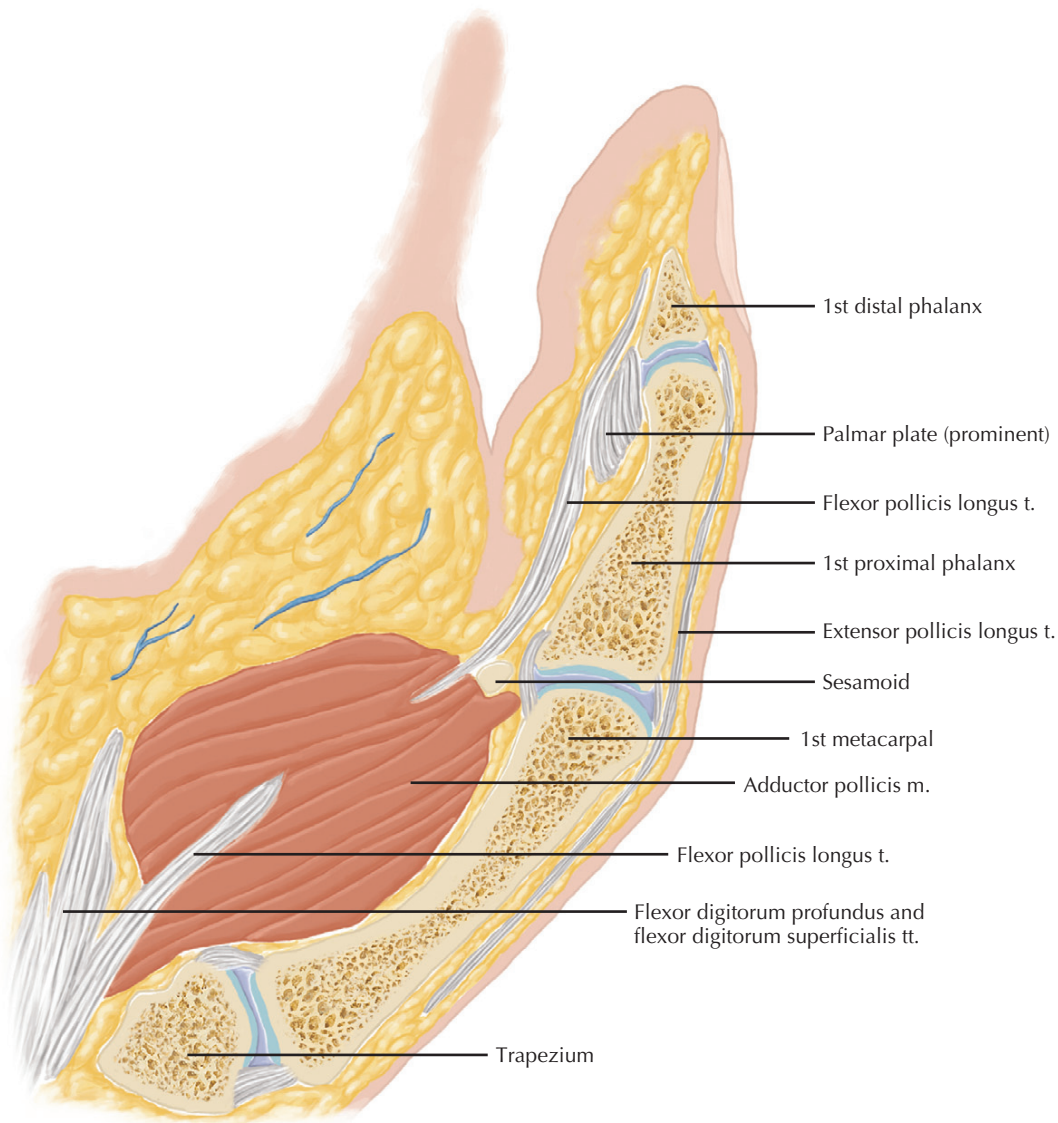




NORMAL VARIANT

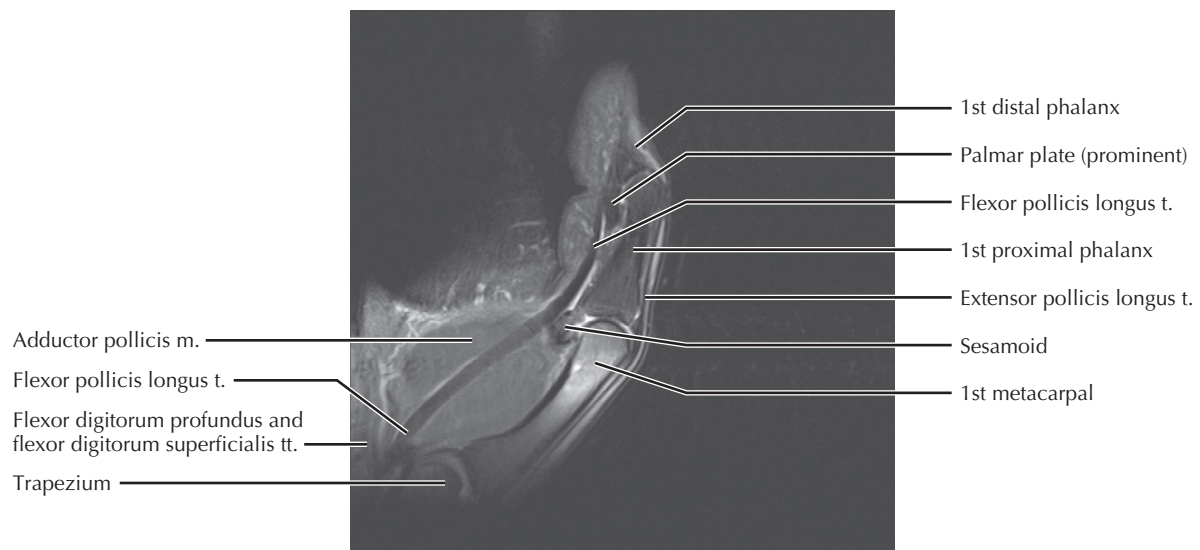
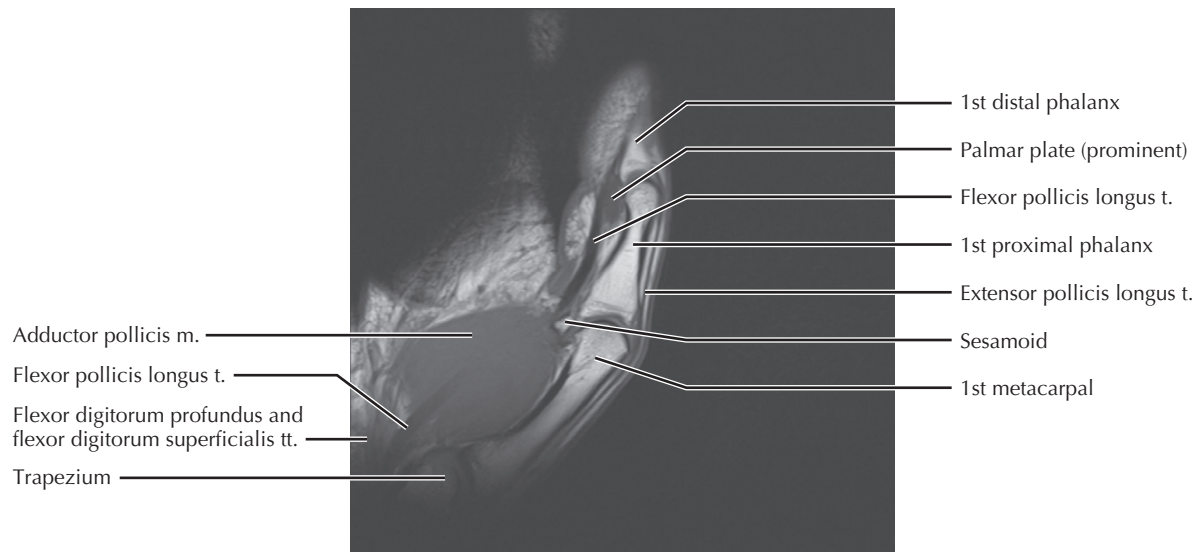
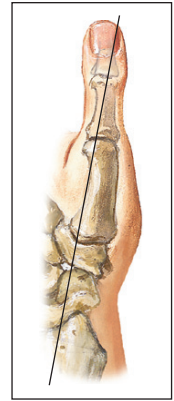
The volar plate in this scan series is especially prominent. This variant was asymptomatic and present bilaterally in the patient.

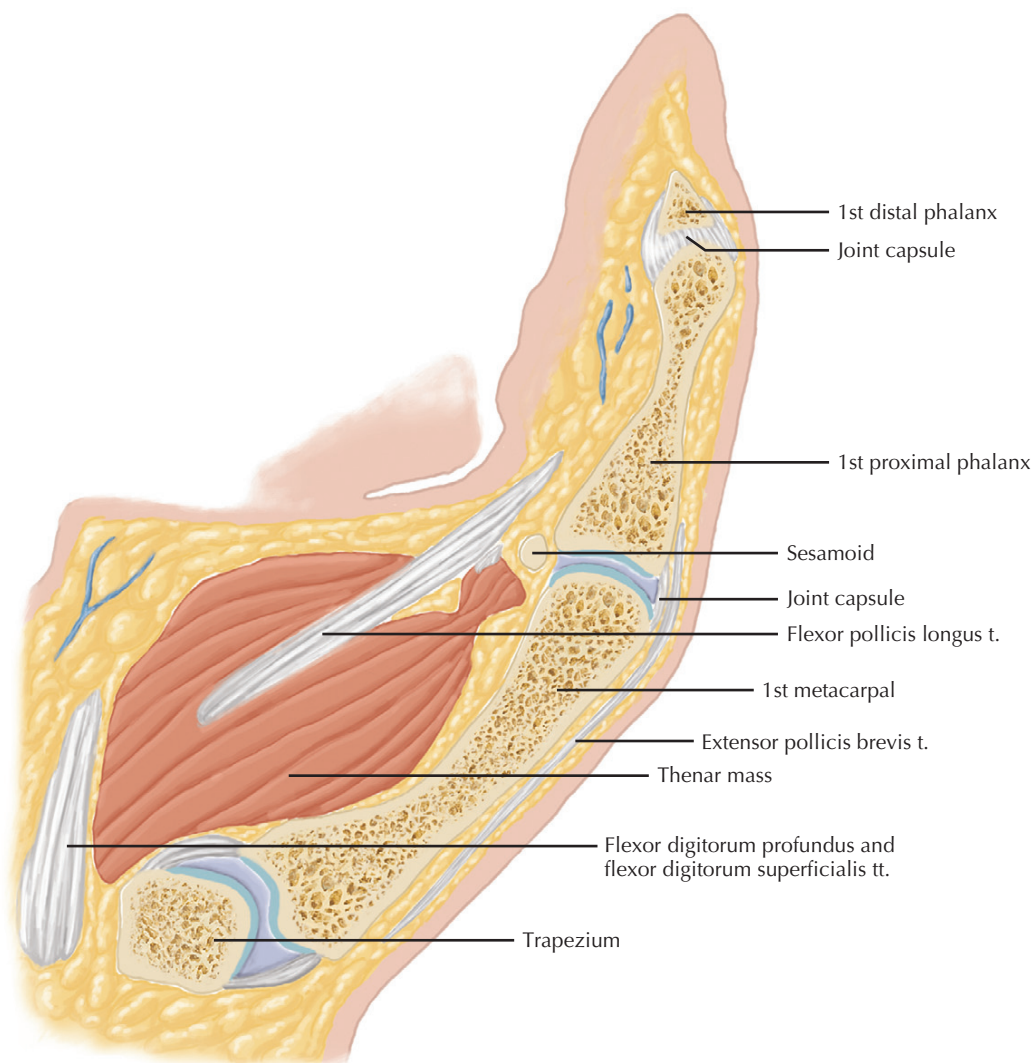


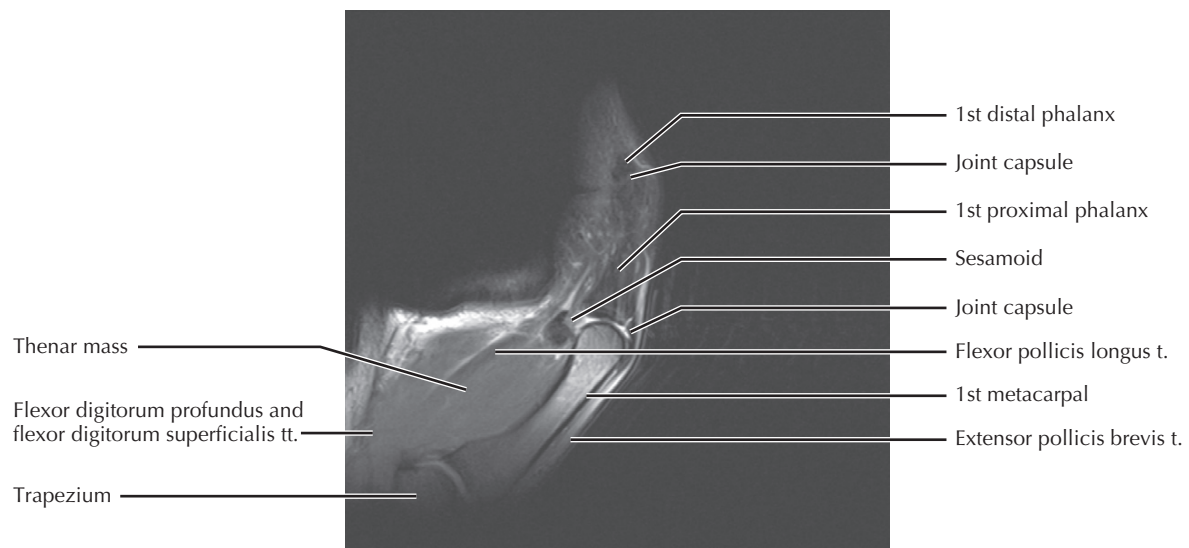
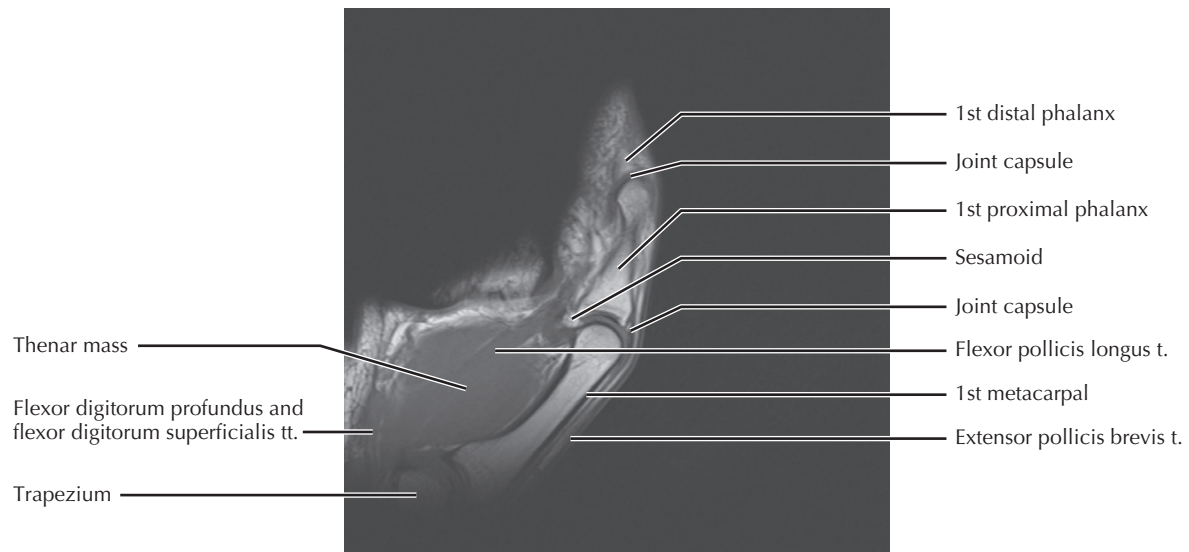
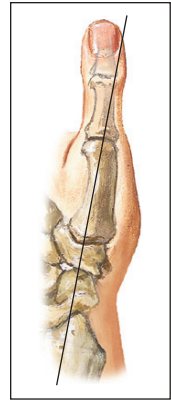


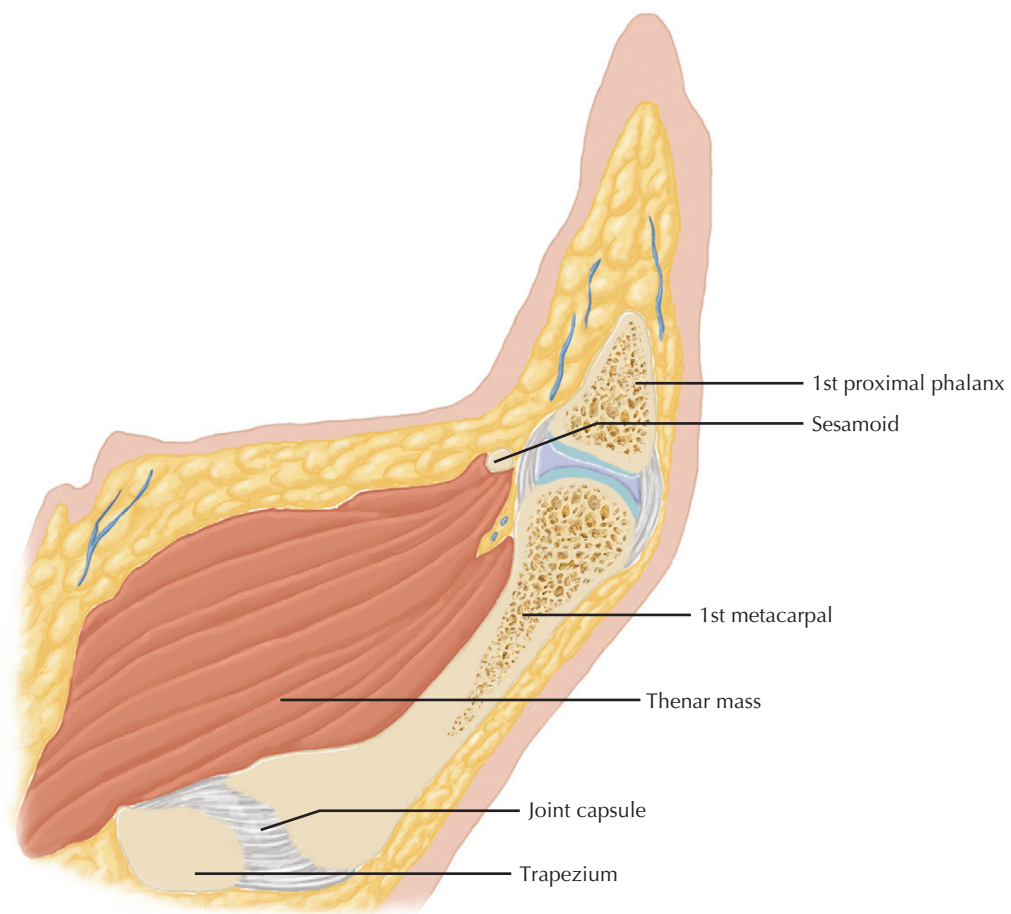
PATHOLOGIC PROCESS

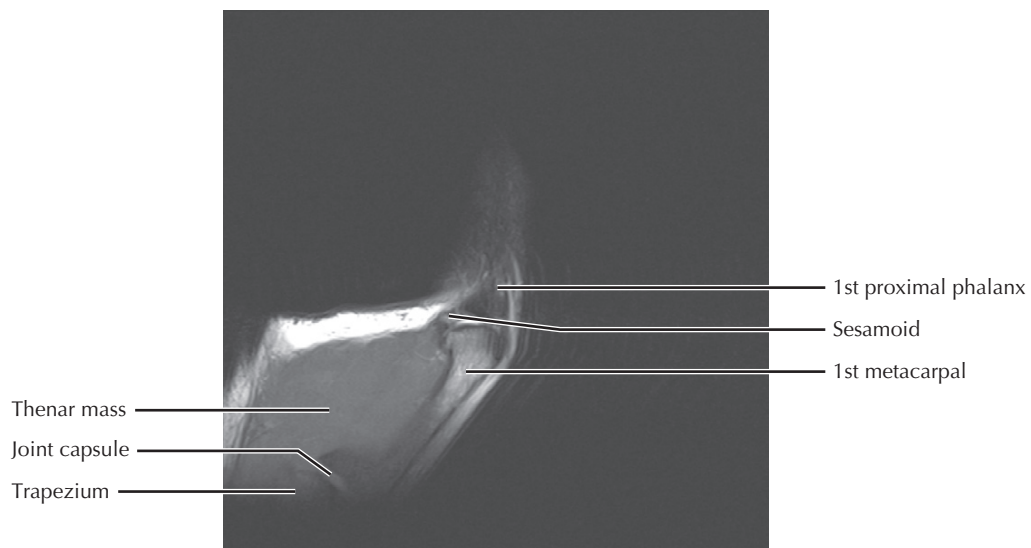
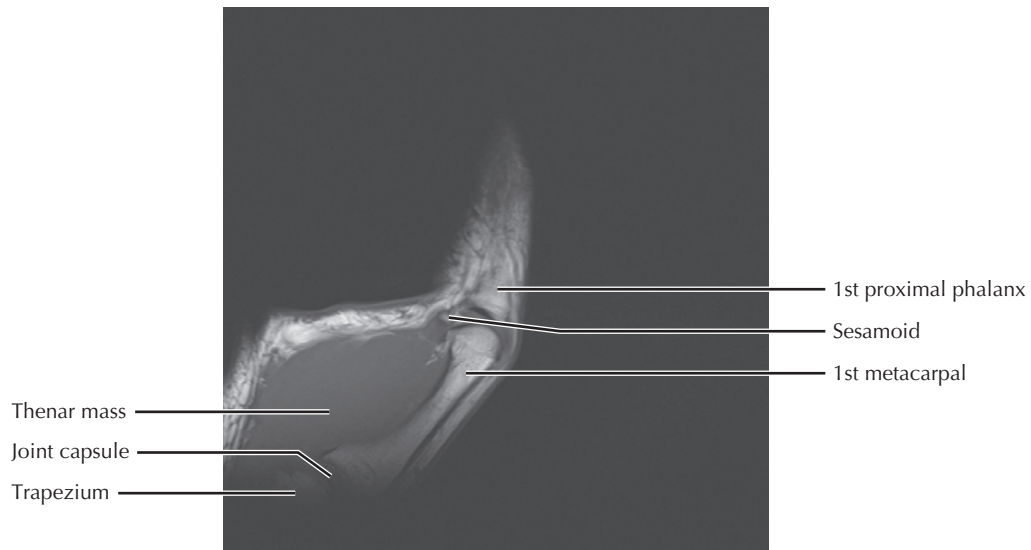
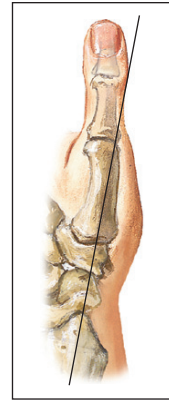
The flexor tendons in the thumb and fingers are held close to the bone by ligaments. Injury to these ligaments is detected on MRI when the flexor tendons become displaced away from the bone in a "bowstring" pattern.











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PART

2

LOWER LIMB

OVERVIEW OF LOWER LIMB 339

HIP 345

THIGH 435

KNEE 451

LOWER LEG 511

ANKLE AND FOOT 529

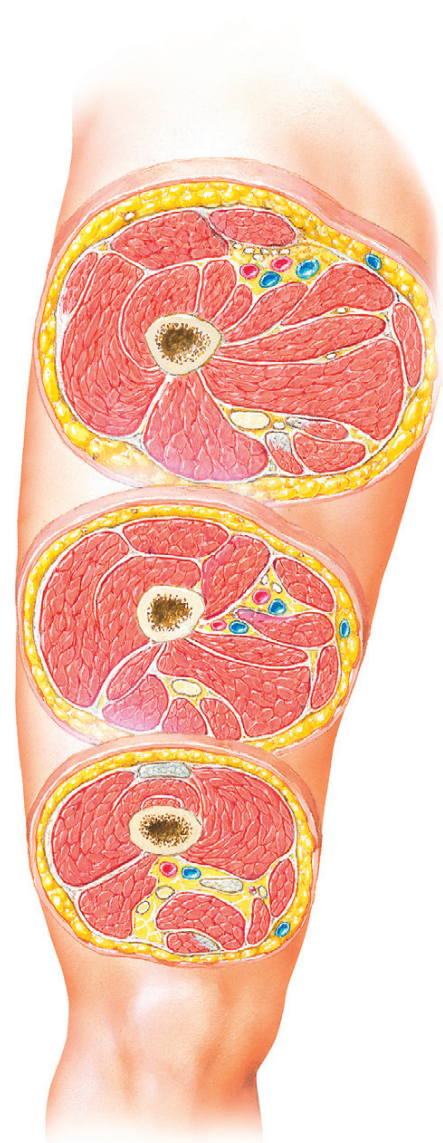
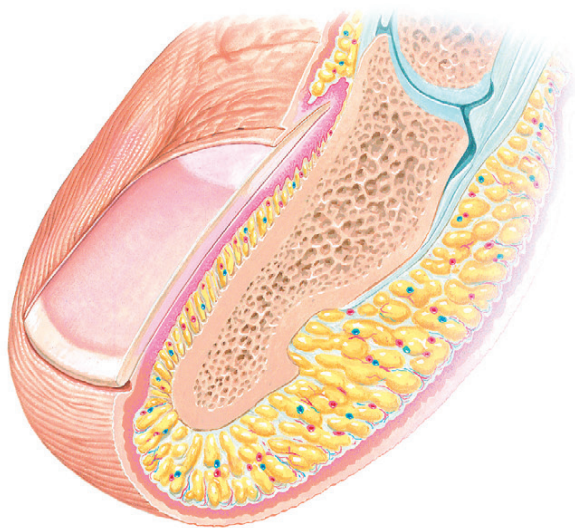
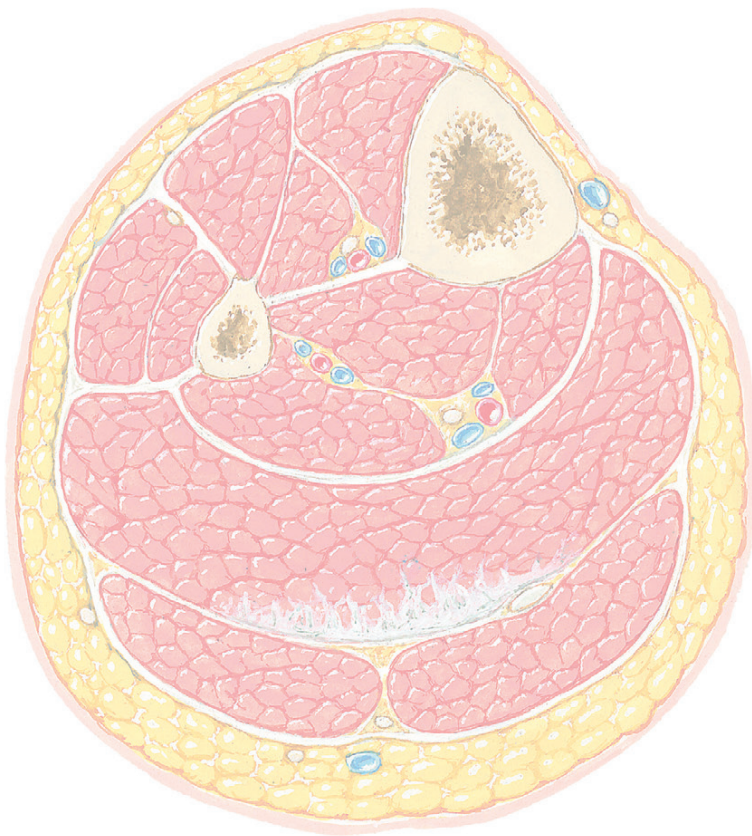
PLANTAR PLATE 601

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Chapter

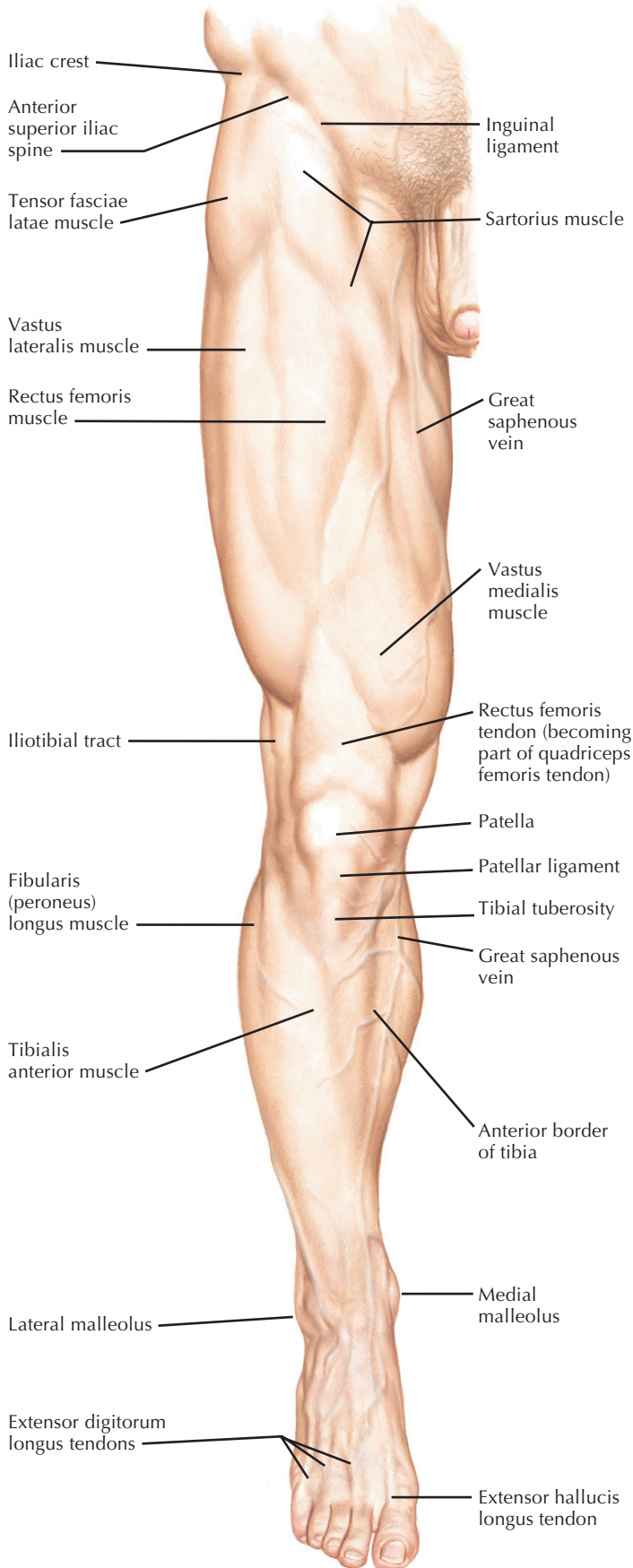
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OVERVIEW OF LOWER LIMB

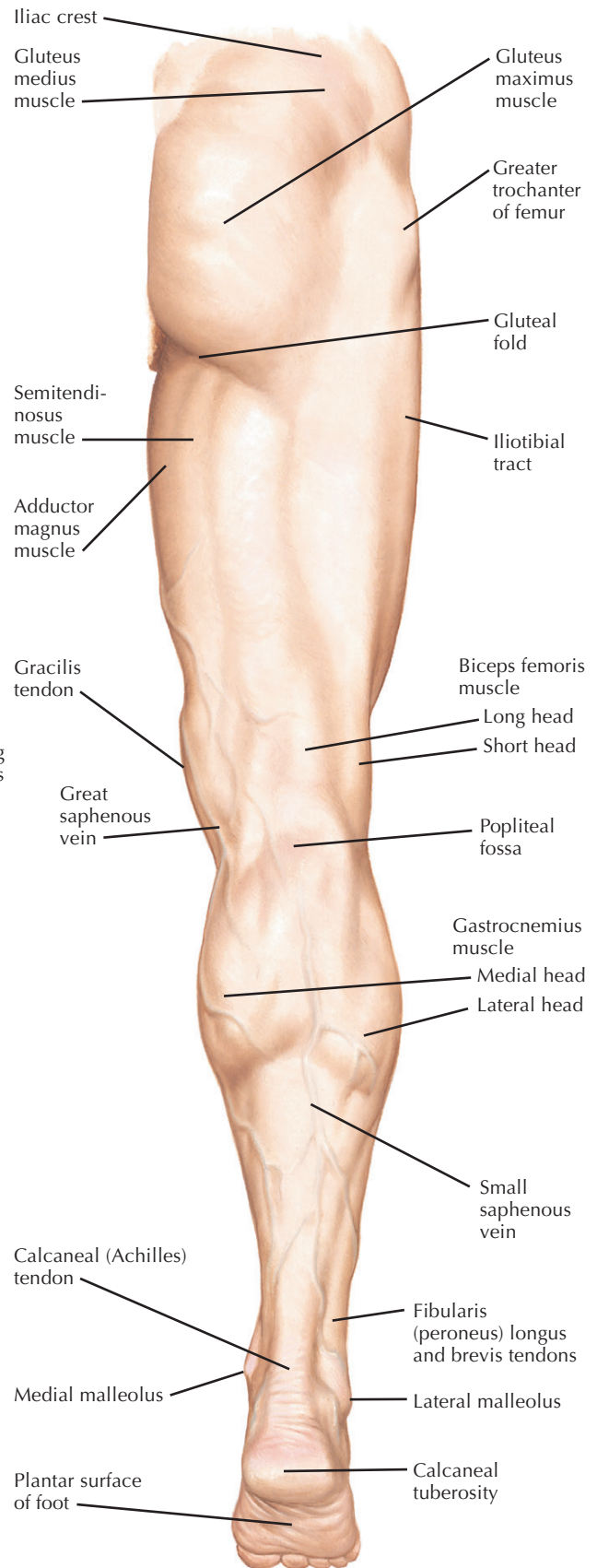


SURFACE ANATOMY OF LOWER LIMB

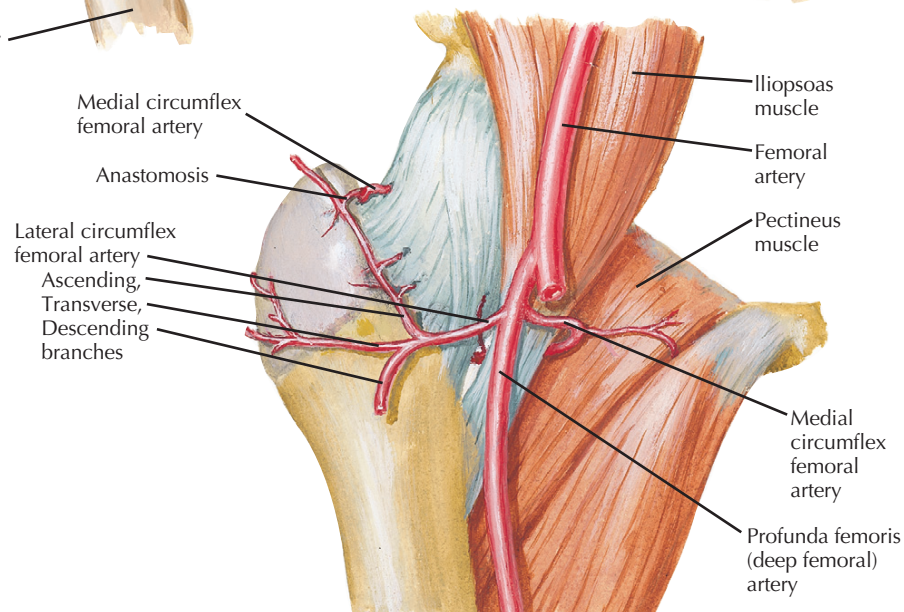
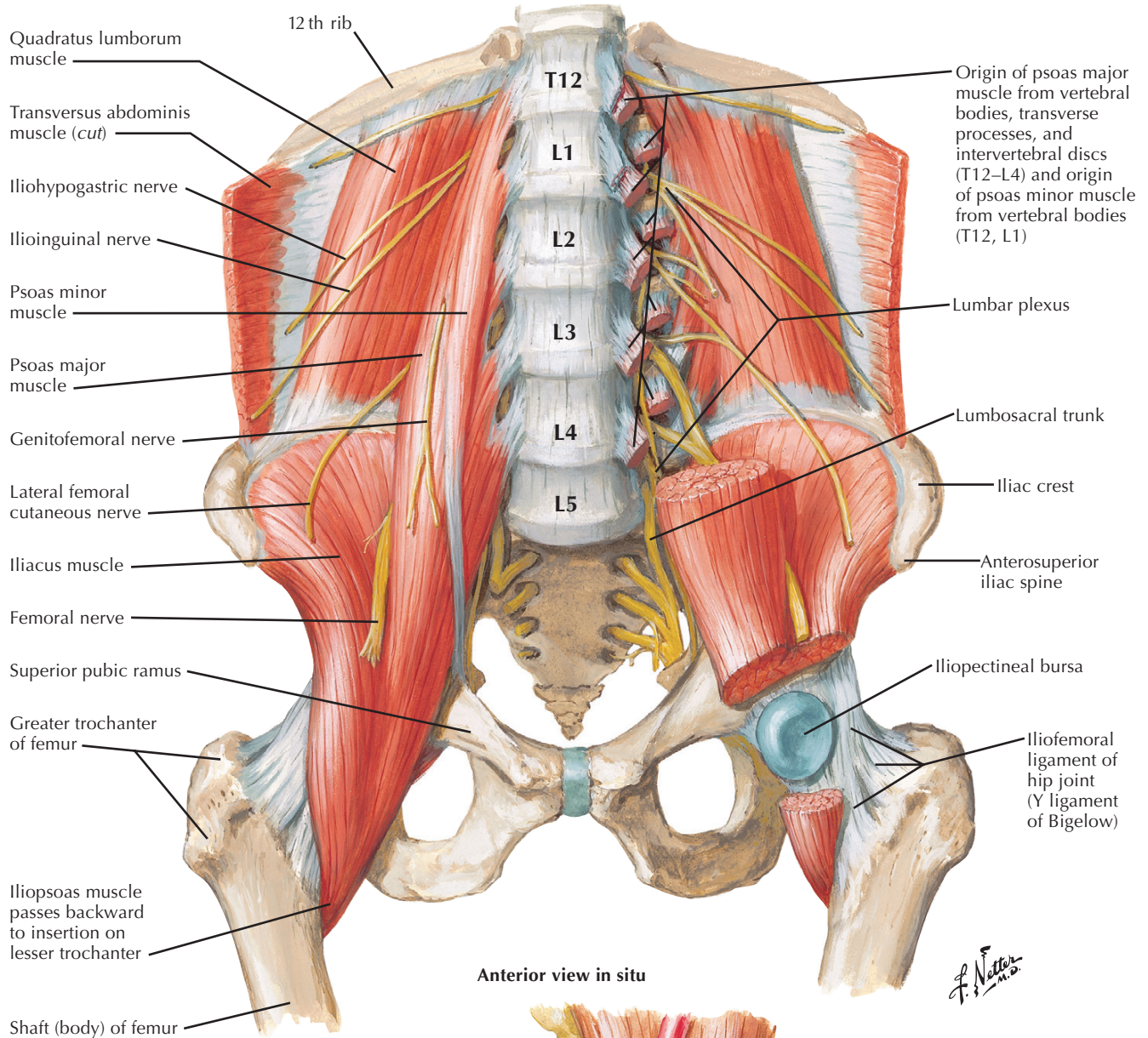
Anterior view



Posterior view

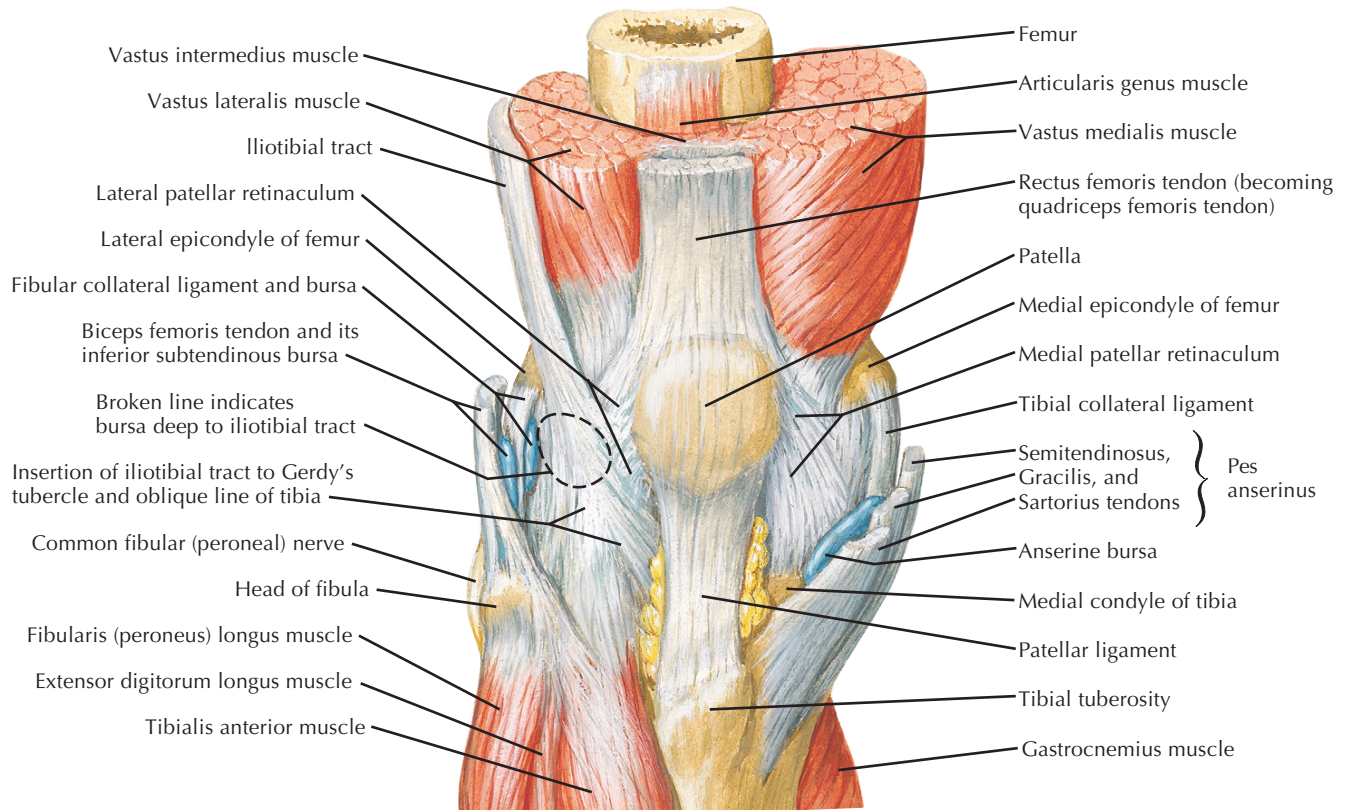


C. Machado
—192—

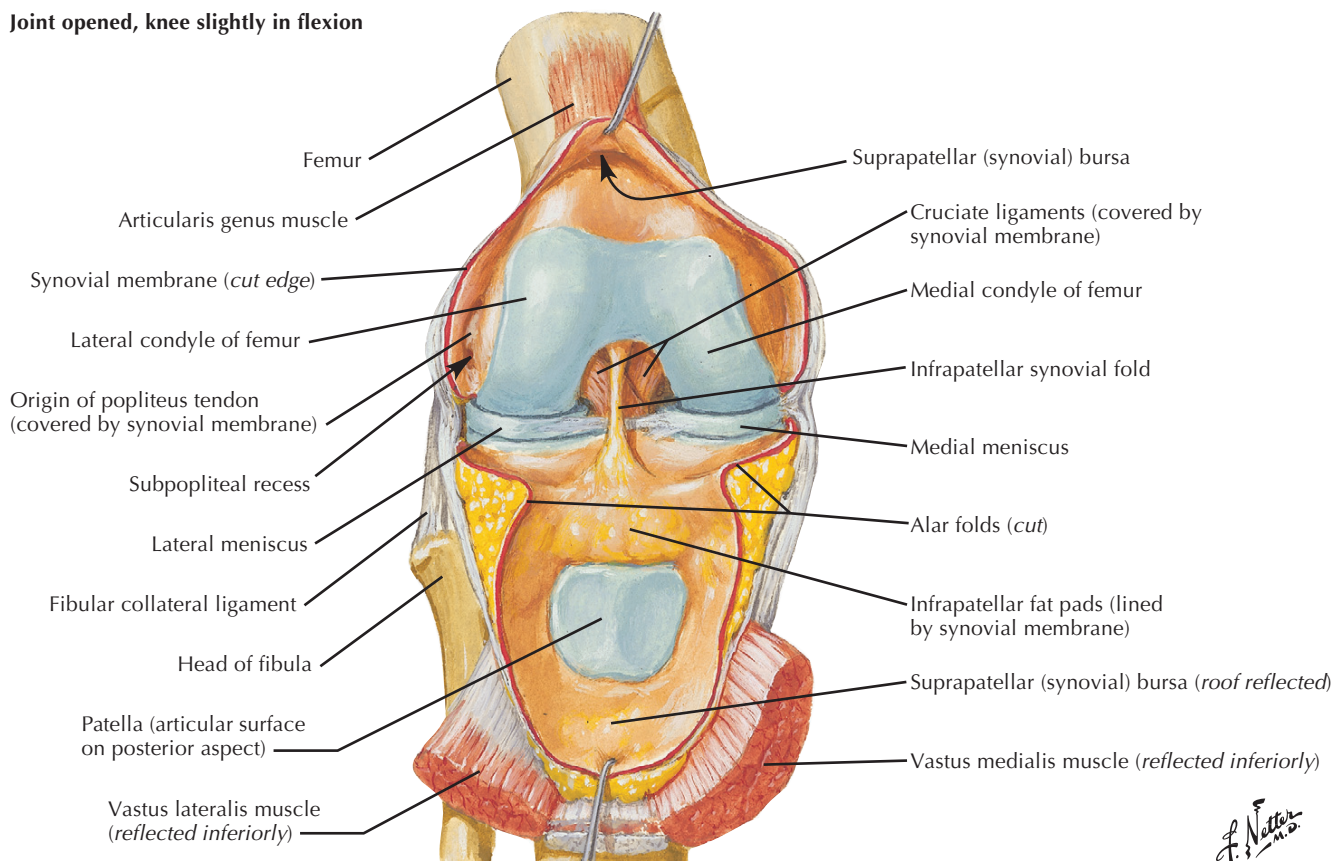


KNEE: ANTERIOR VIEWS

Right knee in extension

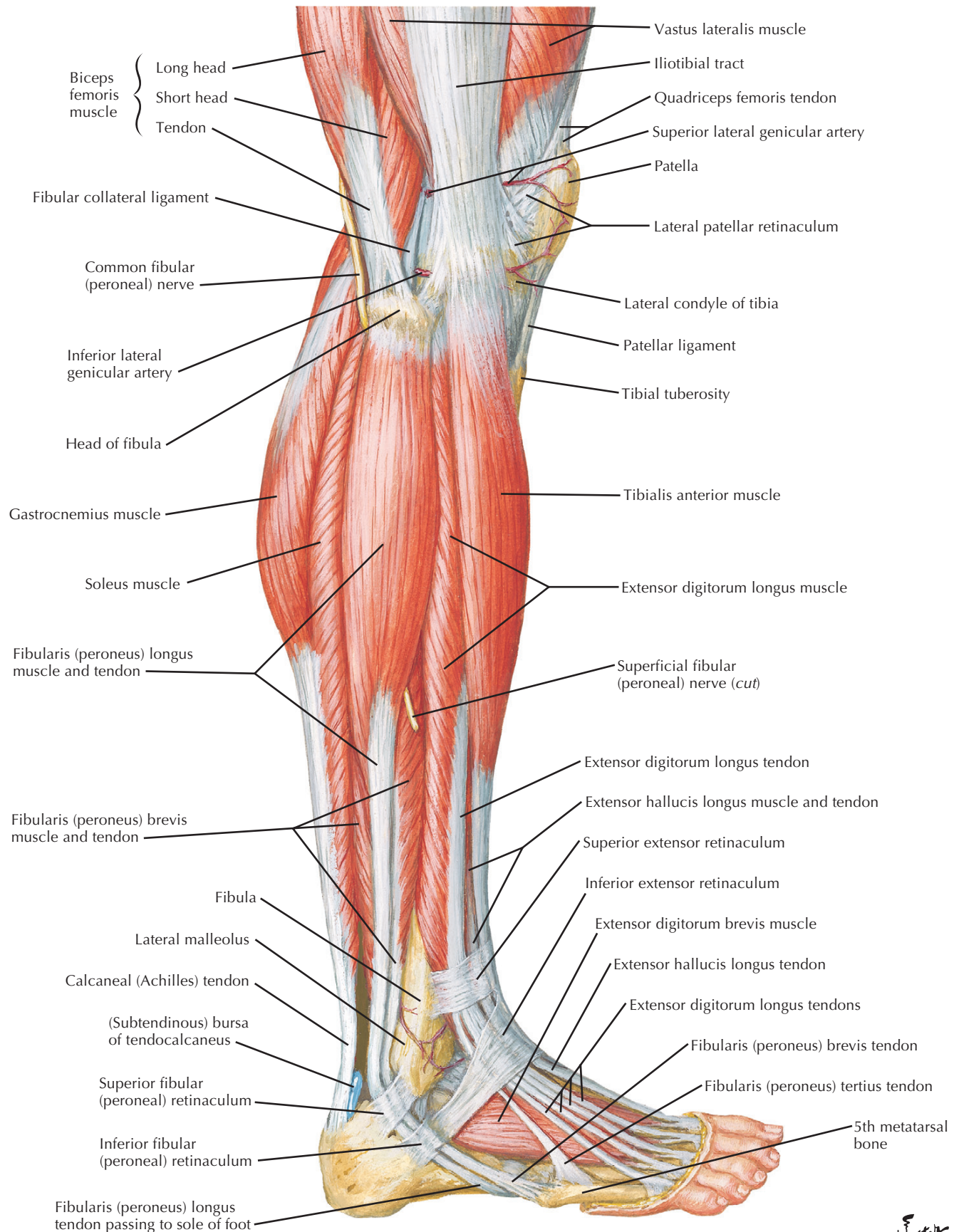


Joint opened, knee slightly in flexion



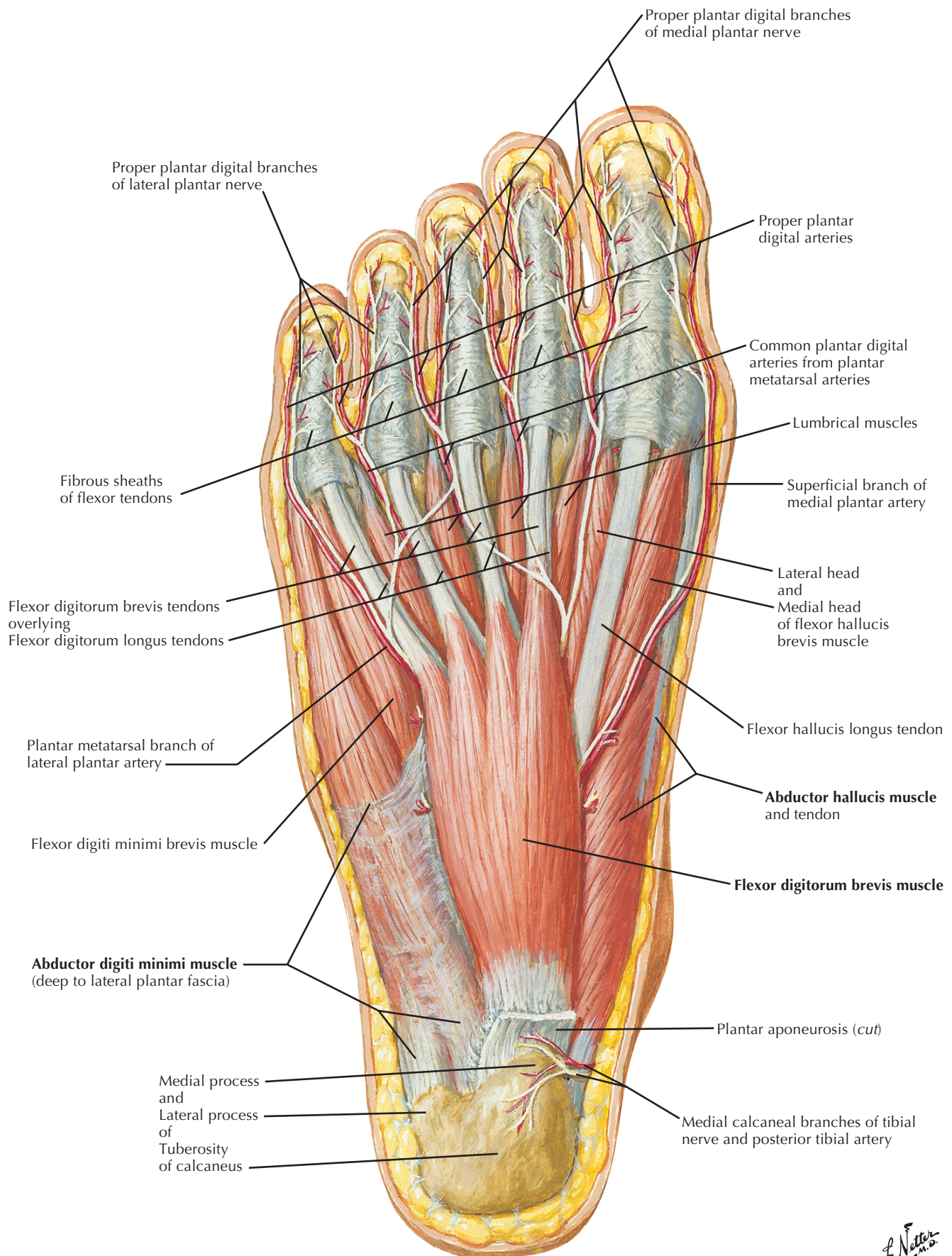
F. Netter M.D.

MUSCLES OF LEG: LATERAL VIEW



F. Netter M.D.

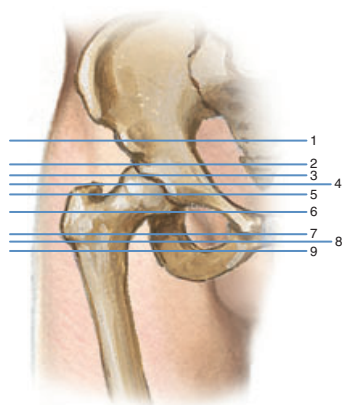
MUSCLES OF SOLE OF FOOT: FIRST LAYER



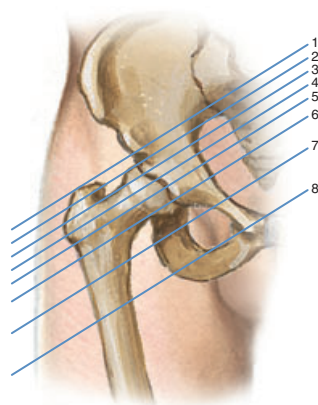
F. Netter M.D.

Chapter

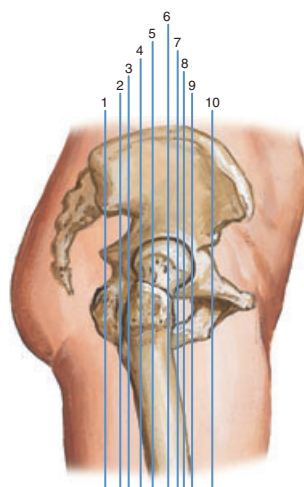
10 HIP



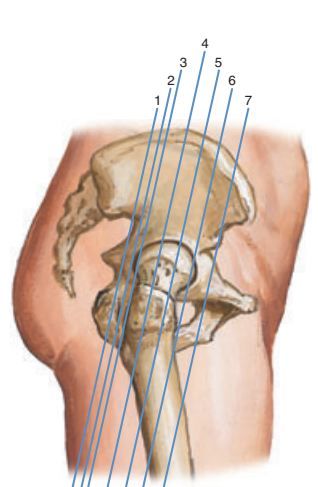
AXIAL 346



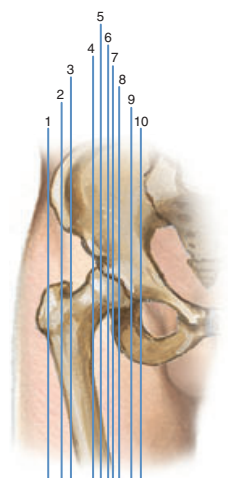
AXIAL OBLIQUE 364



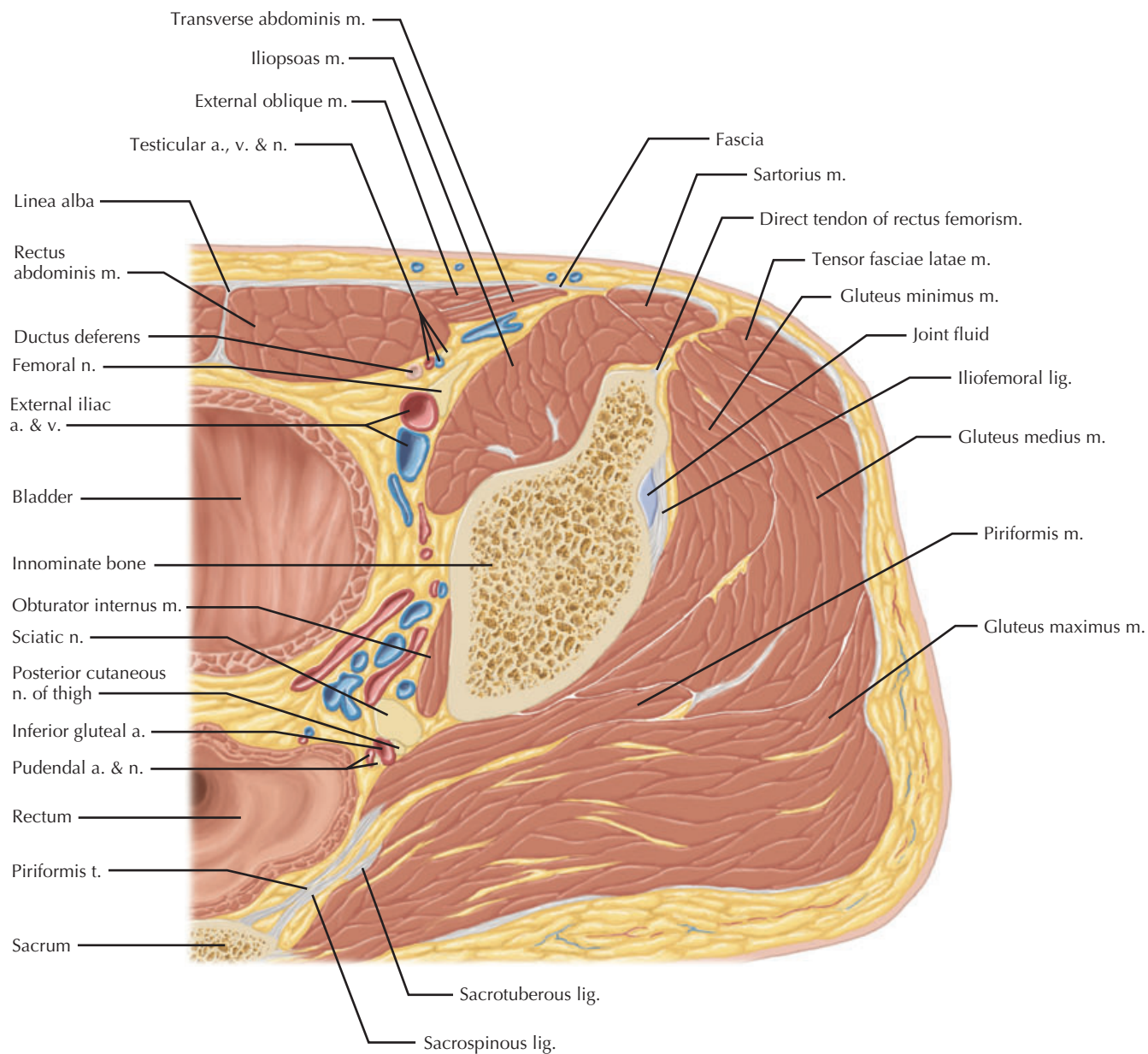
CORONAL 380



CORONAL OBLIQUE 400

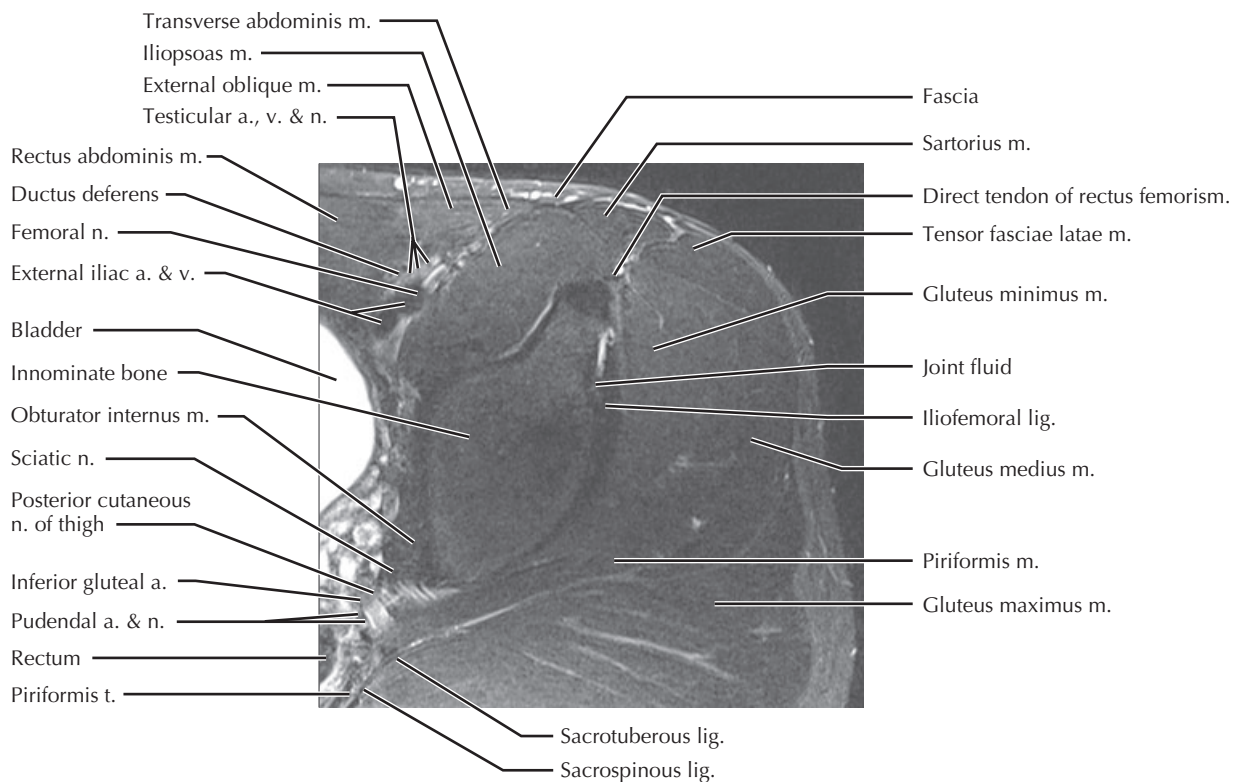
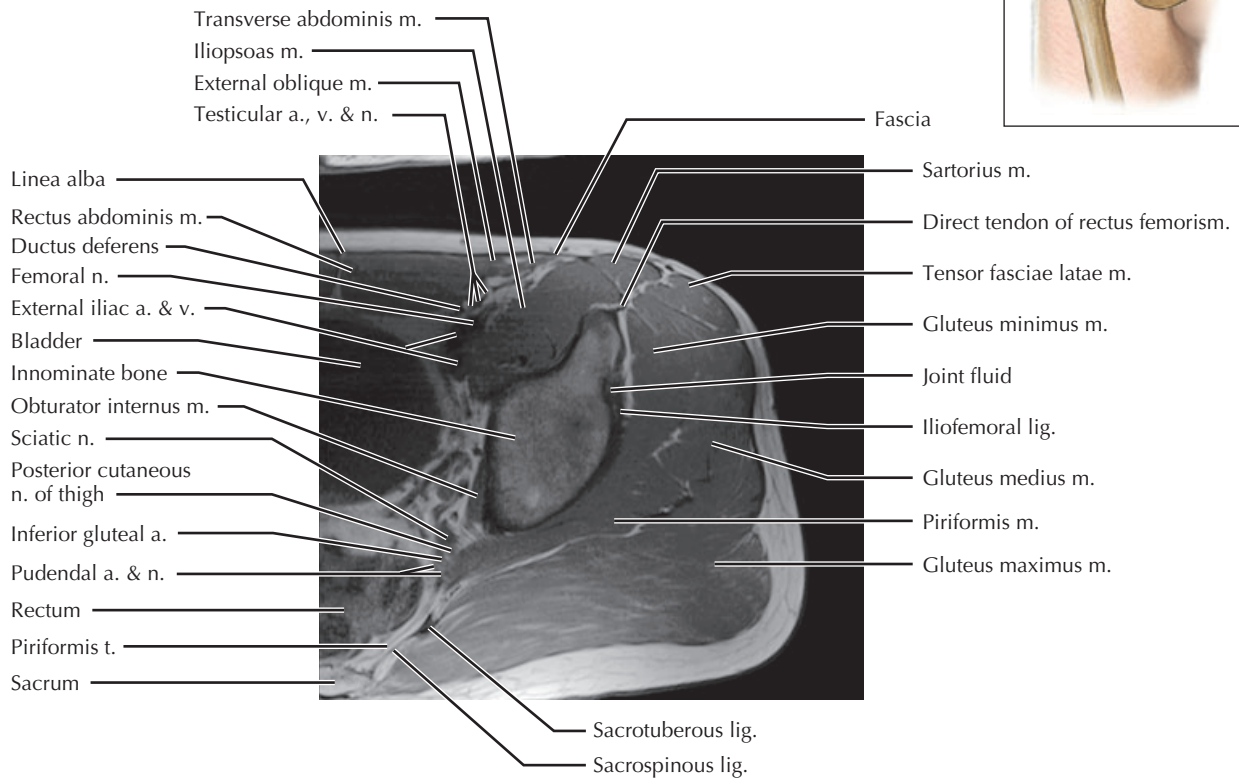
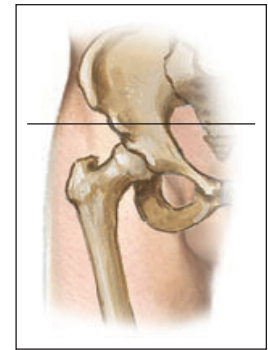


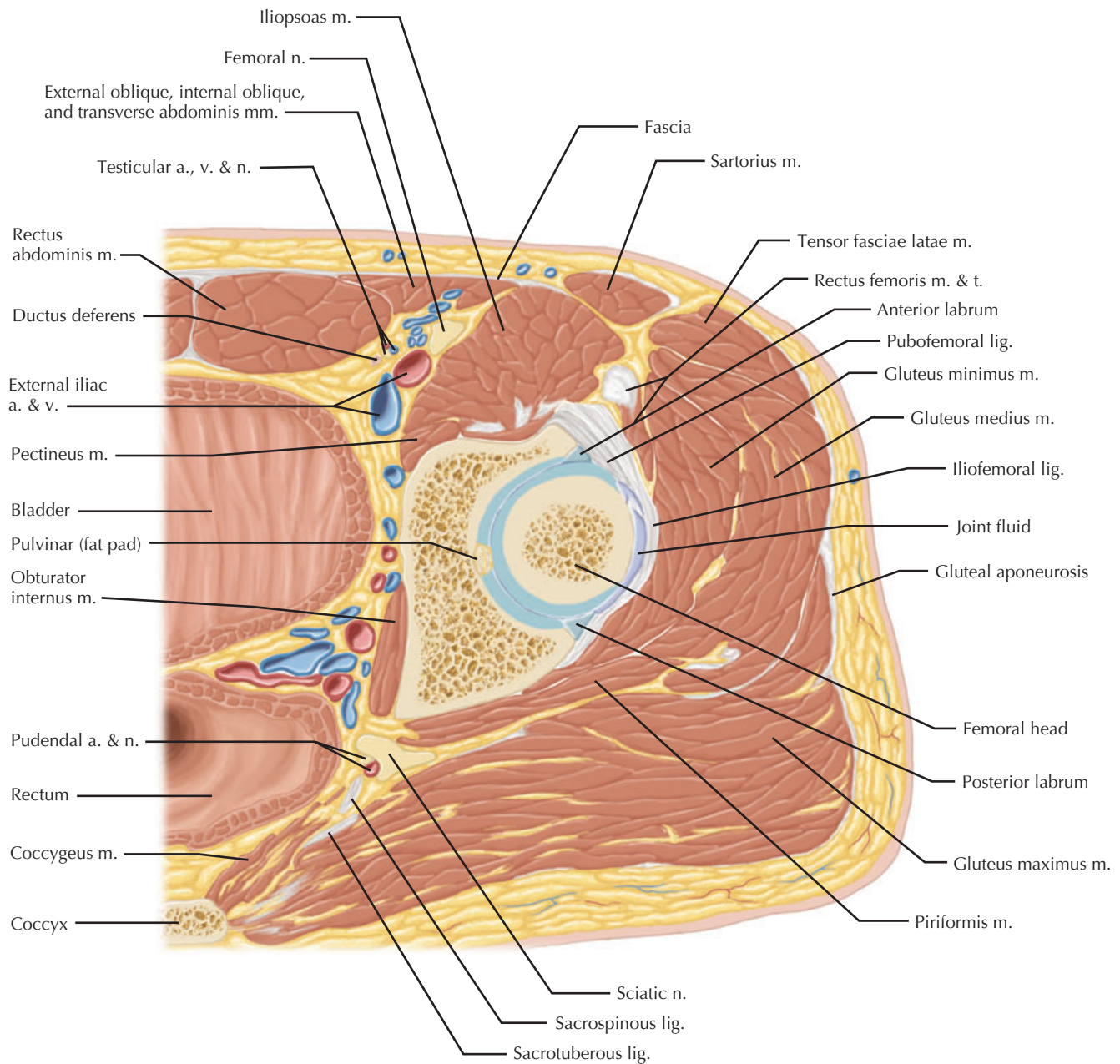
SAGITTAL 414

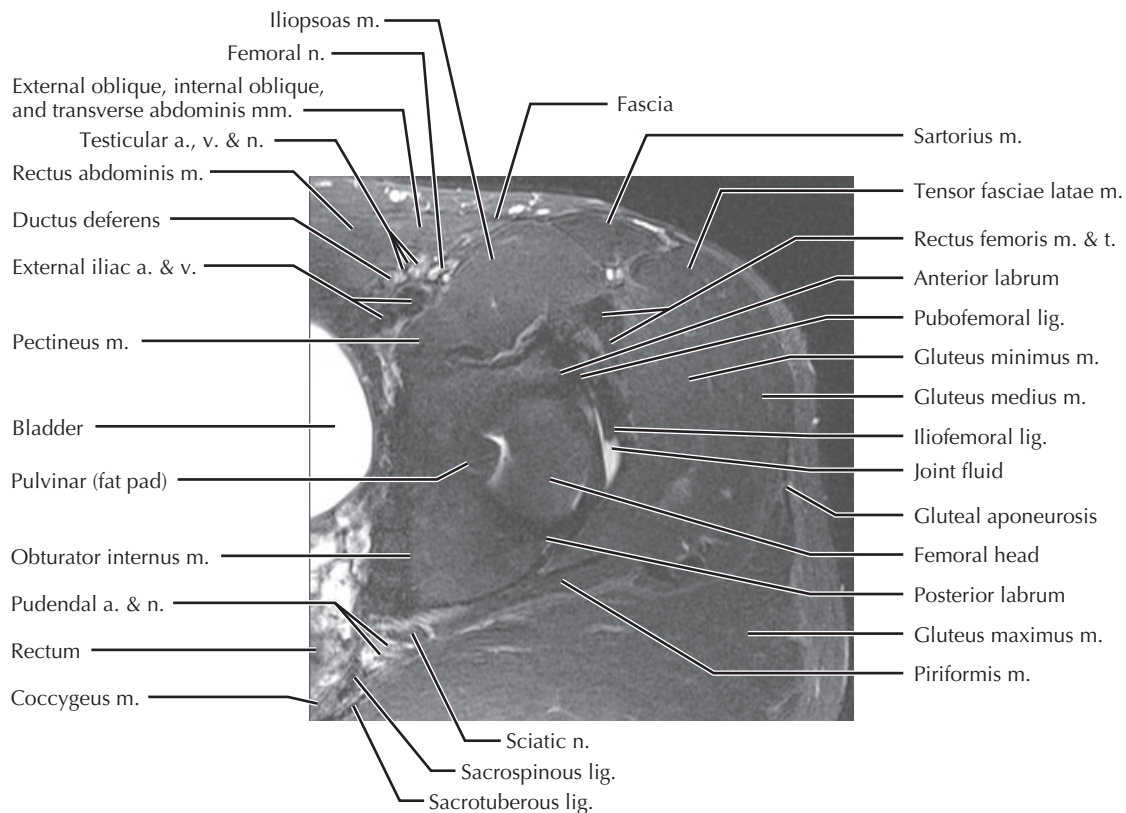
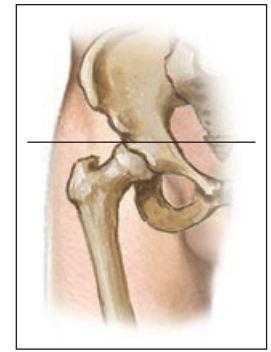
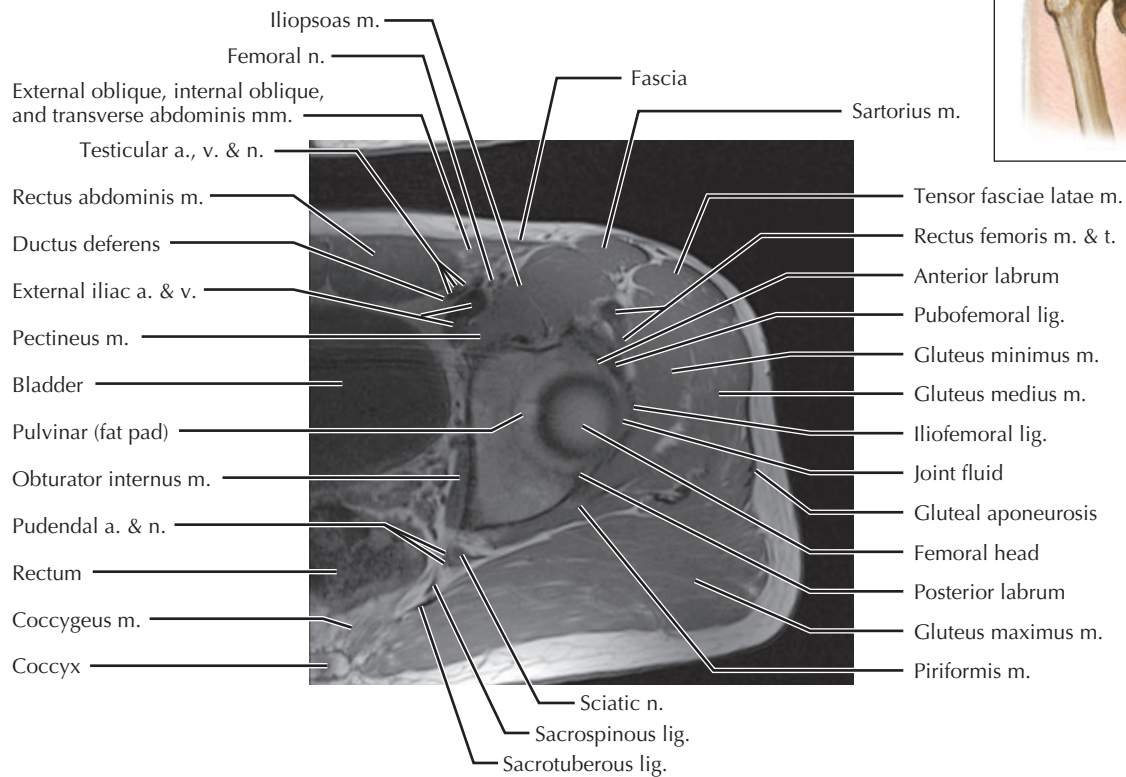


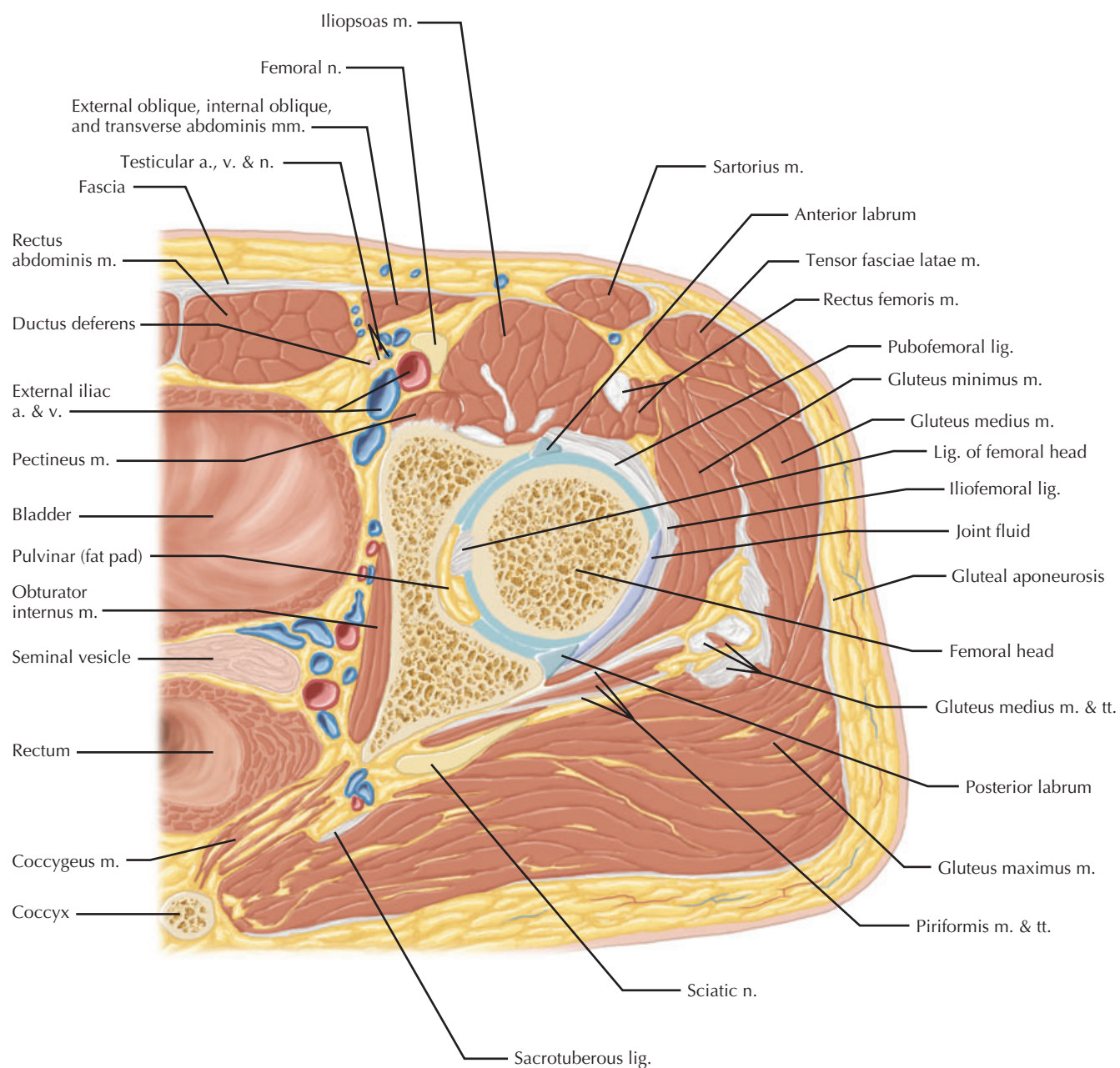
PATHOLOGIC PROCESS

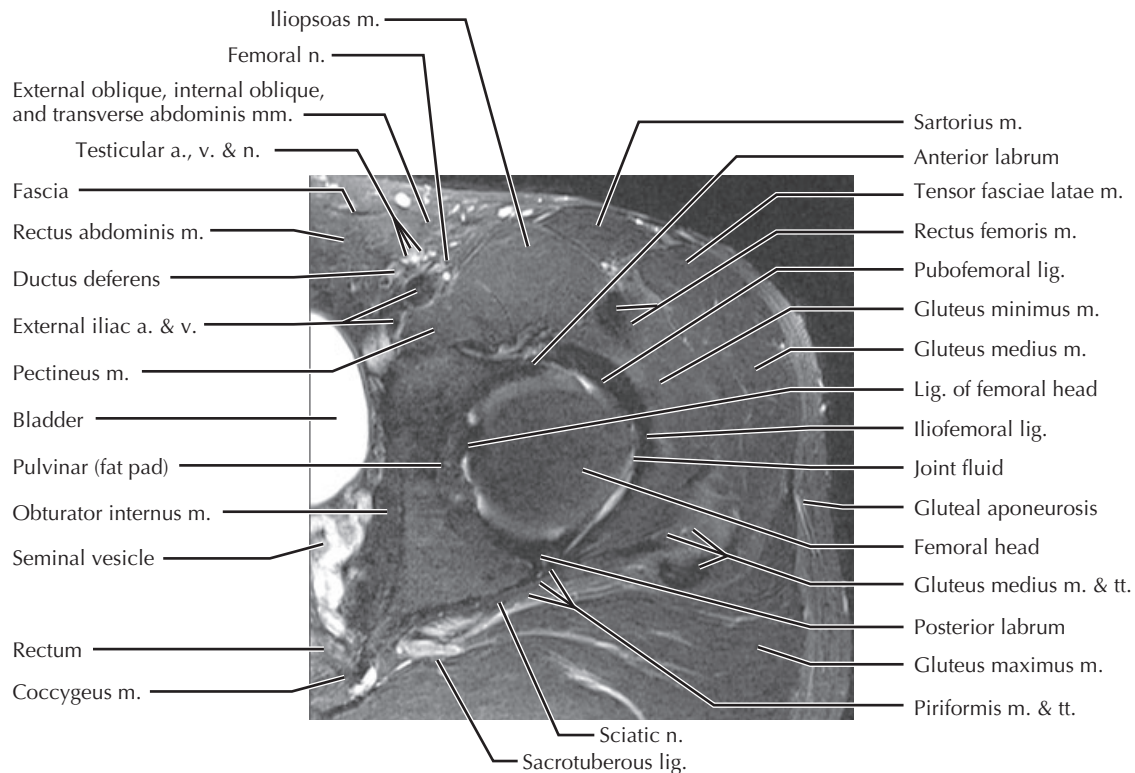
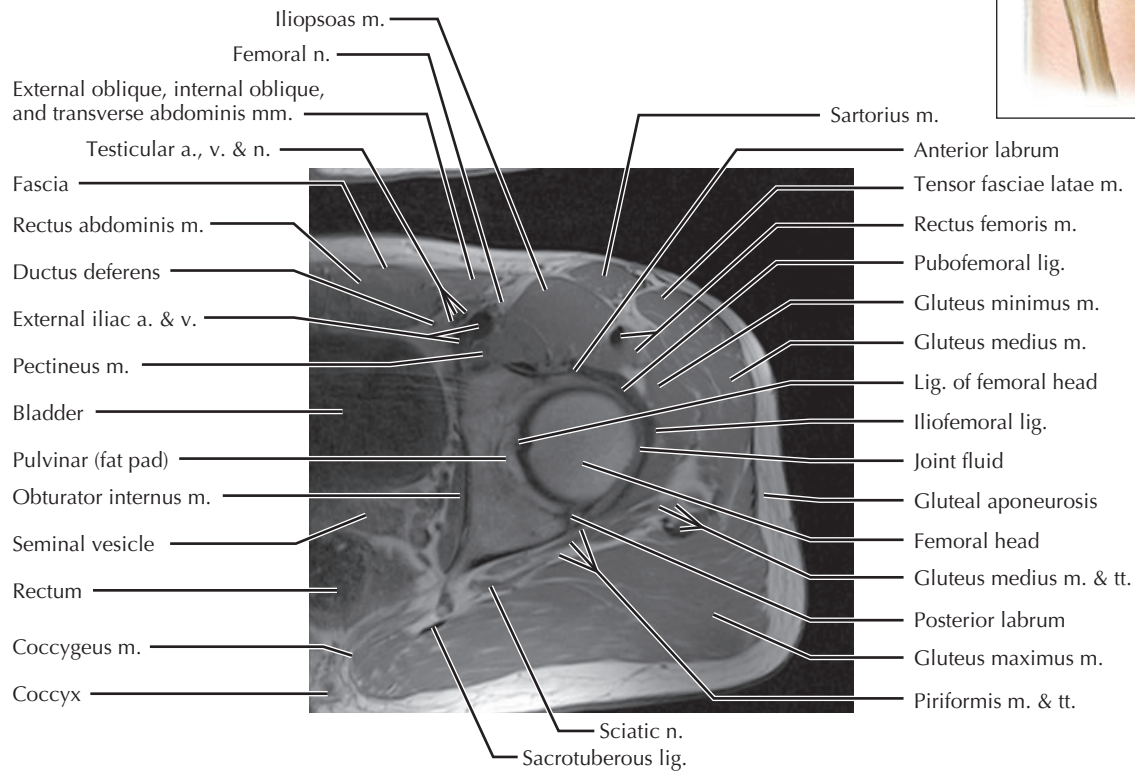
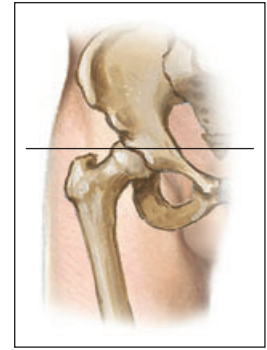
Piriformis syndrome may result from the variability of the sciatic nerve as it travels near the piriformis muscle. The nerve may split as it travels through the muscle or anterior to the muscle. Normally, the sciatic nerve is located superficial to the piriformis. It is susceptible to compressive abnormalities. The MR image may show abnormal signal in the piriformis muscle or asymmetry in size compared with the contralateral piriformis.

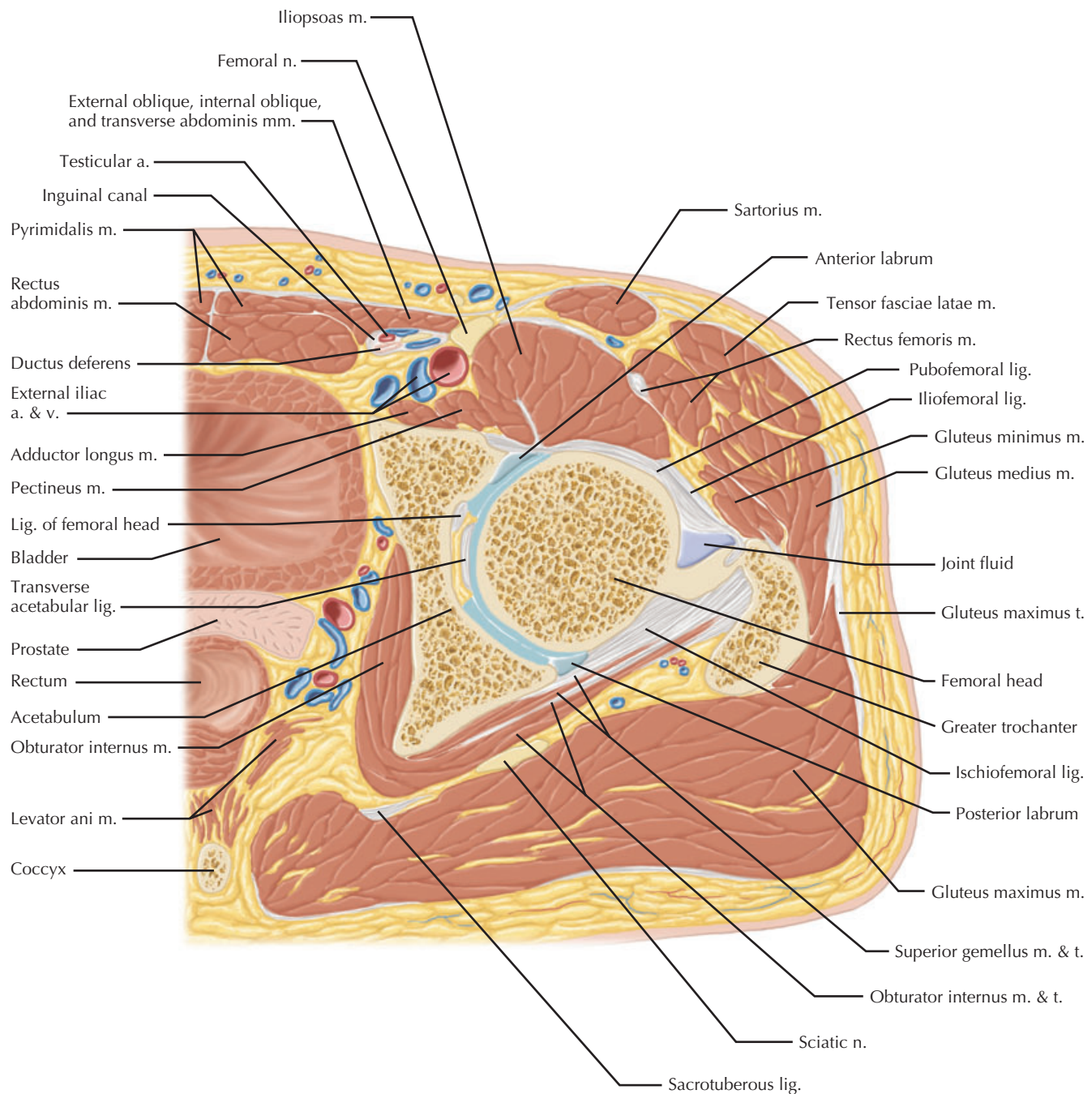






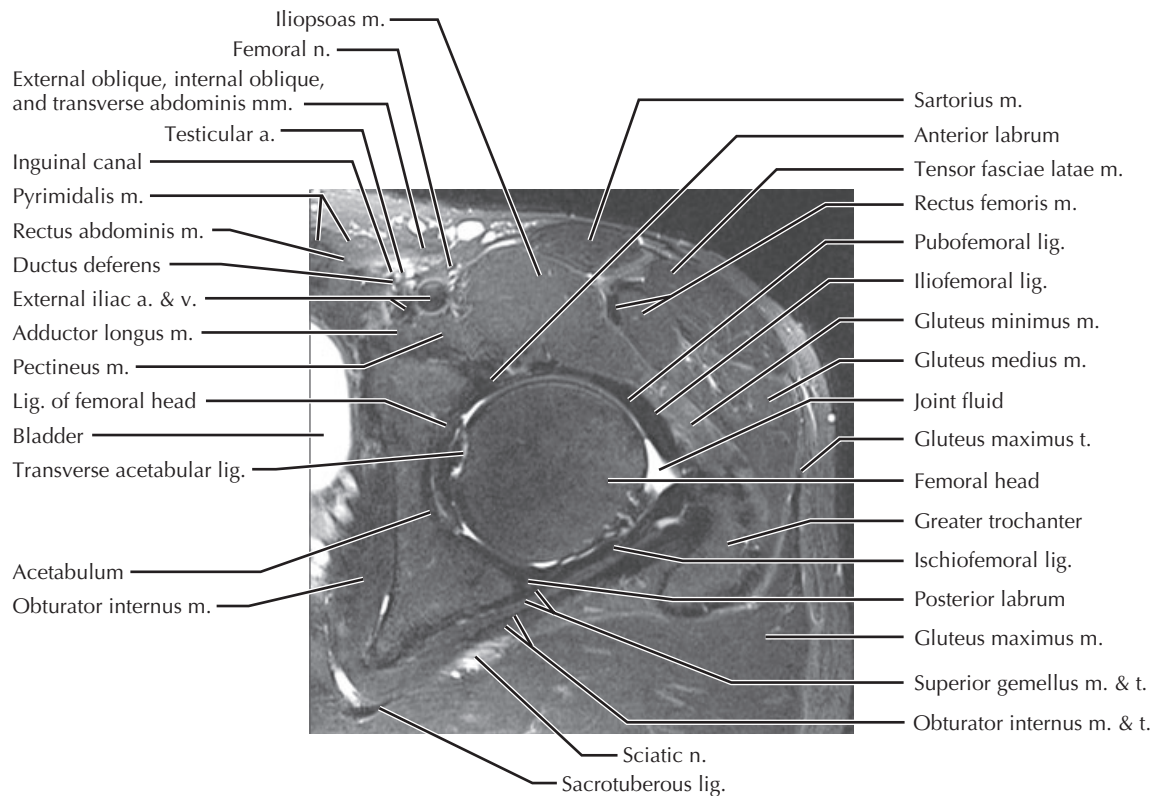
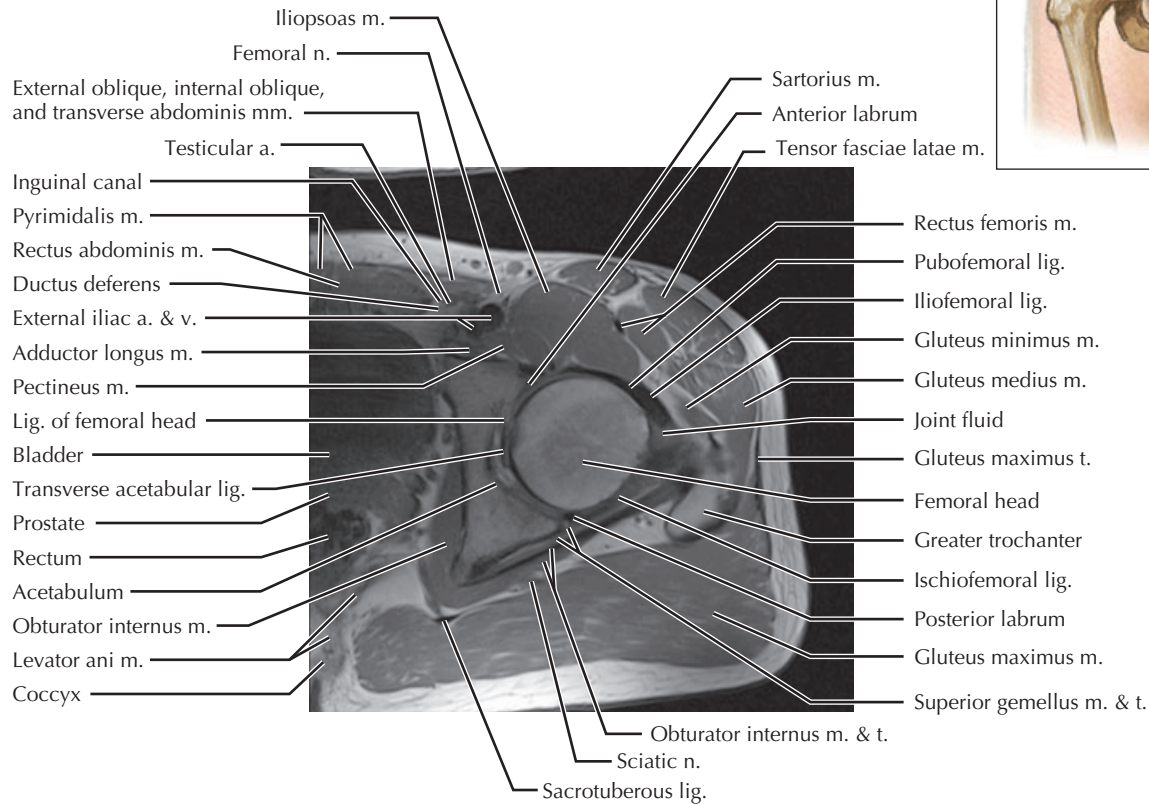
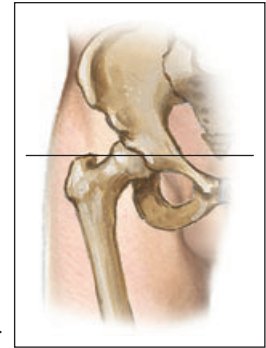


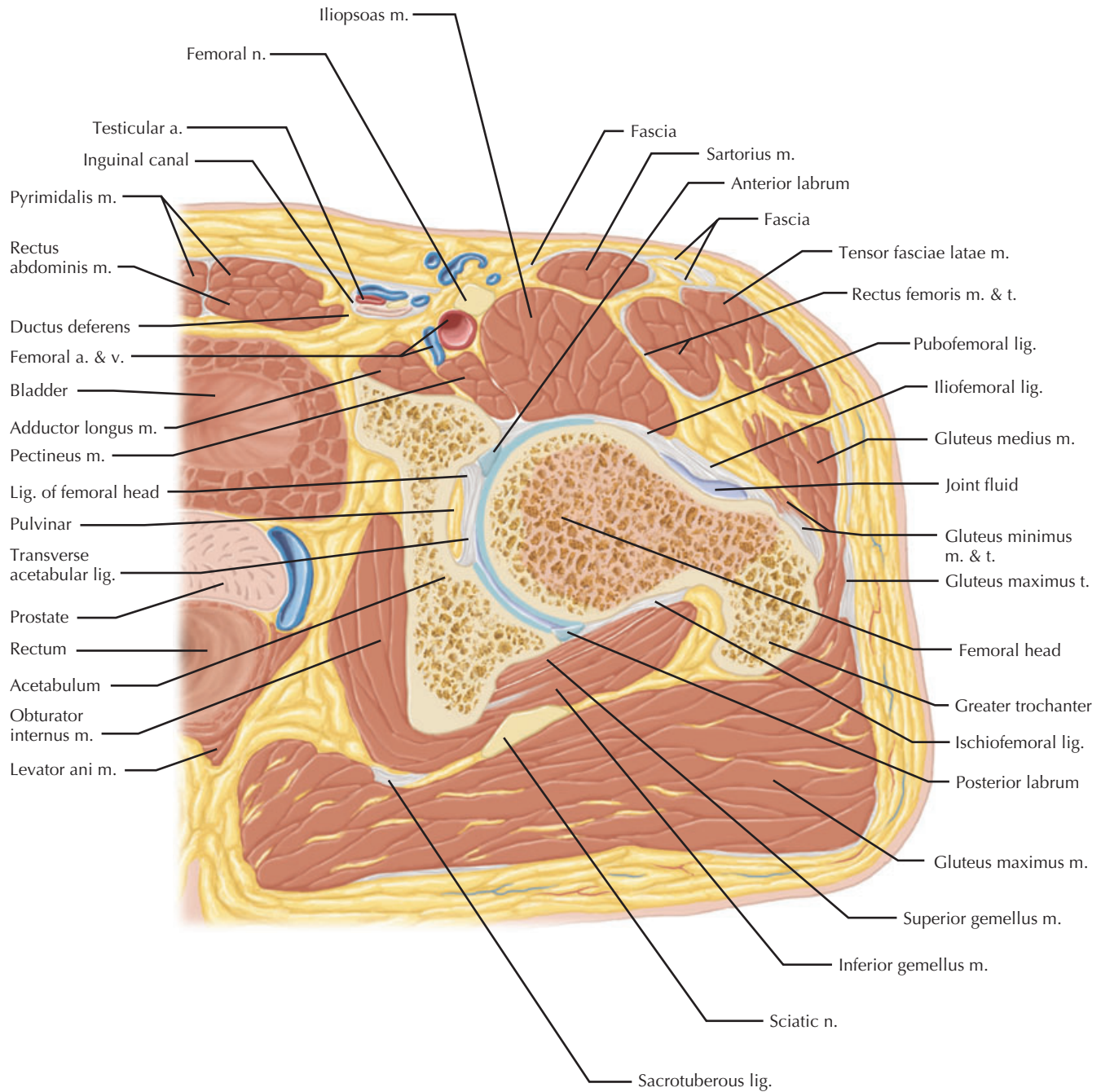


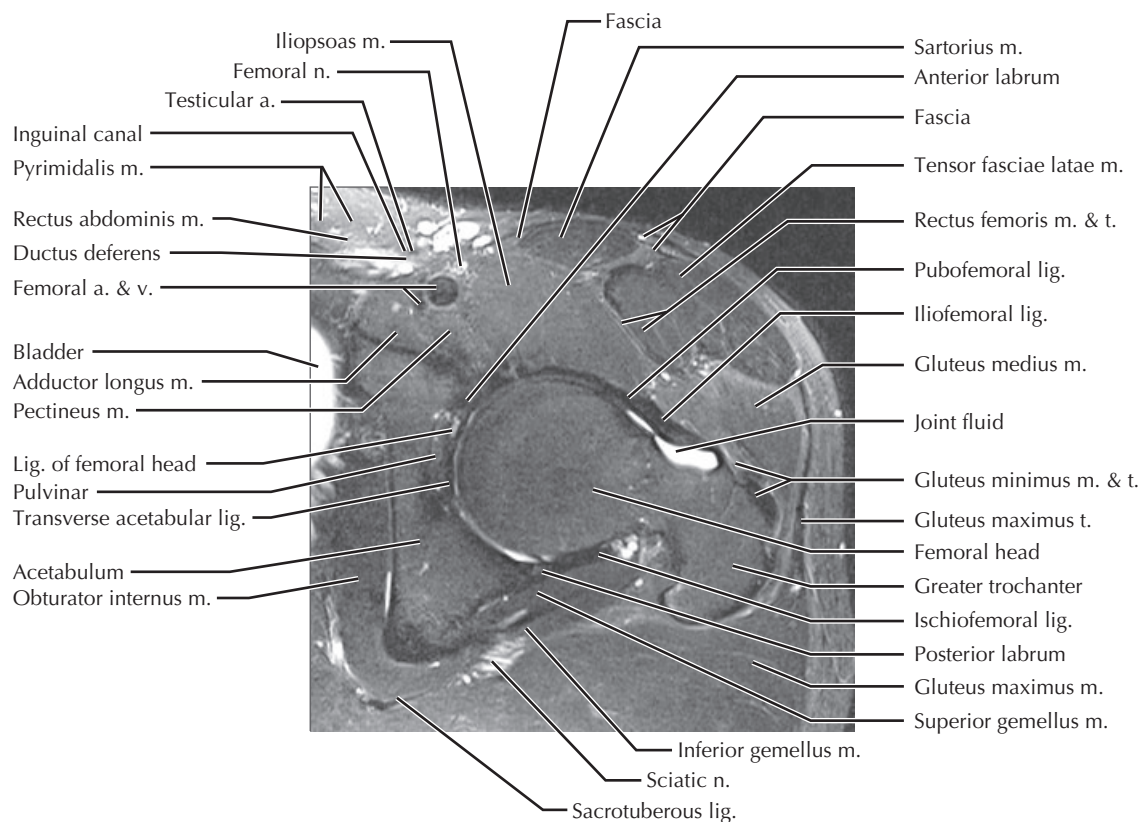
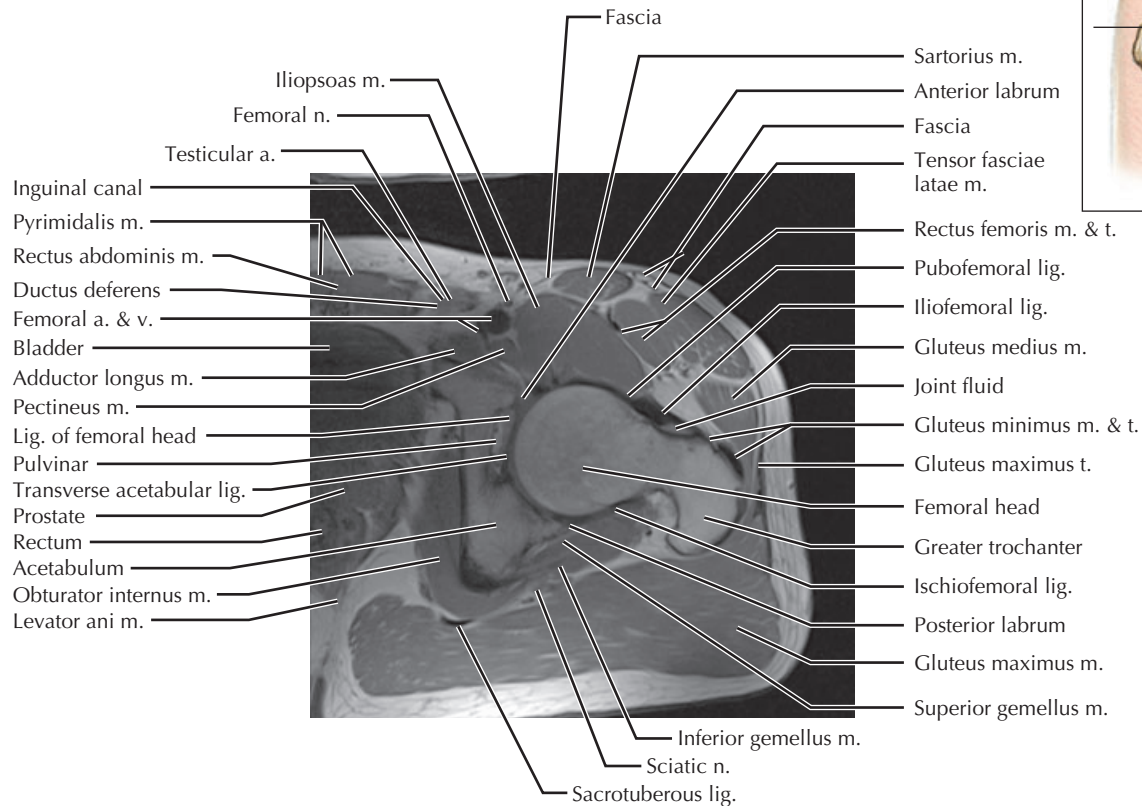


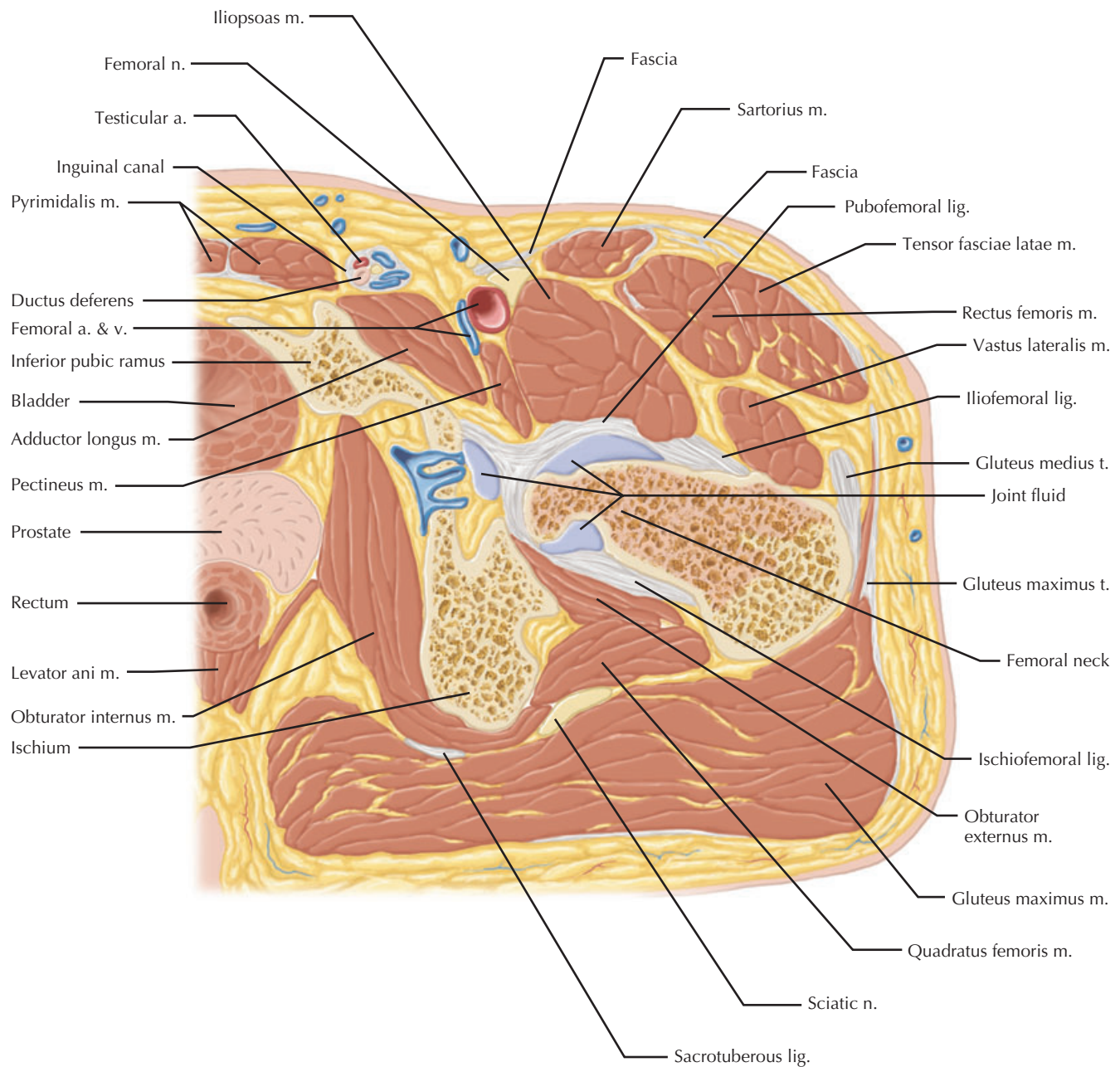
NORMAL VARIANT

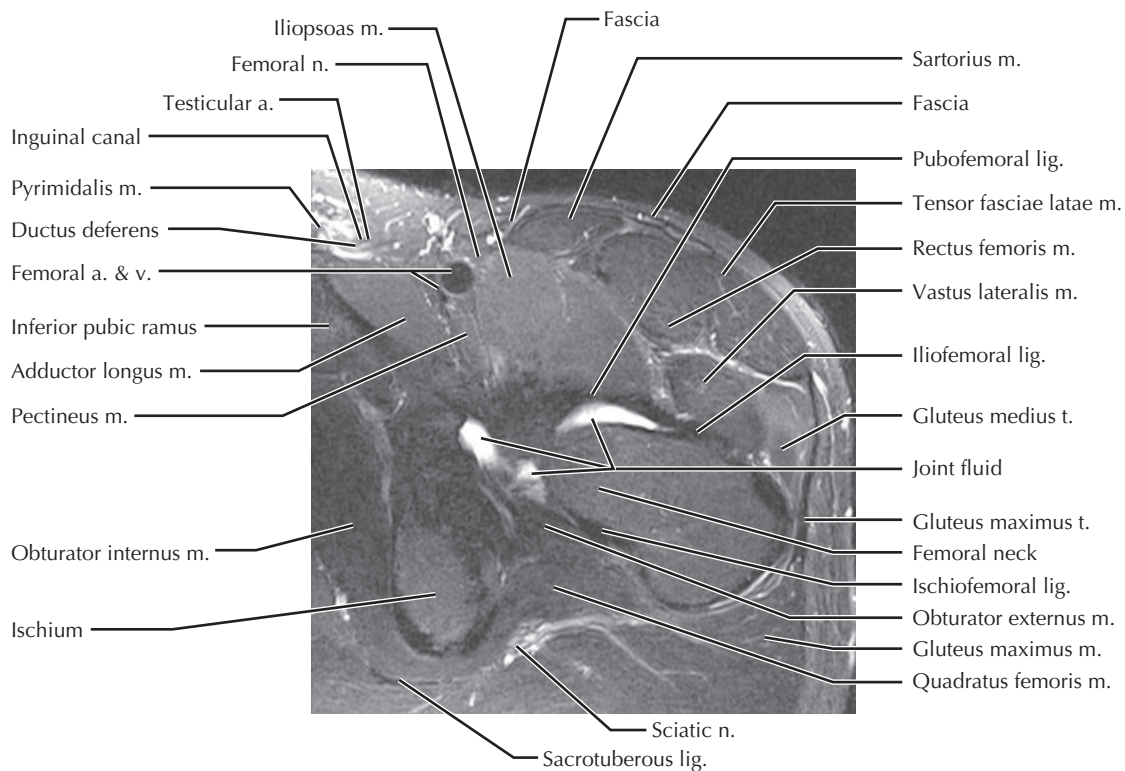
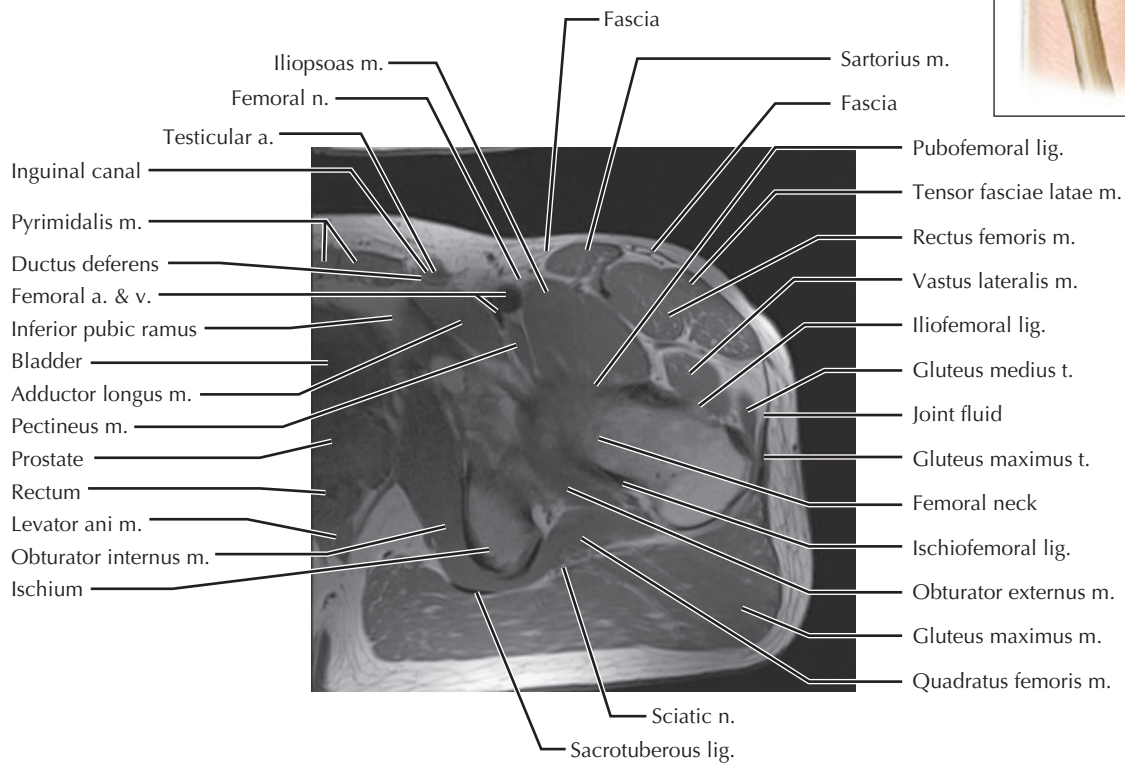
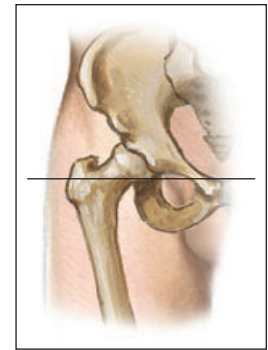
Occasionally, red marrow can be seen in the subchondral location of the femoral head. This is most often seen in women.

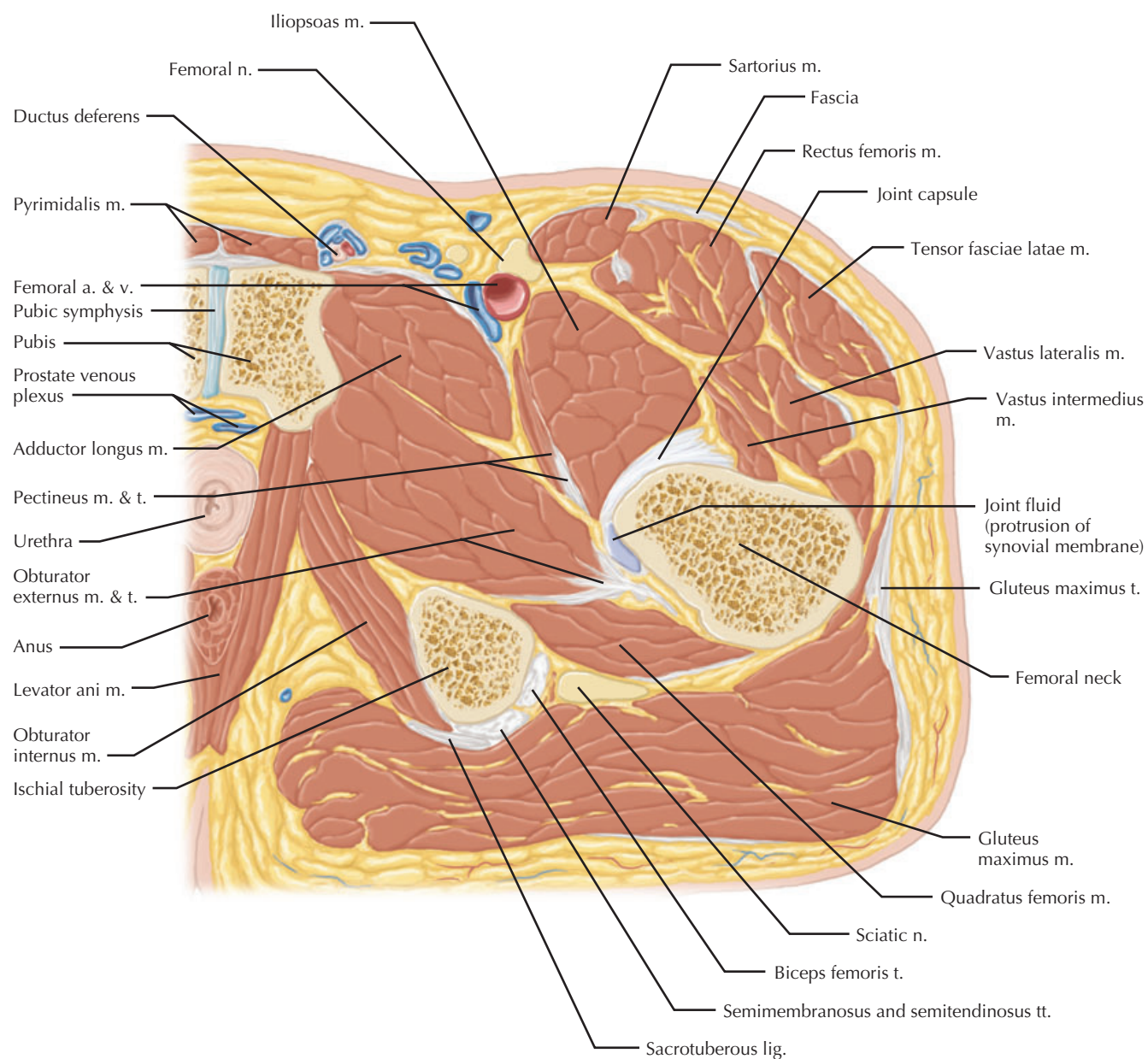


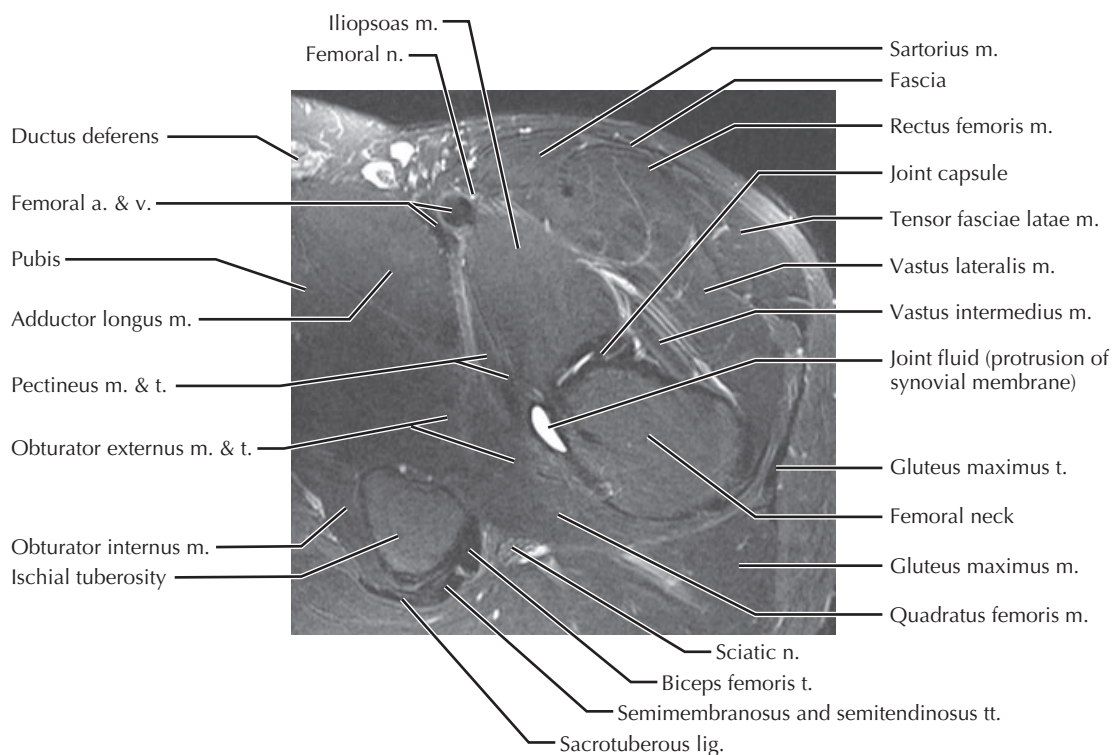
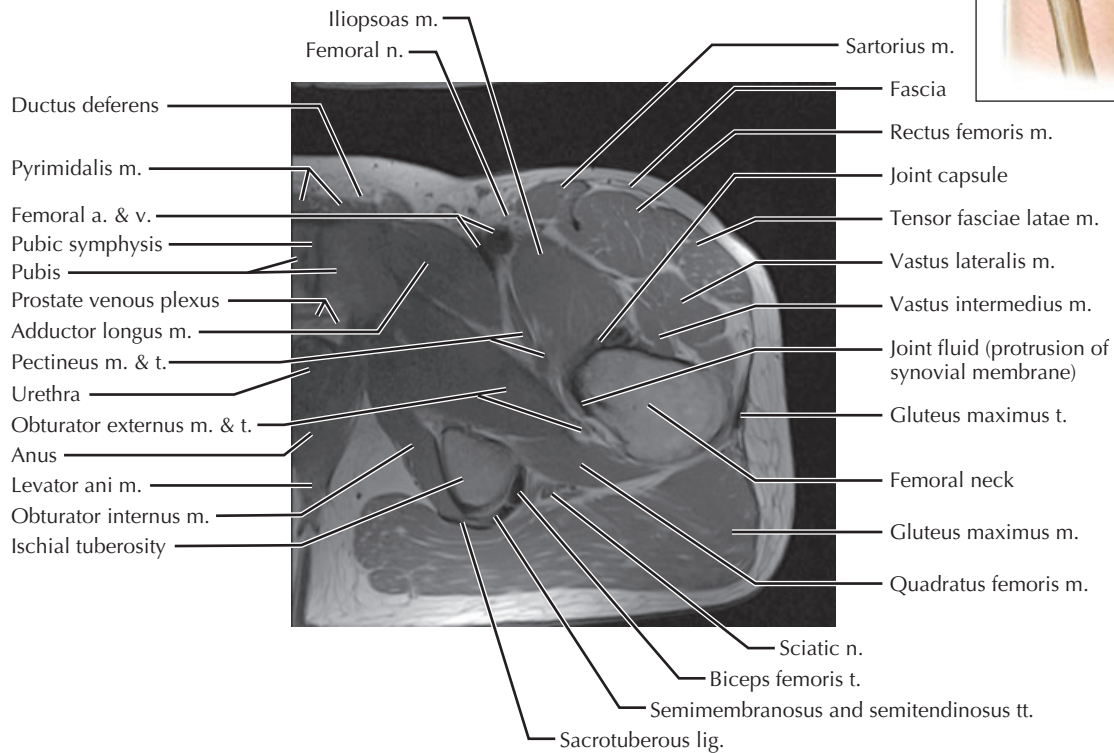
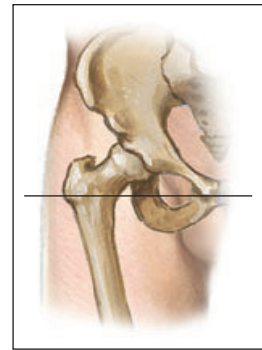


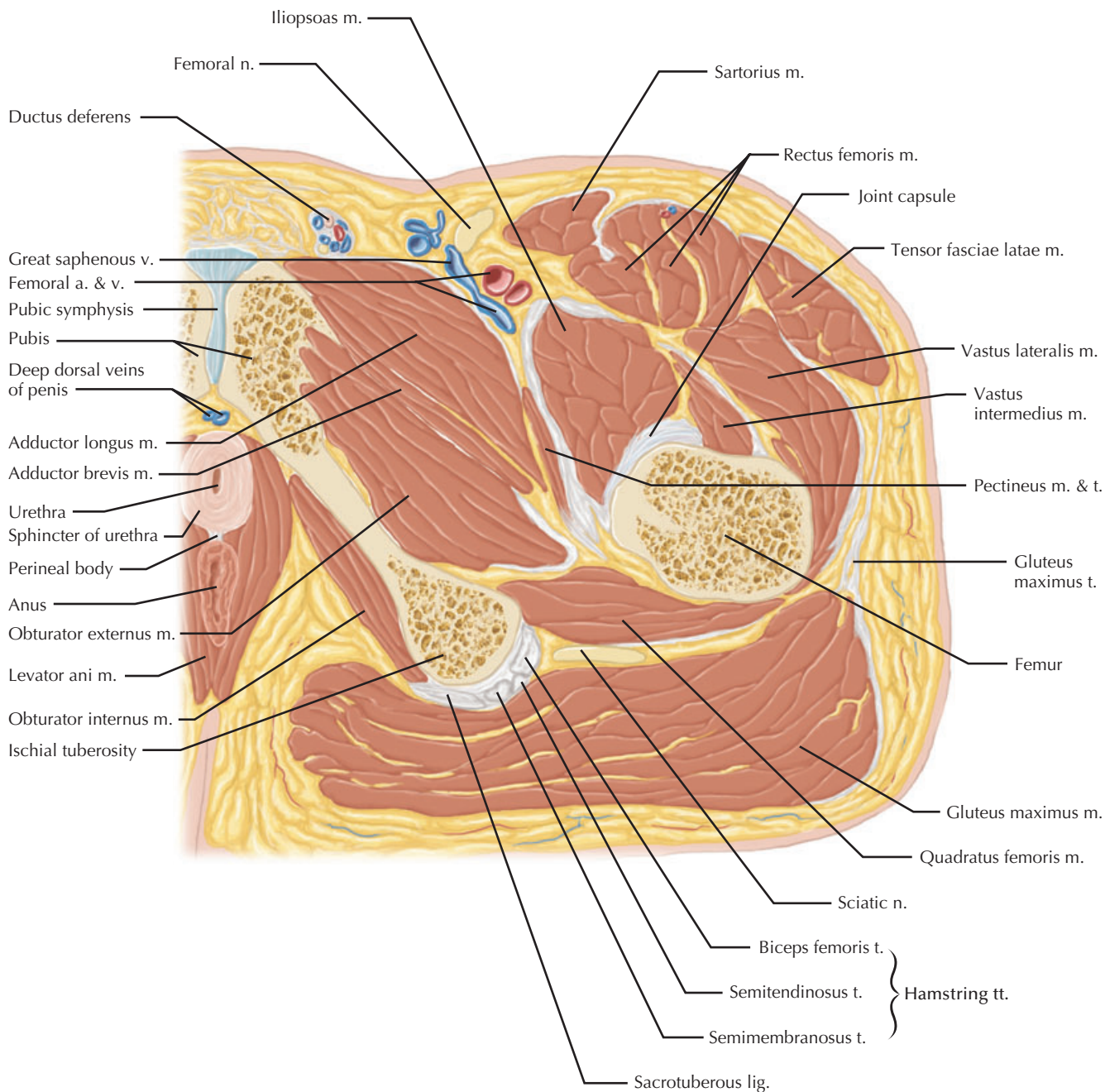






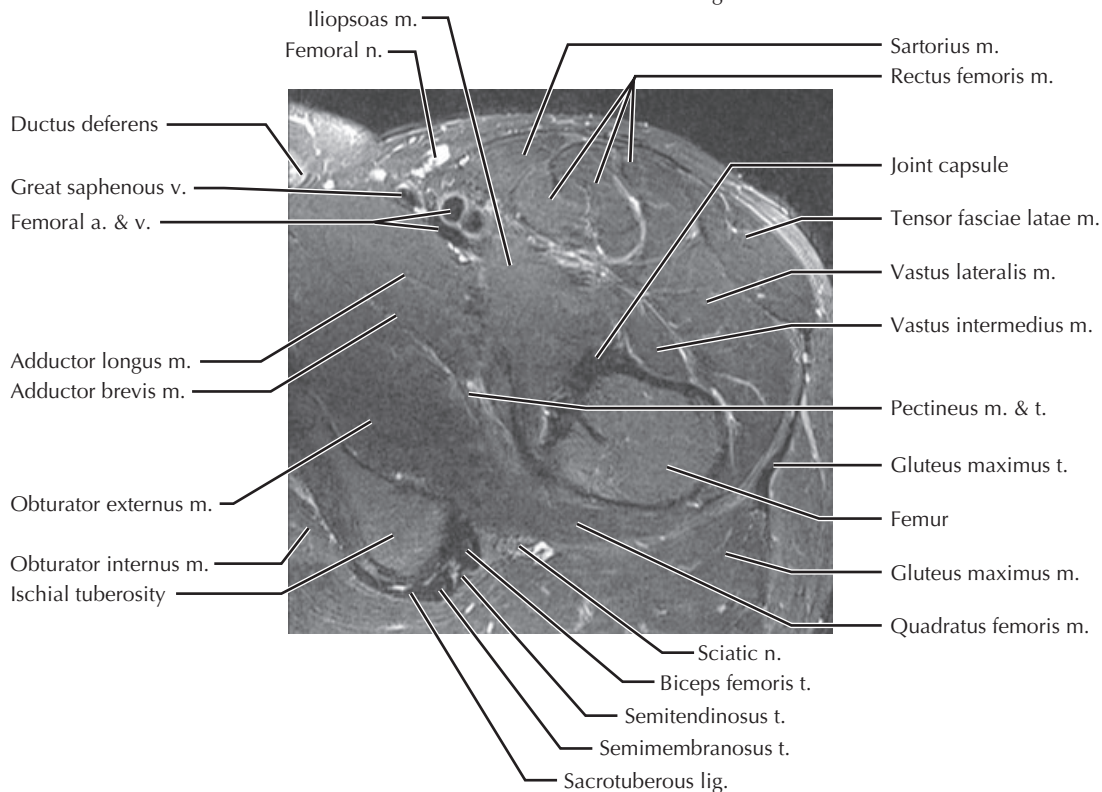
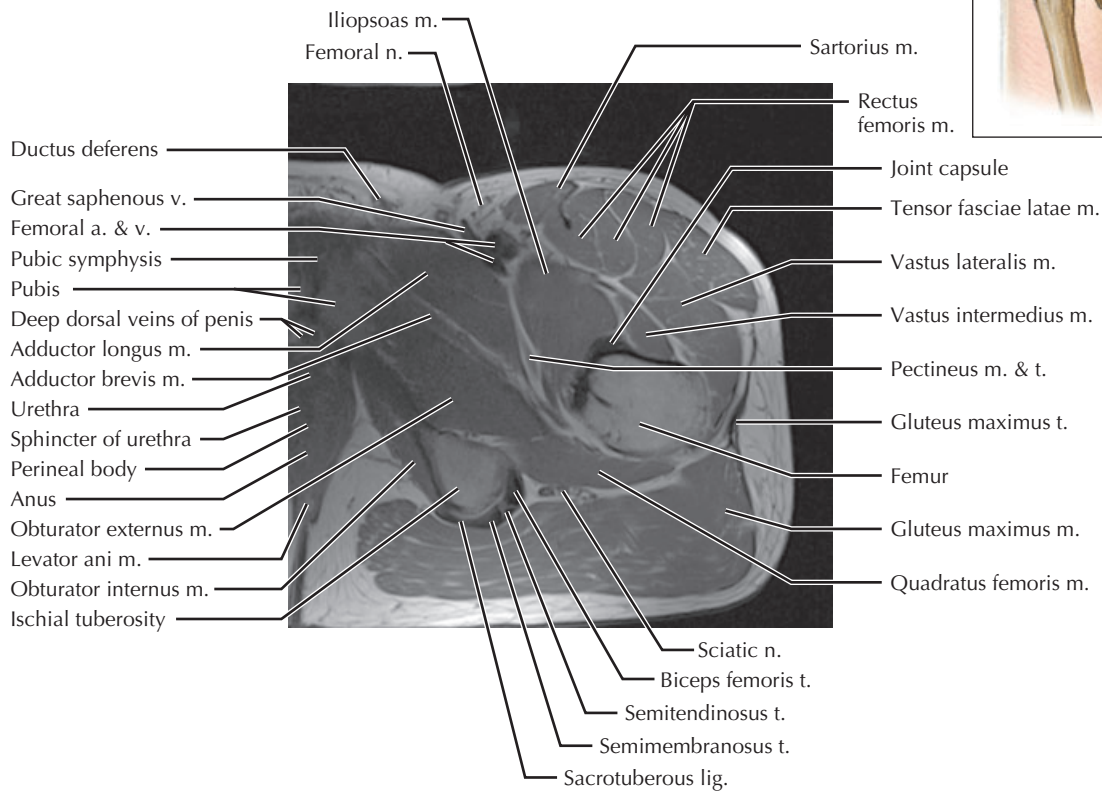
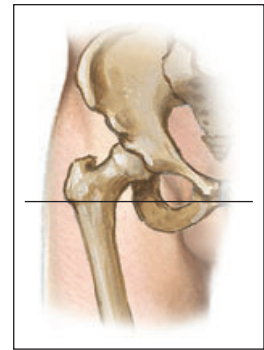


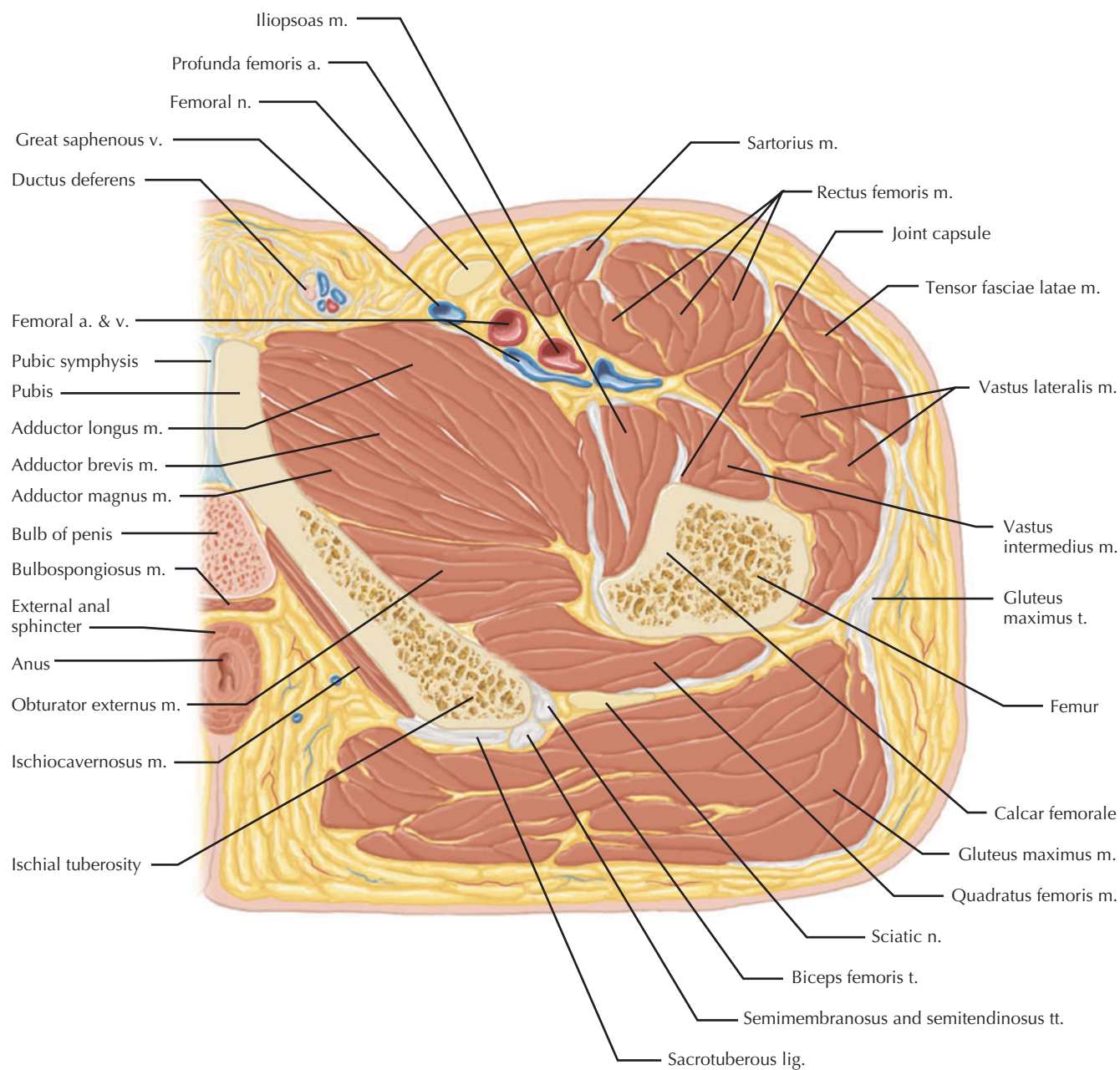




PATHOLOGIC PROCESS

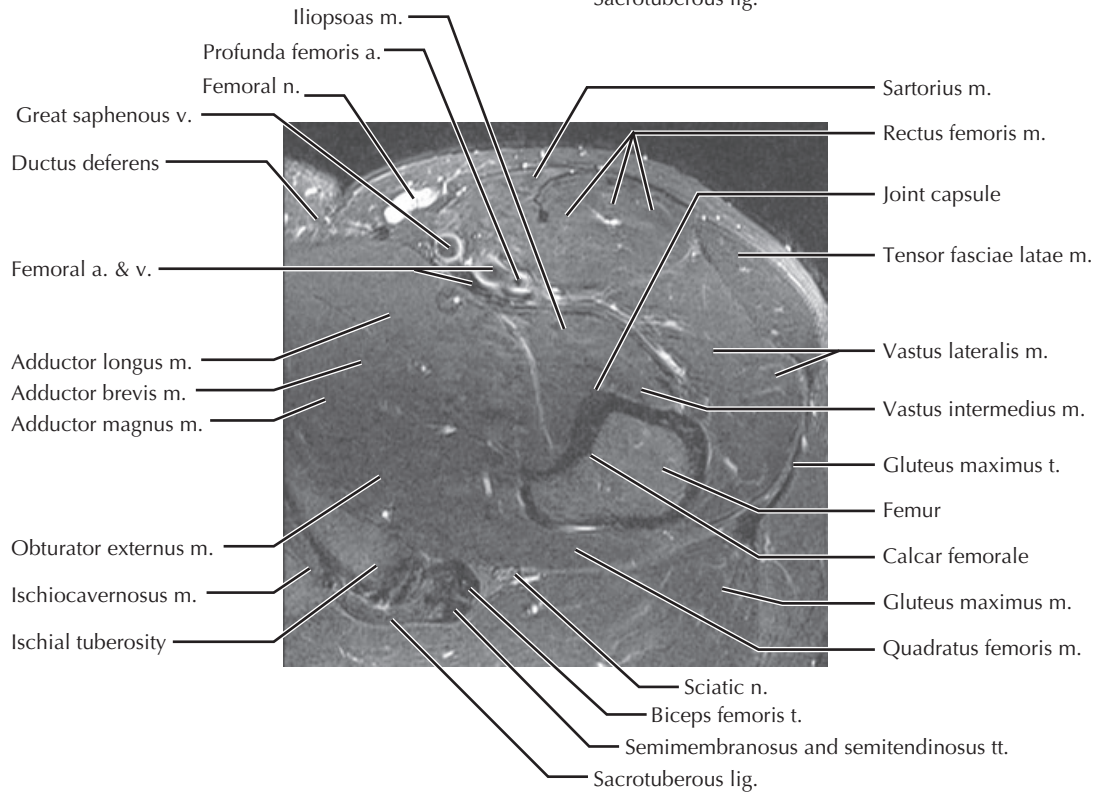
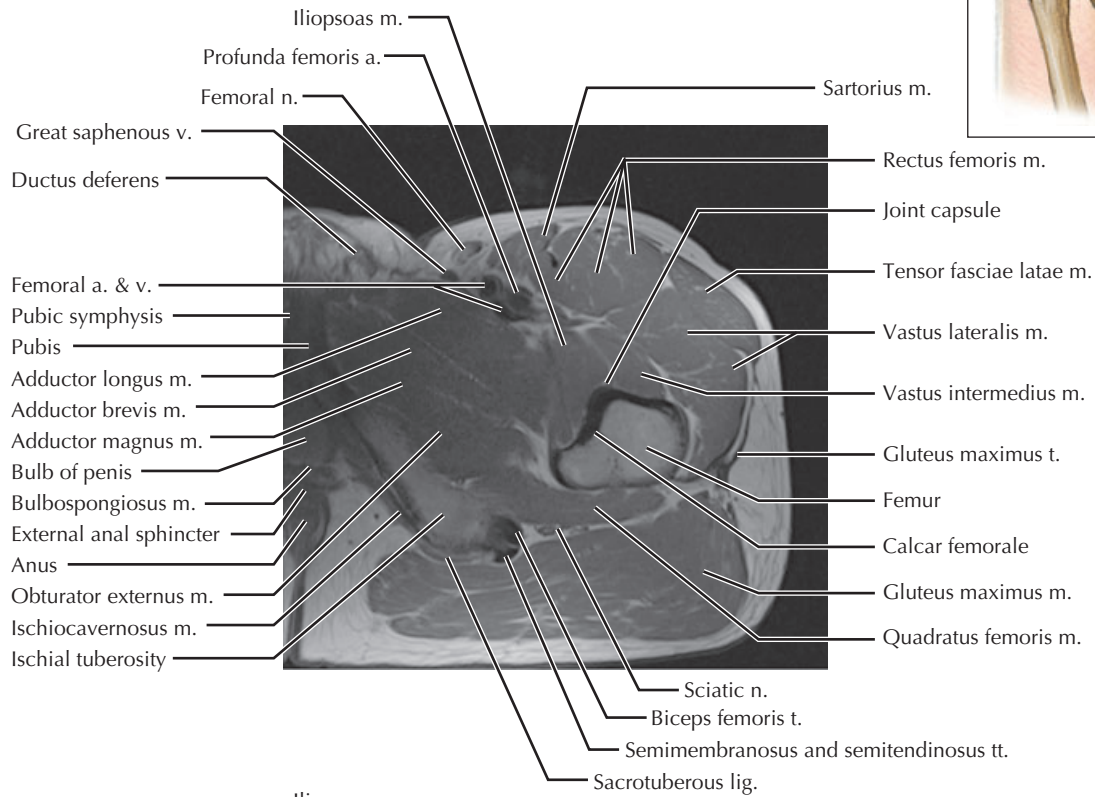
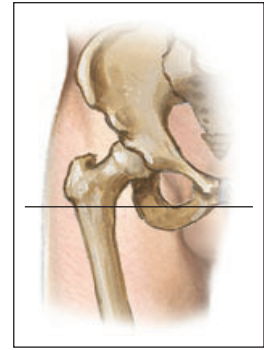
Hamstring injuries may present clinically with "sciatic" symptoms. The hamstring tendon origin on the ischial tuberosity should be carefully inspected for abnormal signal, suggesting tendinopathy, partial tears, or avulsions.

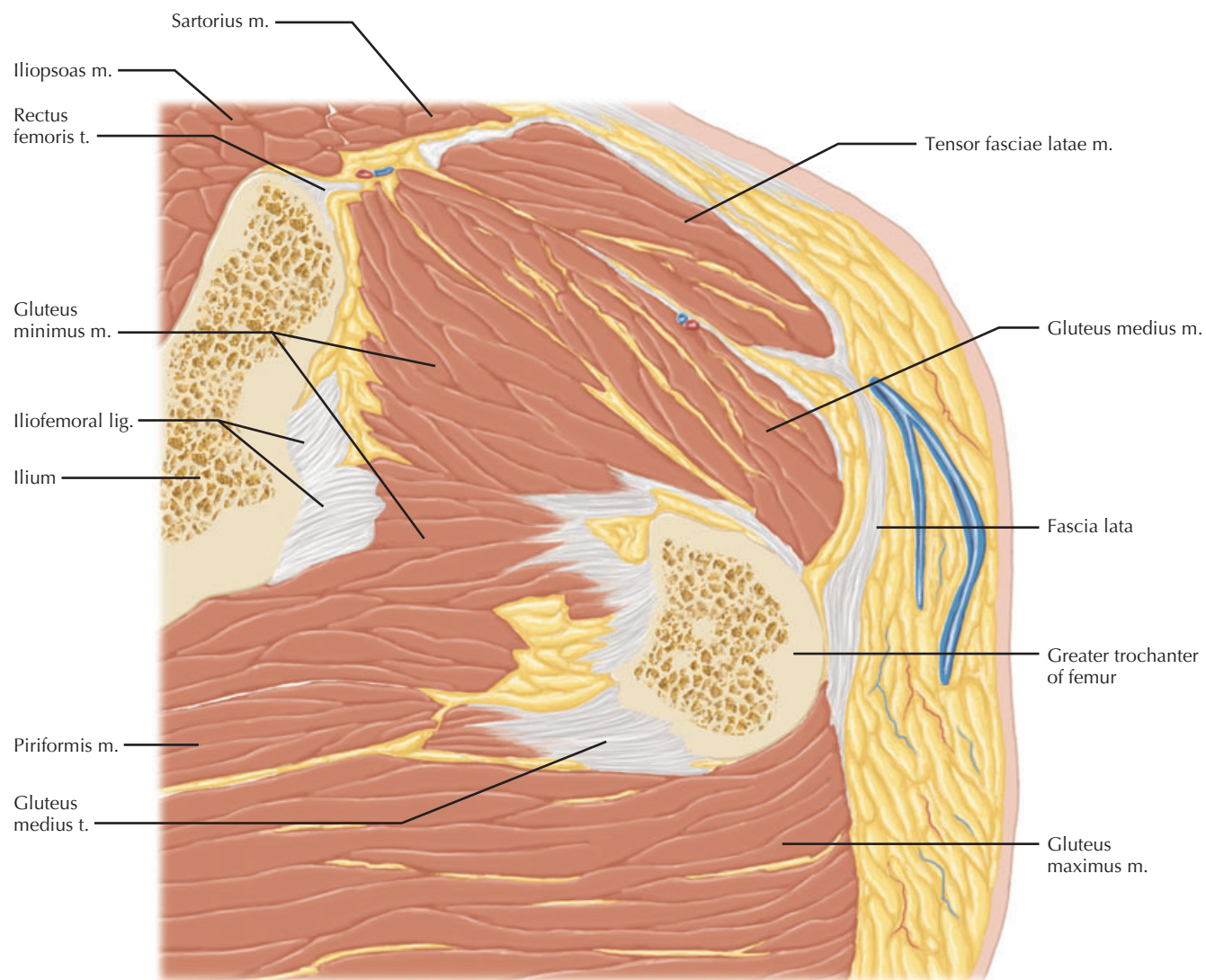


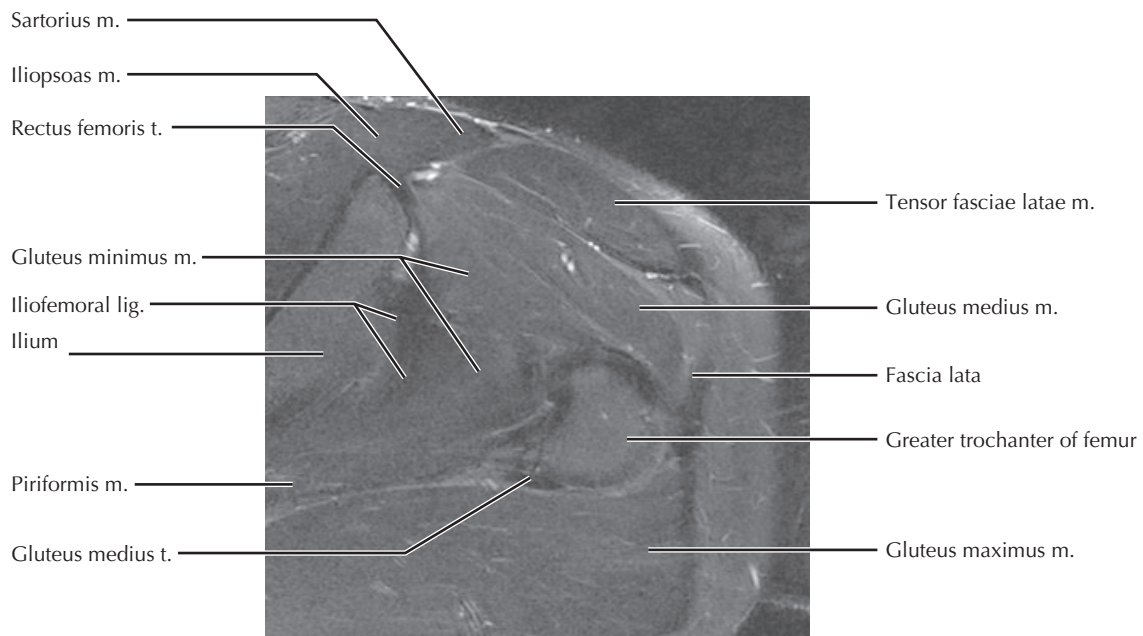
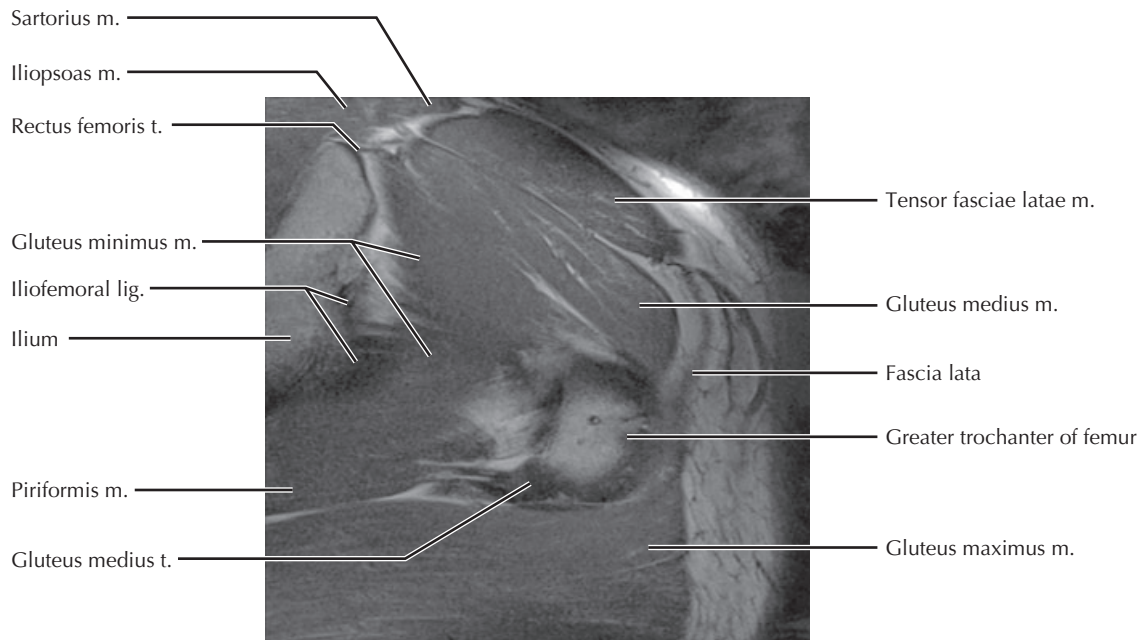
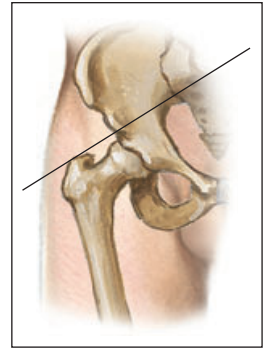


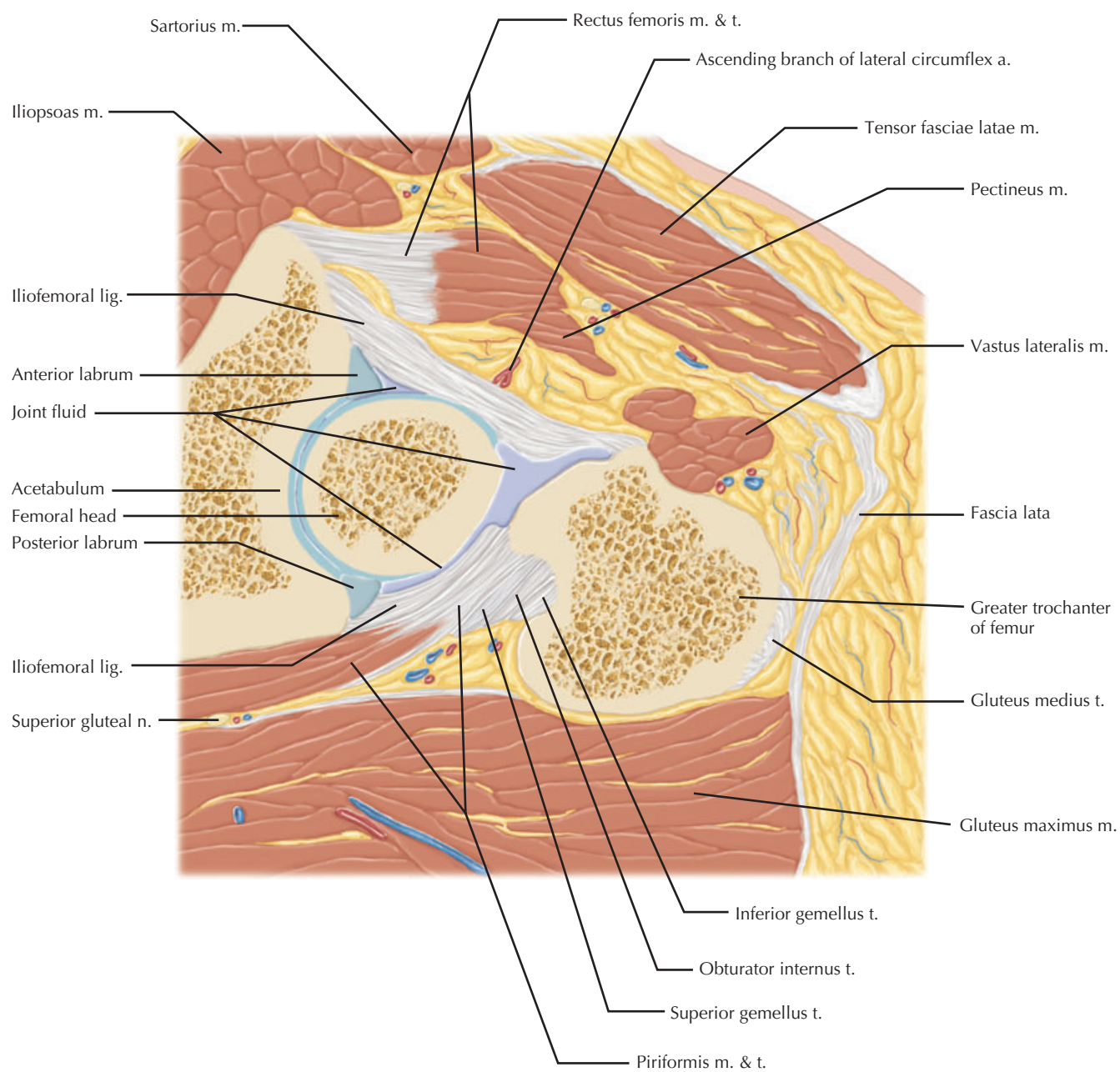
NORMAL ANATOMY

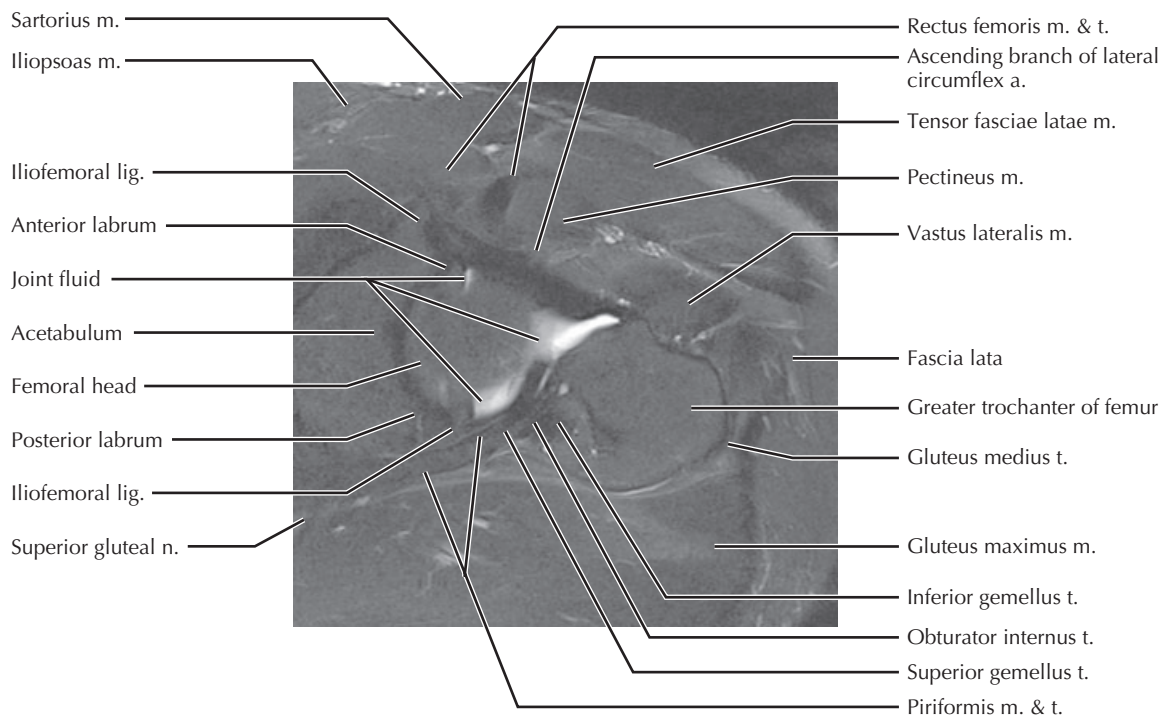
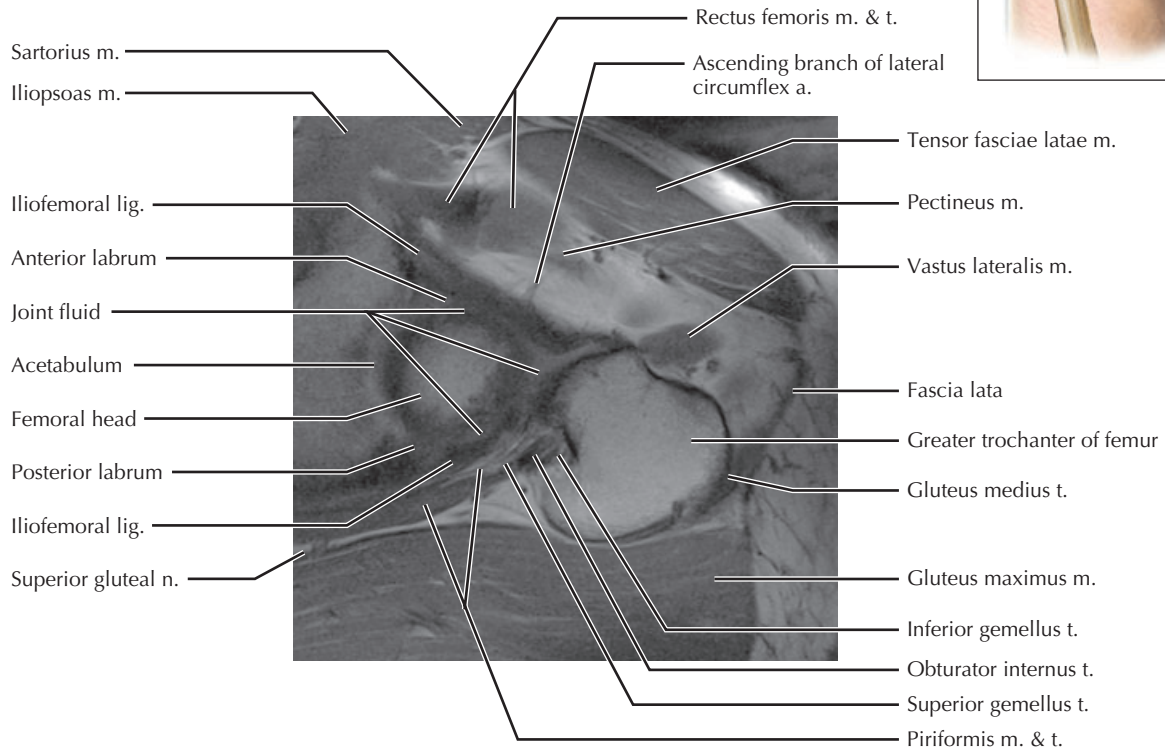
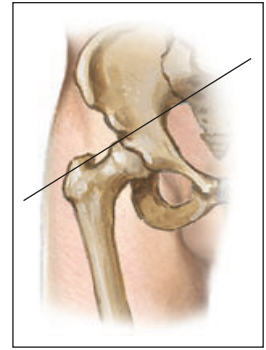
The trabeculae in the femoral neck can thicken from stresses and may mimic a stress fracture. The location is classic in the femoral neck and is referred to as the "calcar femorale." It is seen as linear low signal on MRI, as can the physeal scar at the femoral head-neck junction.

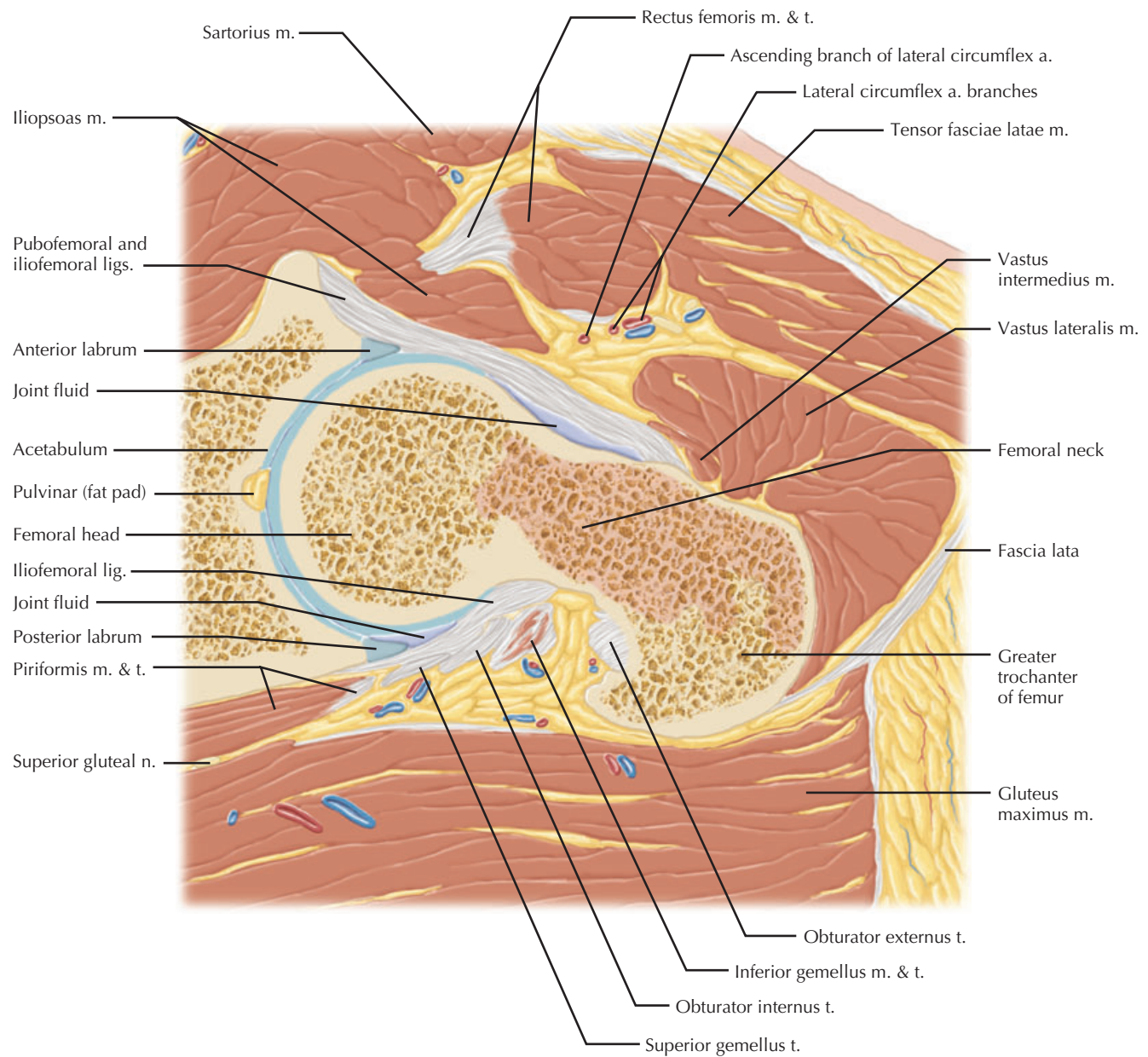






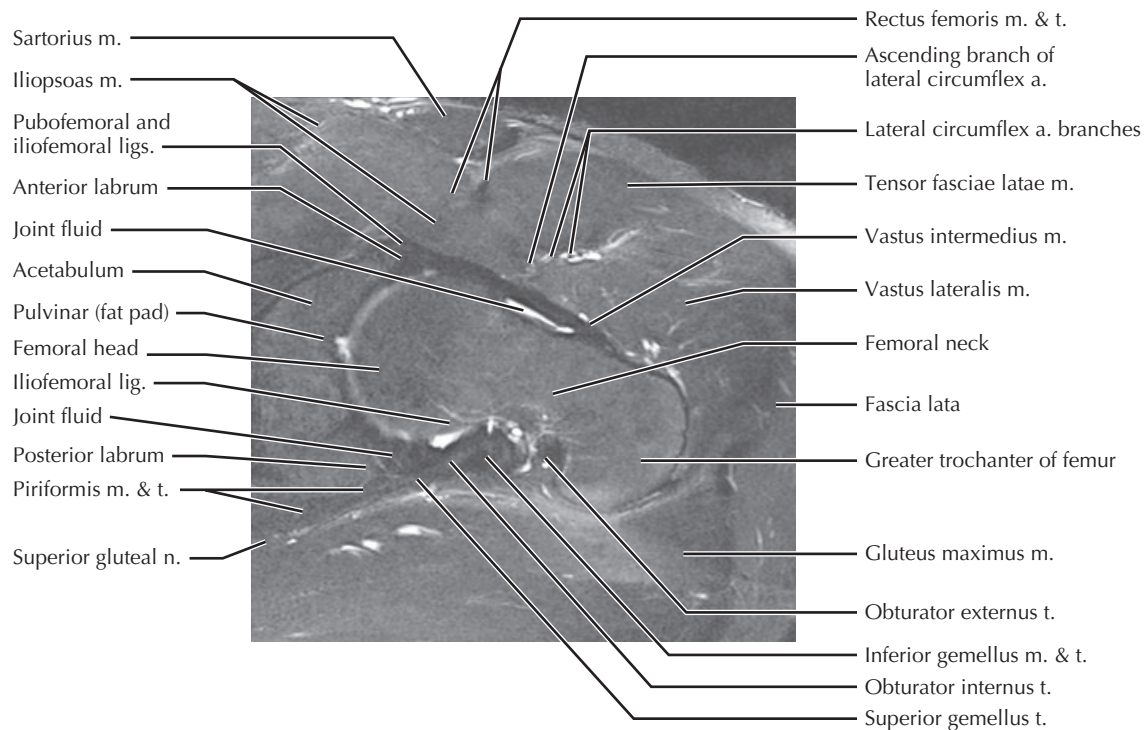
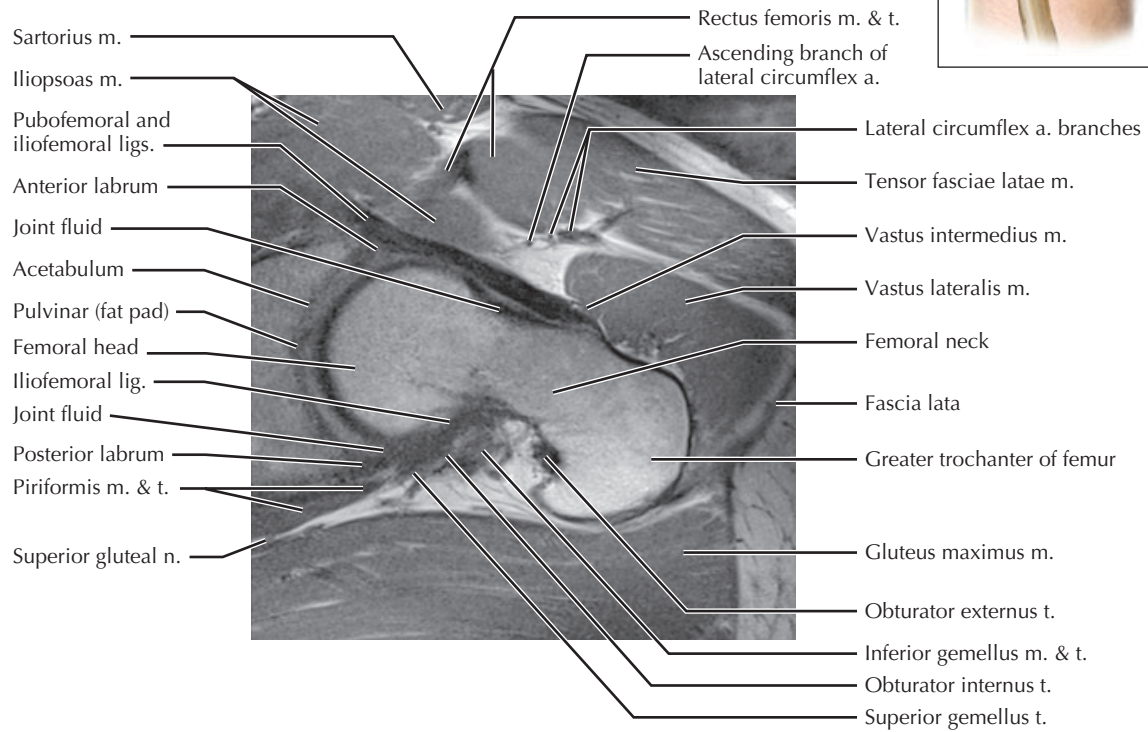
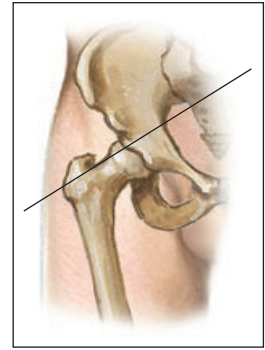


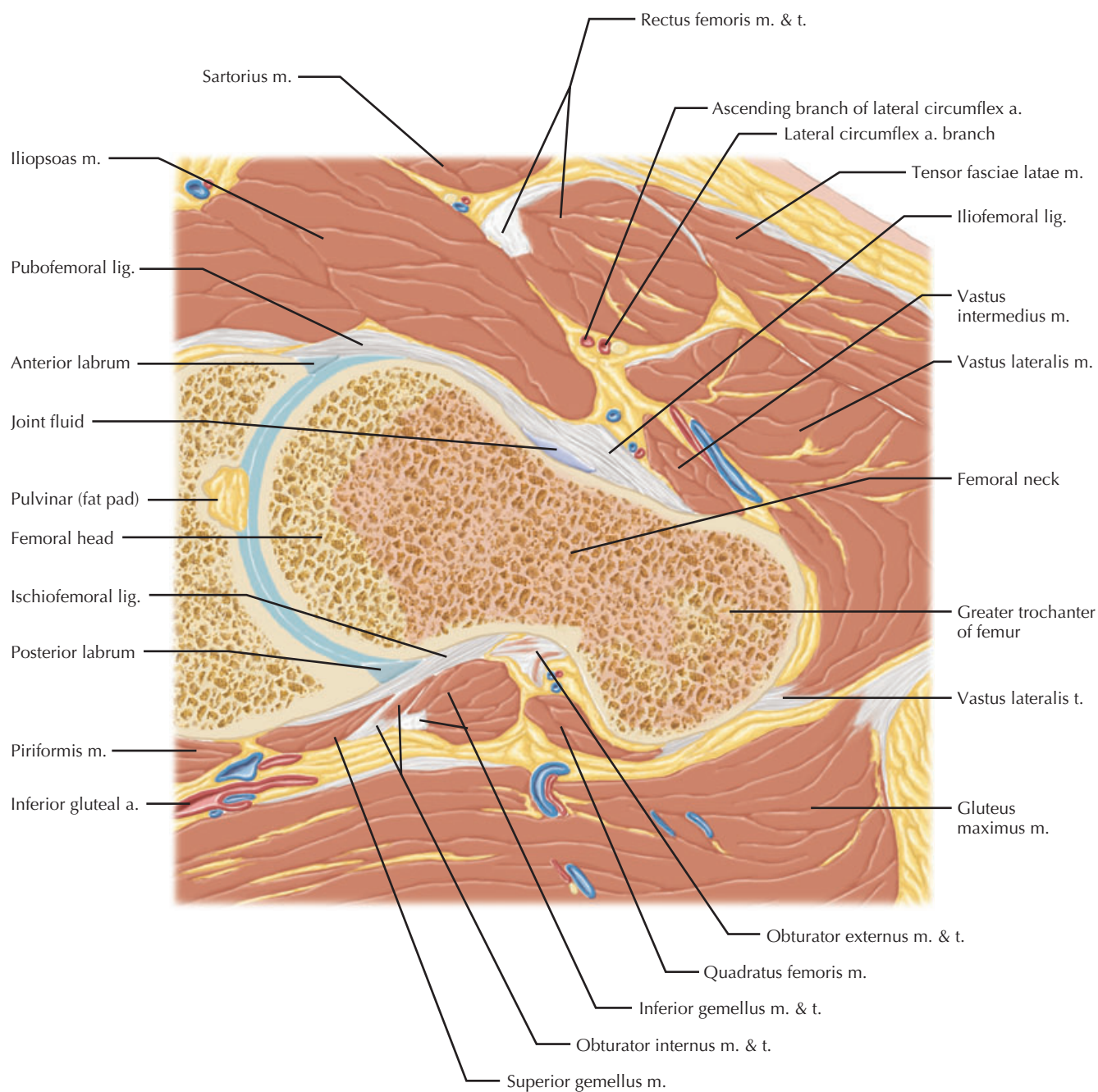




DIAGNOSTIC CONSIDERATION

Oblique coronal and oblique axial MR images oriented along the plane of the femoral neck allow for evaluation of labrum pathology and femoroacetabular impingement.

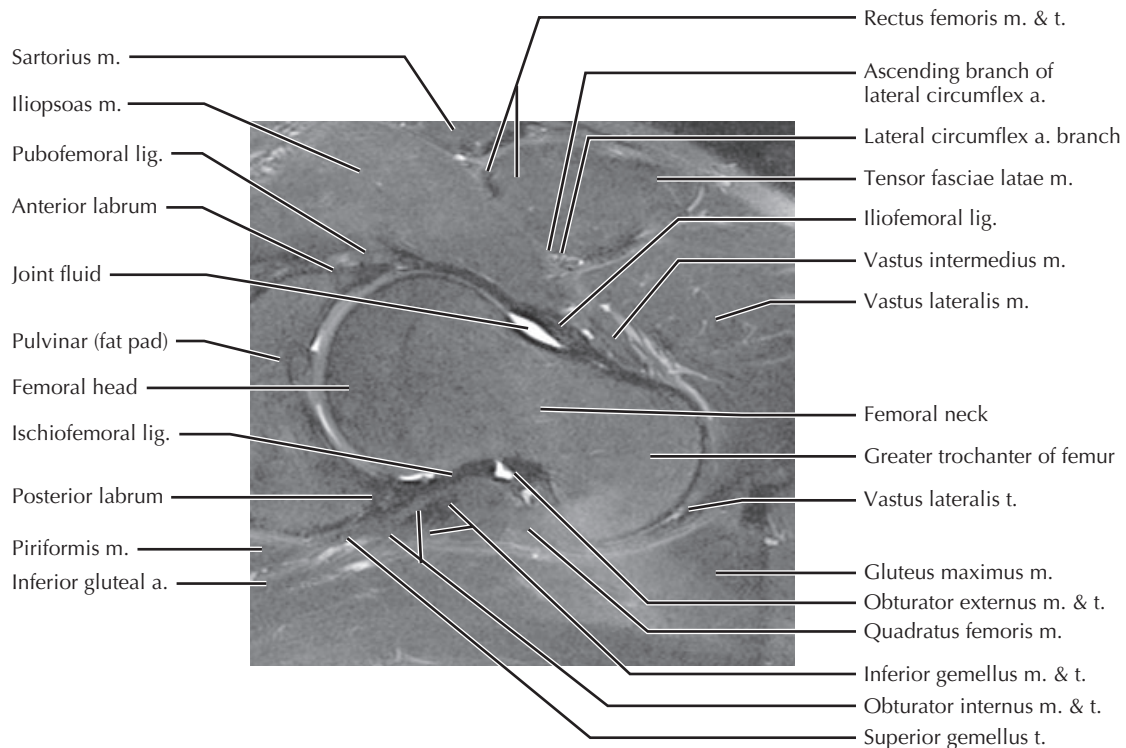
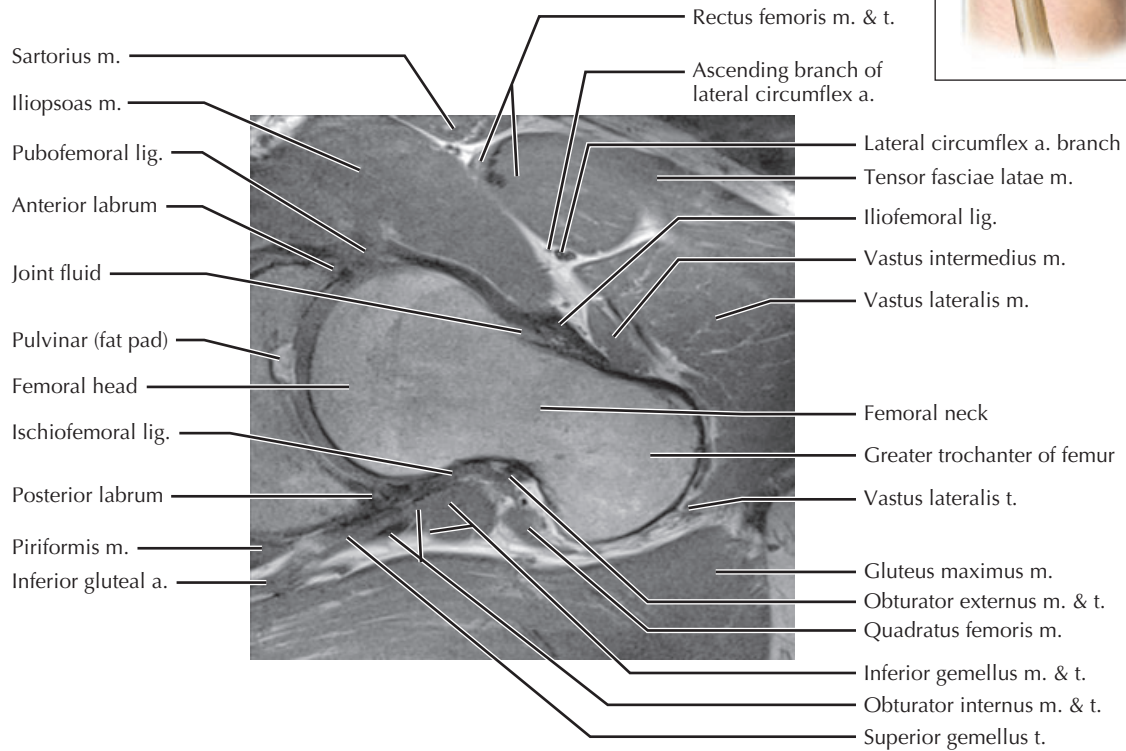
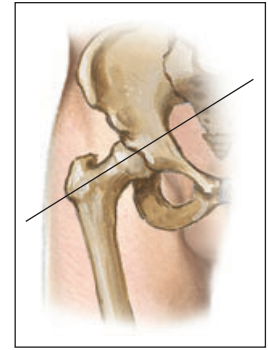


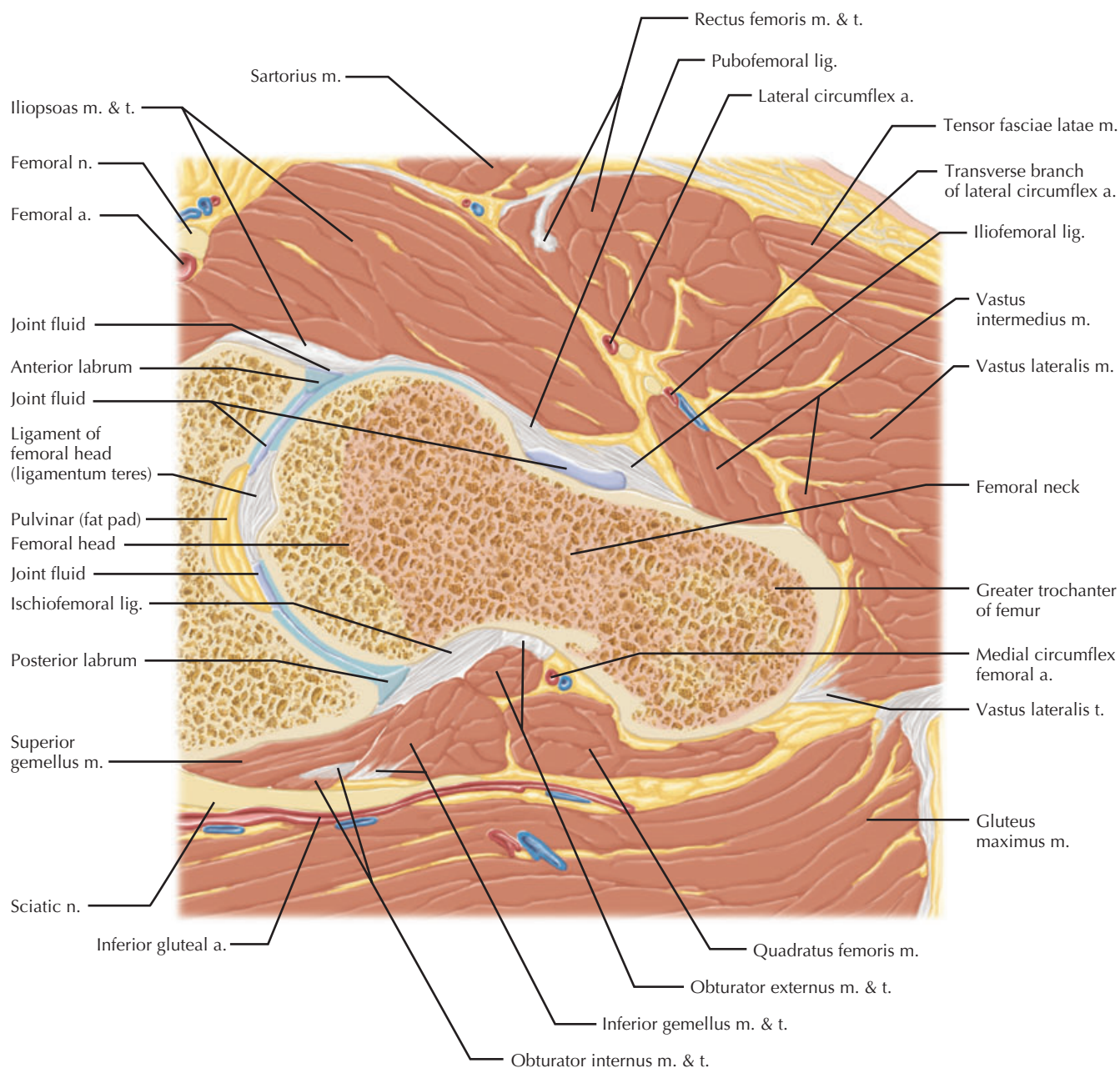


PATHOLOGIC PROCESS

Femoroacetabular impingement of the "cam" type is caused by abutment of an abnormally shaped femoral head with the acetabulum, resulting in chondral and labral injuries secondary to shearing forces from the reduced femoral head clearance. Chondral abnormalities are located adjacent to the abnormal superior anterior labrum.

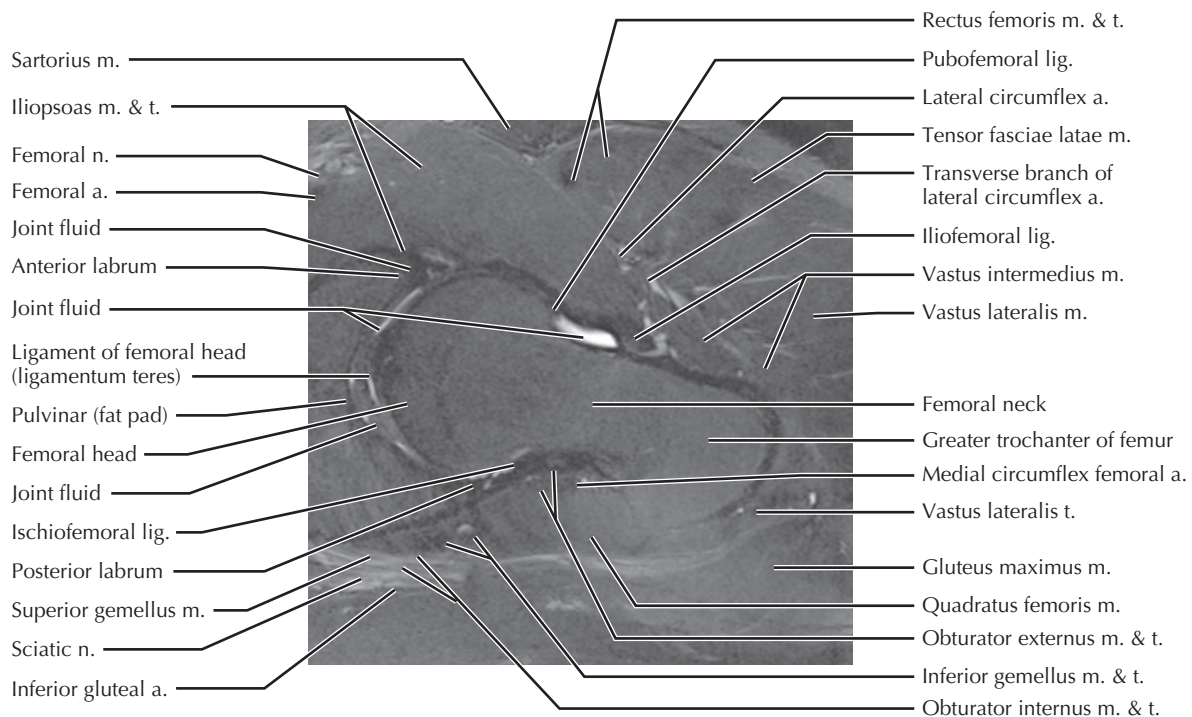
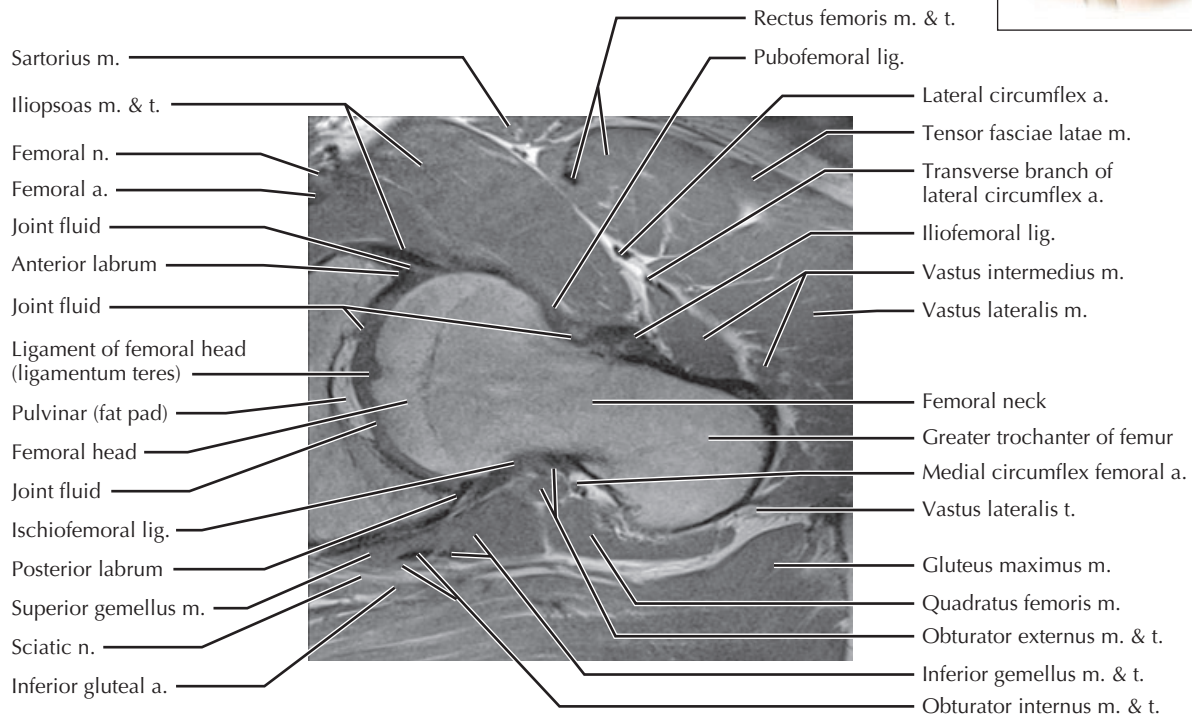
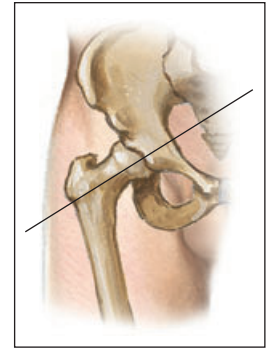
Femoroacetabular impingement of the "pincer" type is caused by overcoverage of the femoral head by the acetabulum. The acetabulum can reduce the femoral head clearance. Associated chondral abnormalities are in the posterior aspect of the acetabulum.

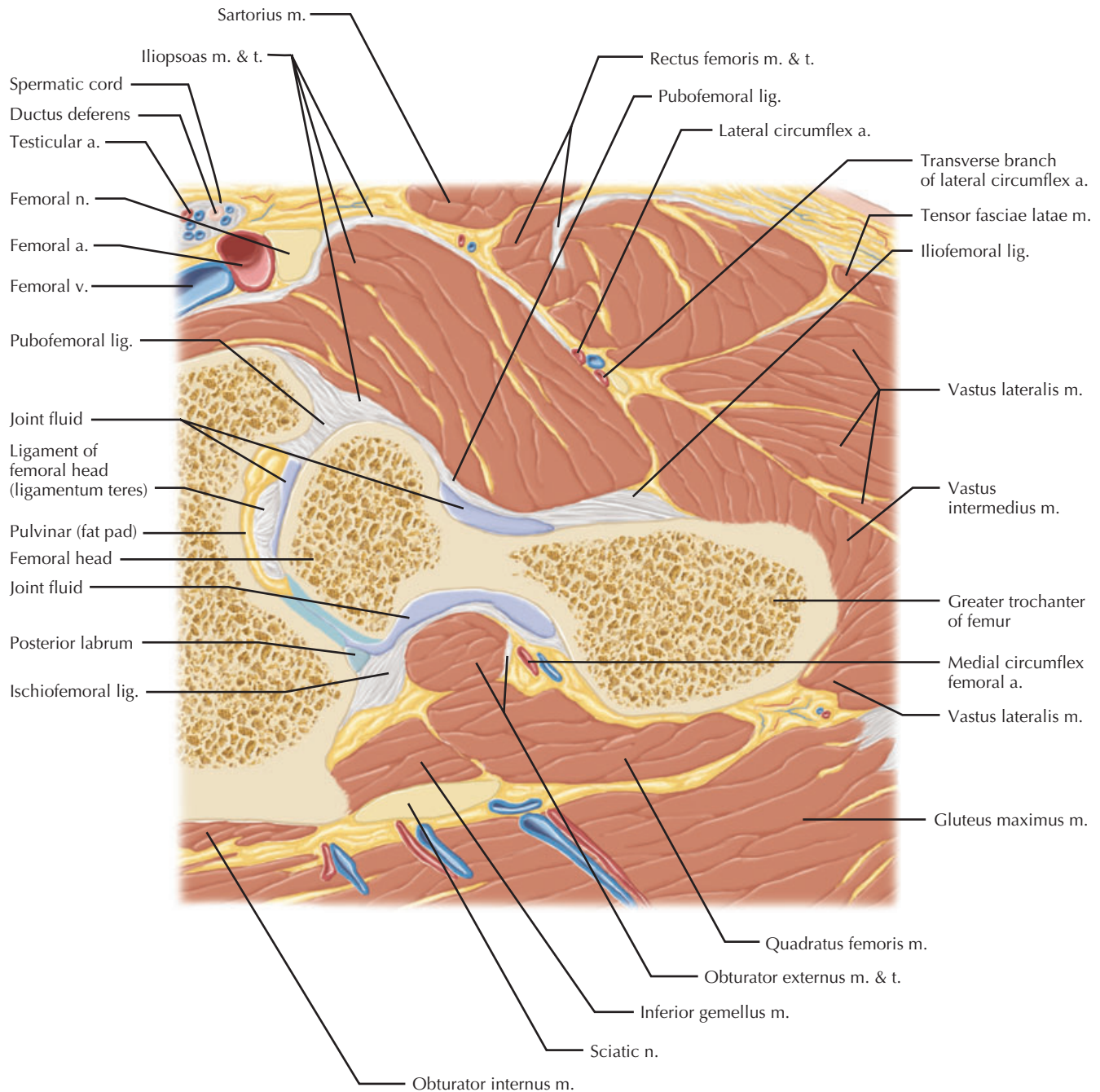


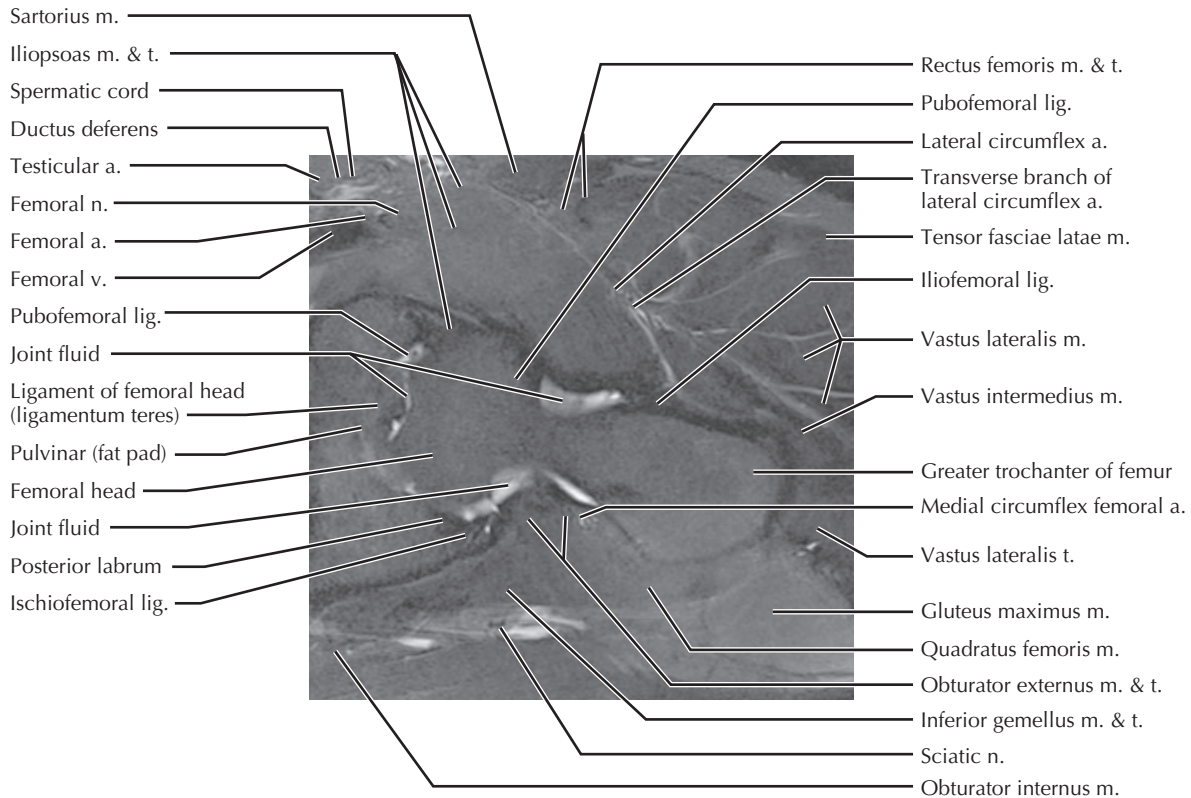
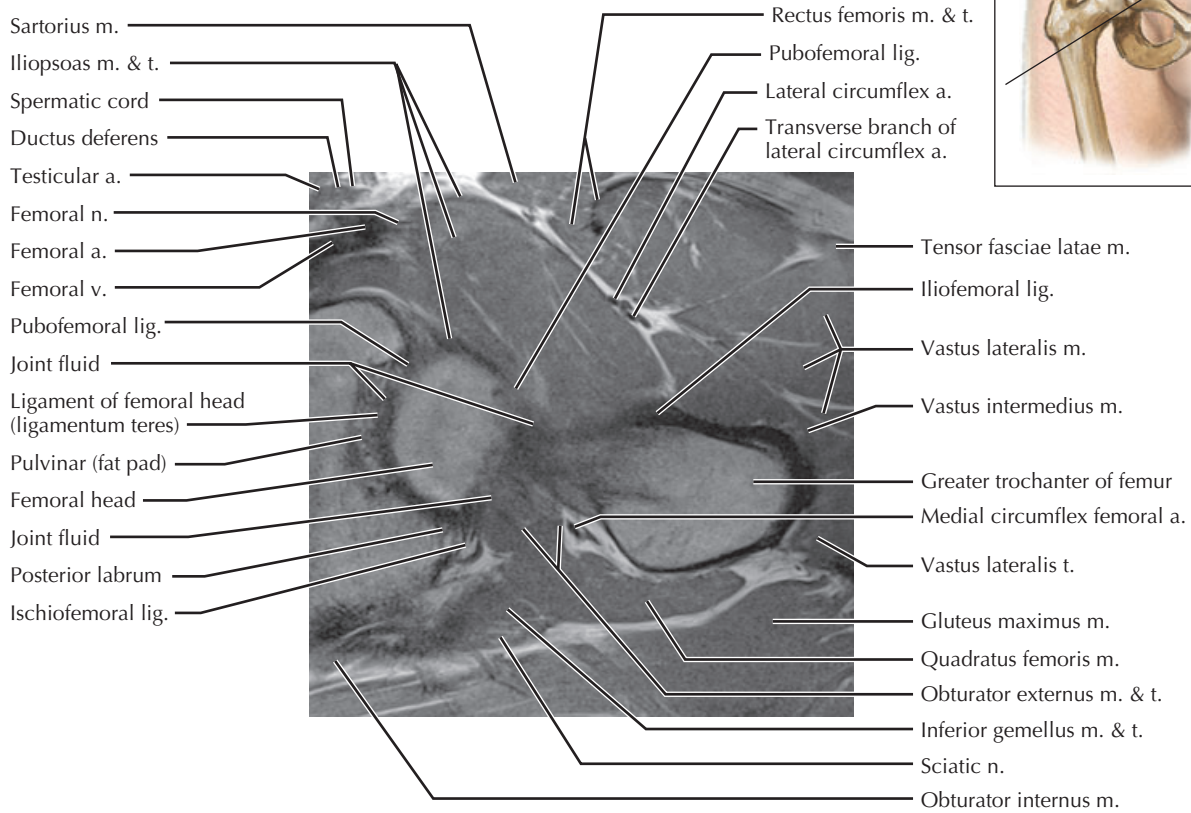
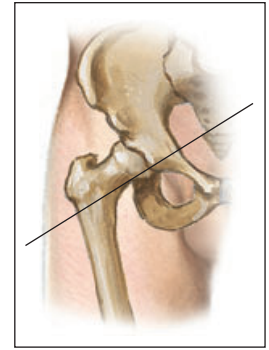


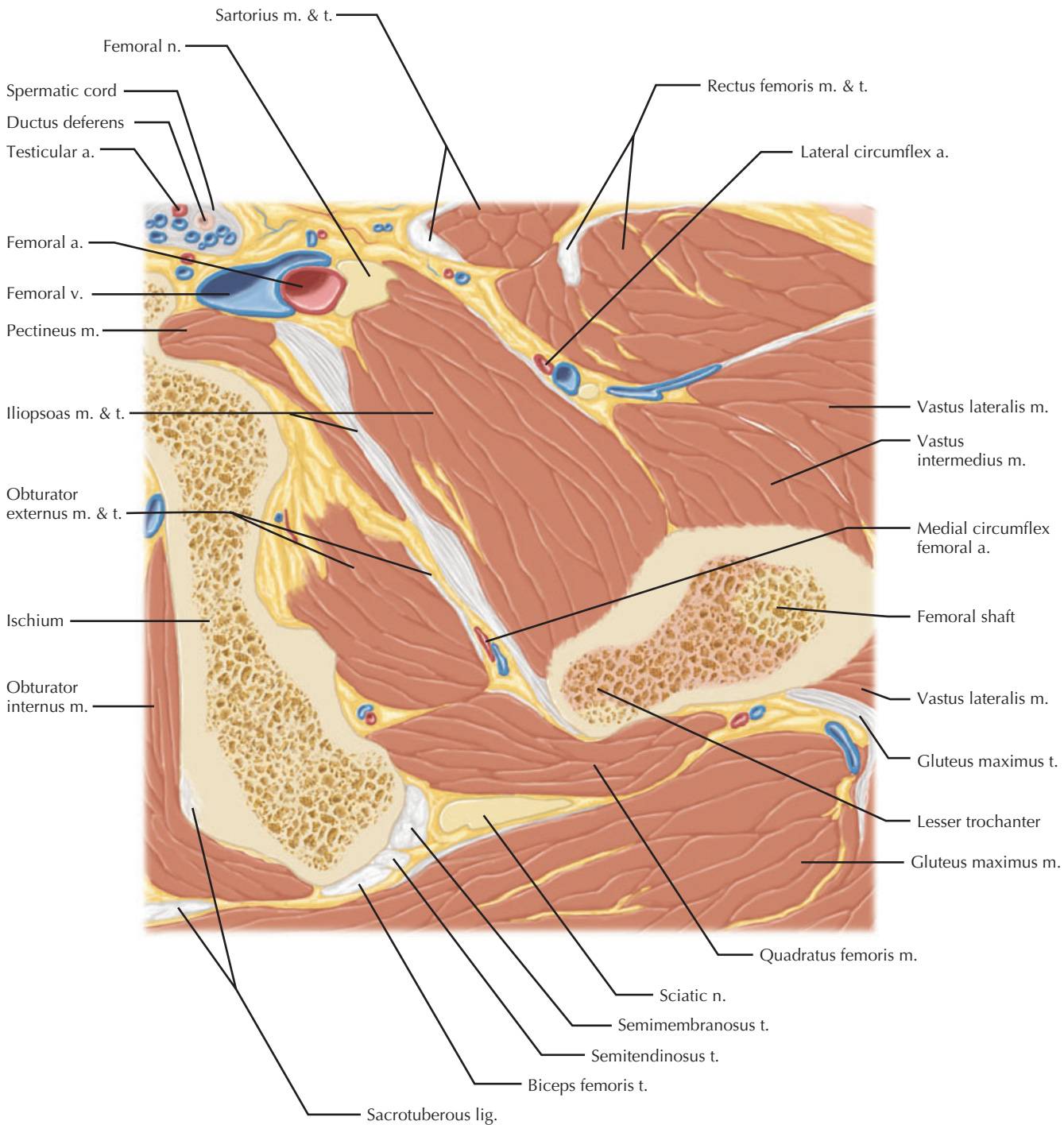
DIAGNOSTIC CONSIDERATION

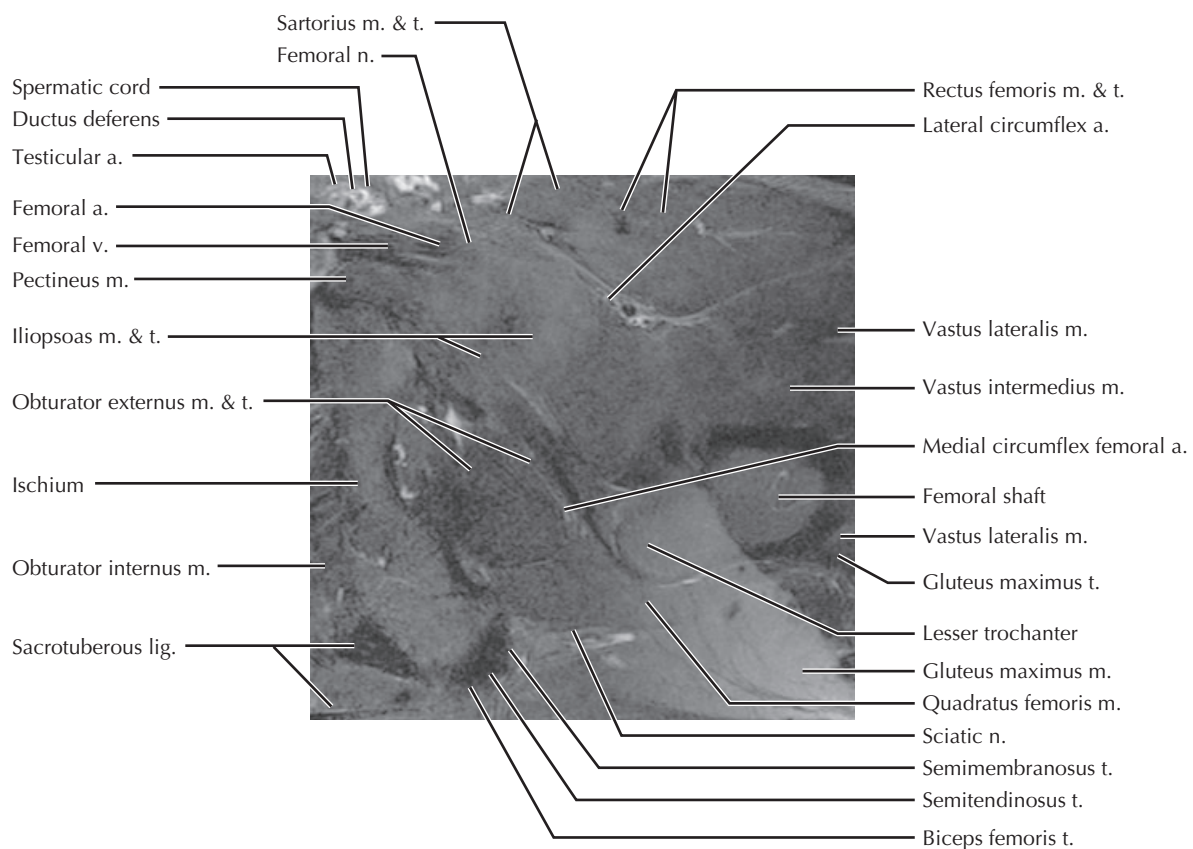
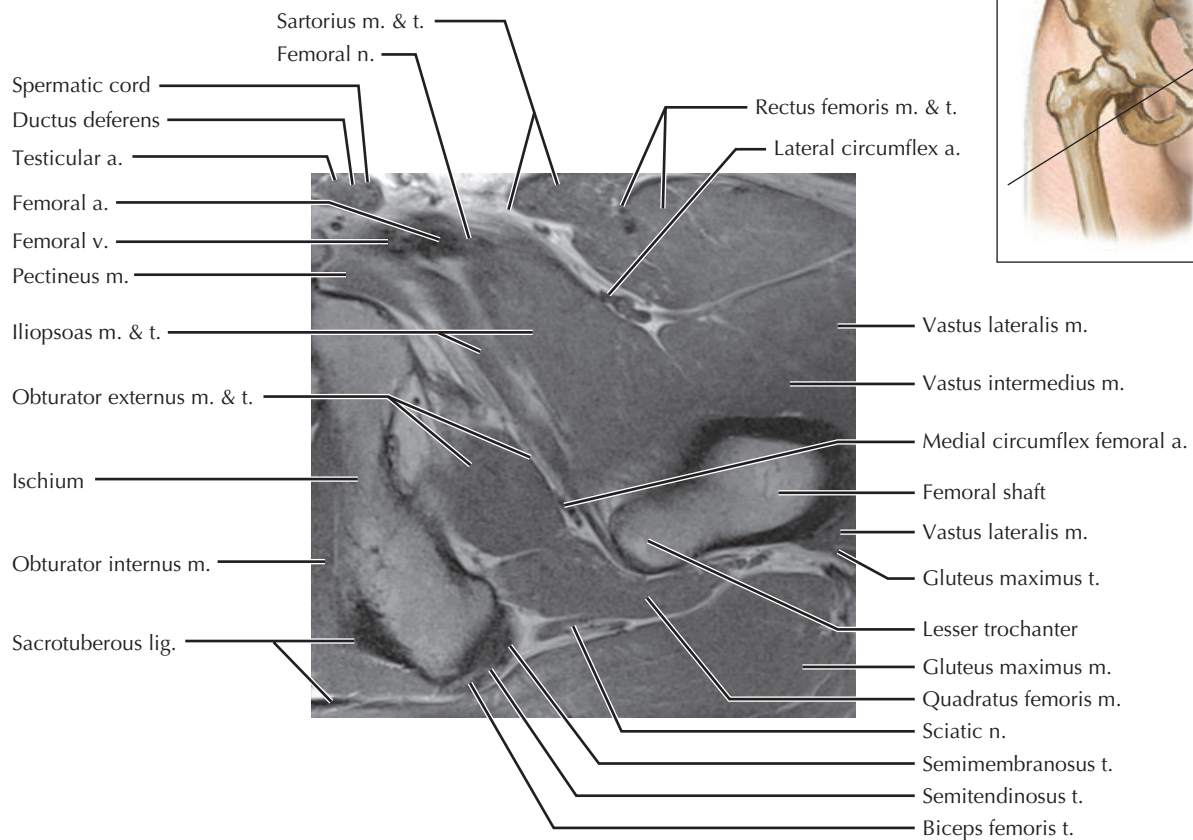
Pitfalls in diagnosing labrum pathology include the acetabular cartilage as it undercuts the labrum and the iliopsoas tendon as it crosses anterior to the labrum. Both the cartilage and the interface between the tendon and labrum demonstrate intermediate signal, which can be misinterpreted as labral tears.

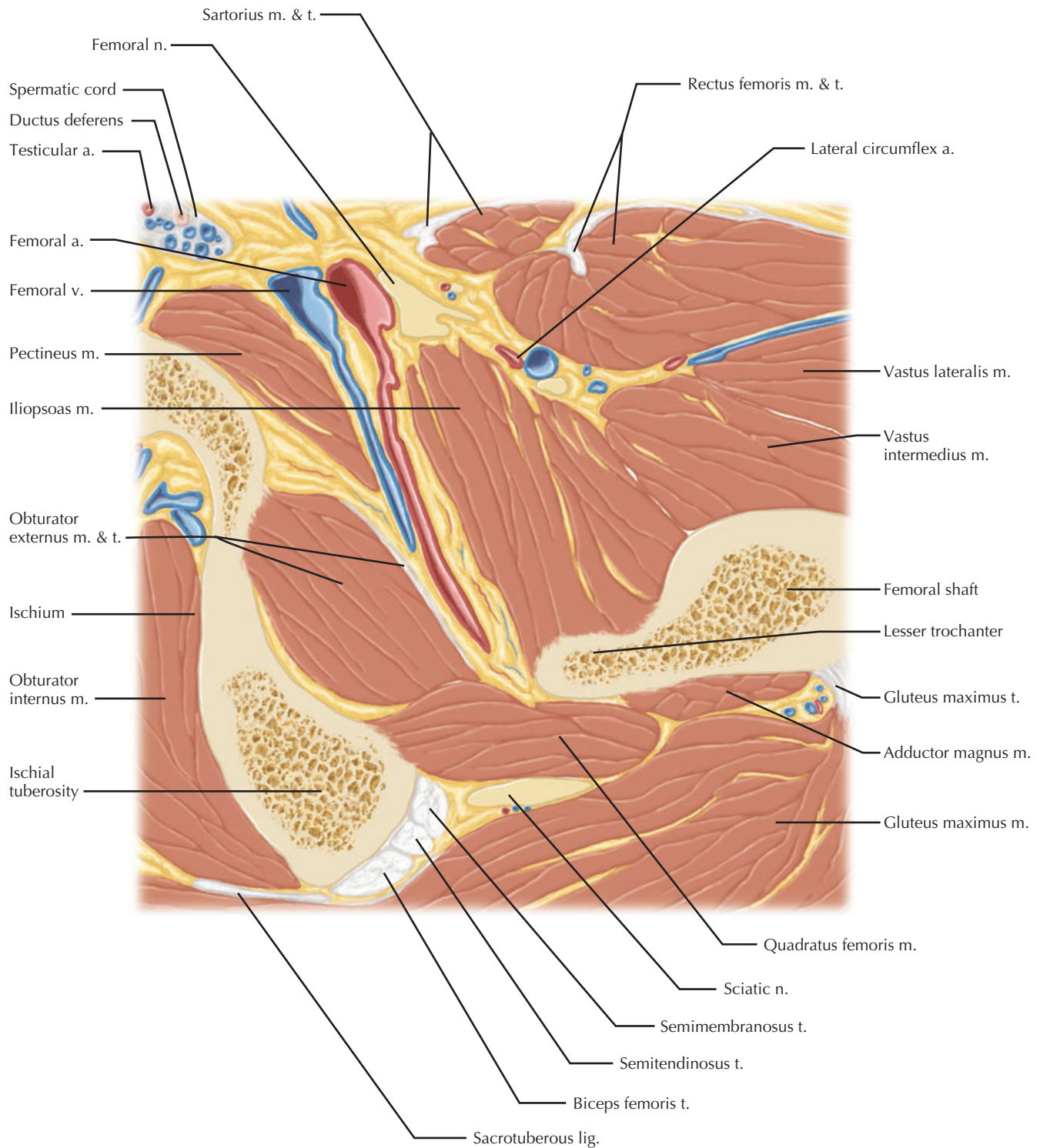


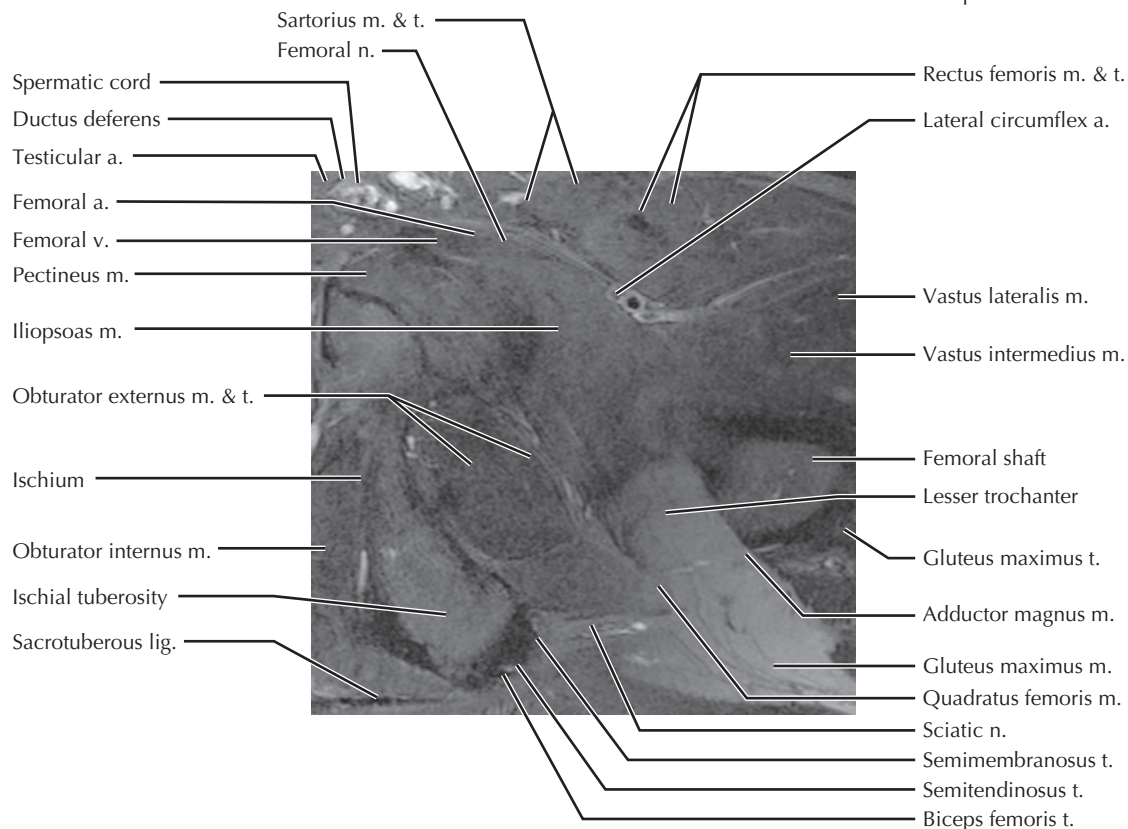
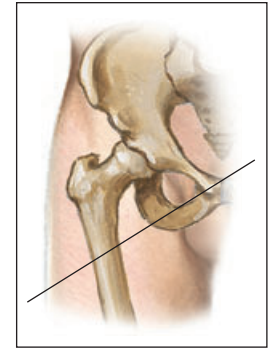
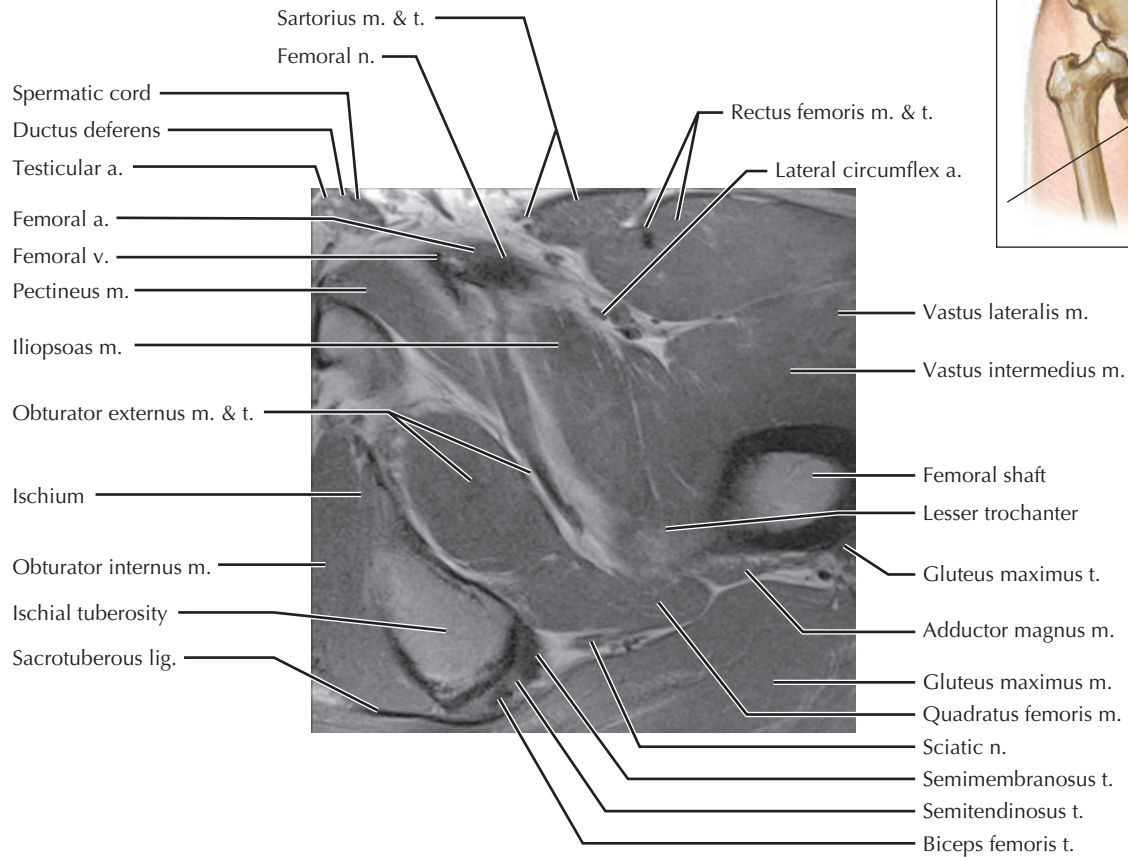


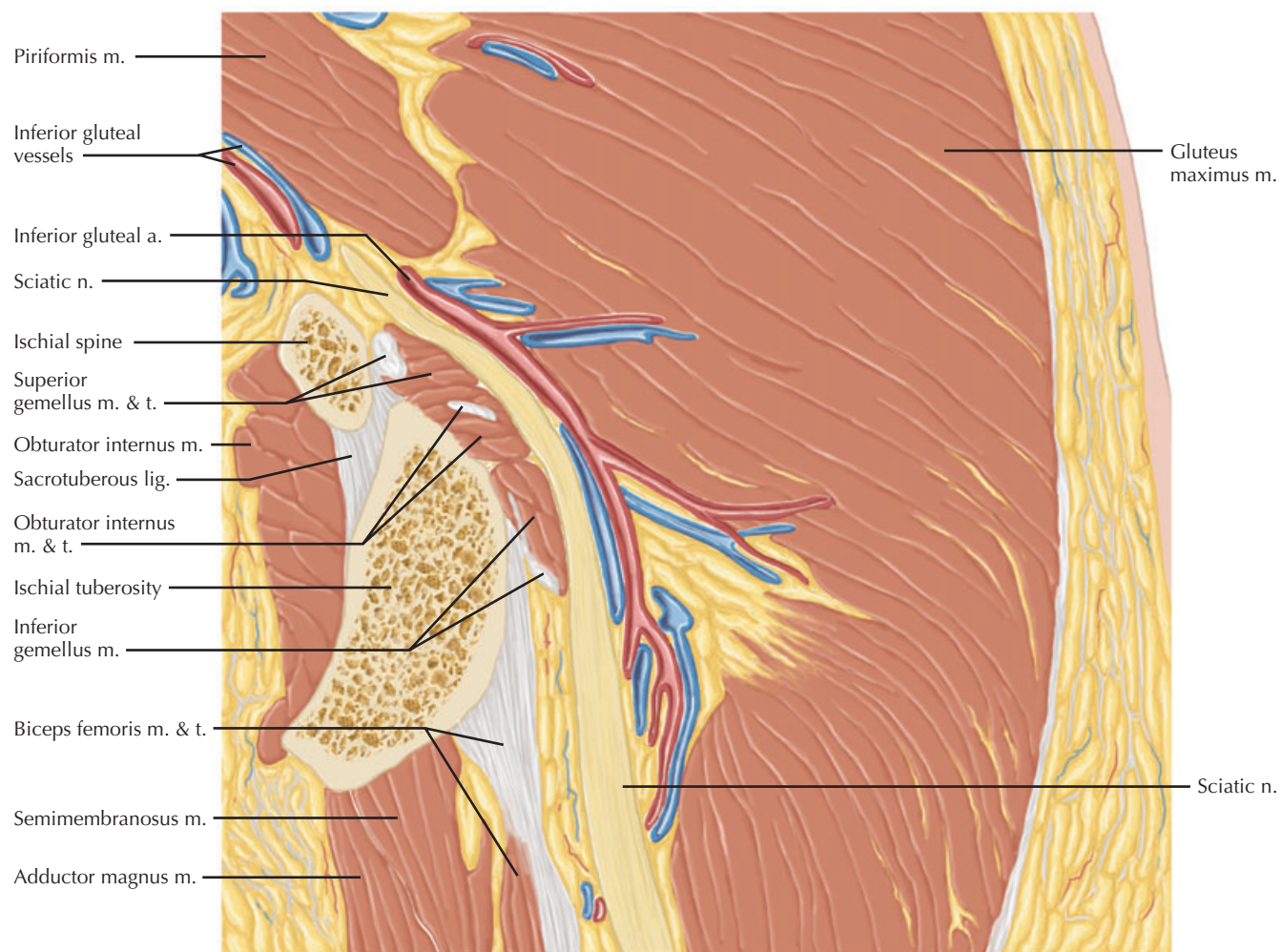


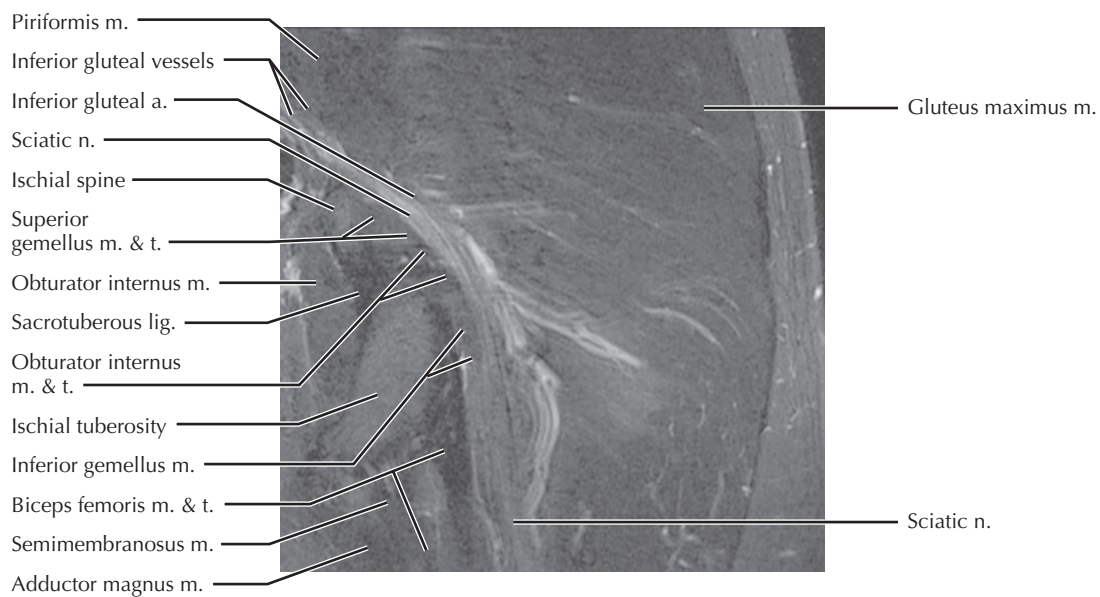
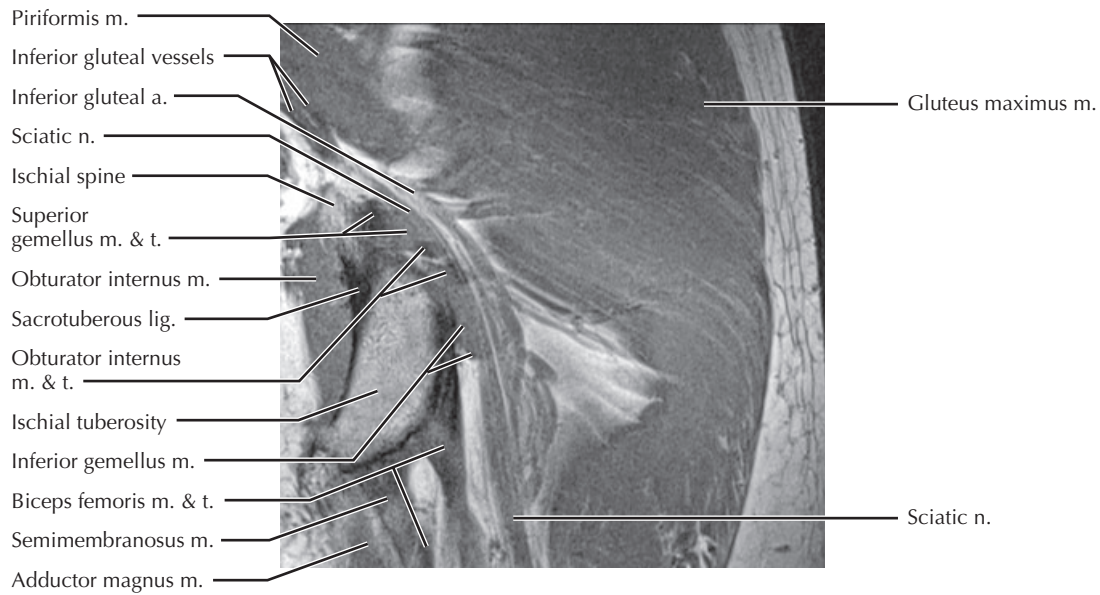
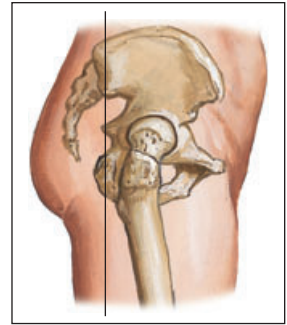


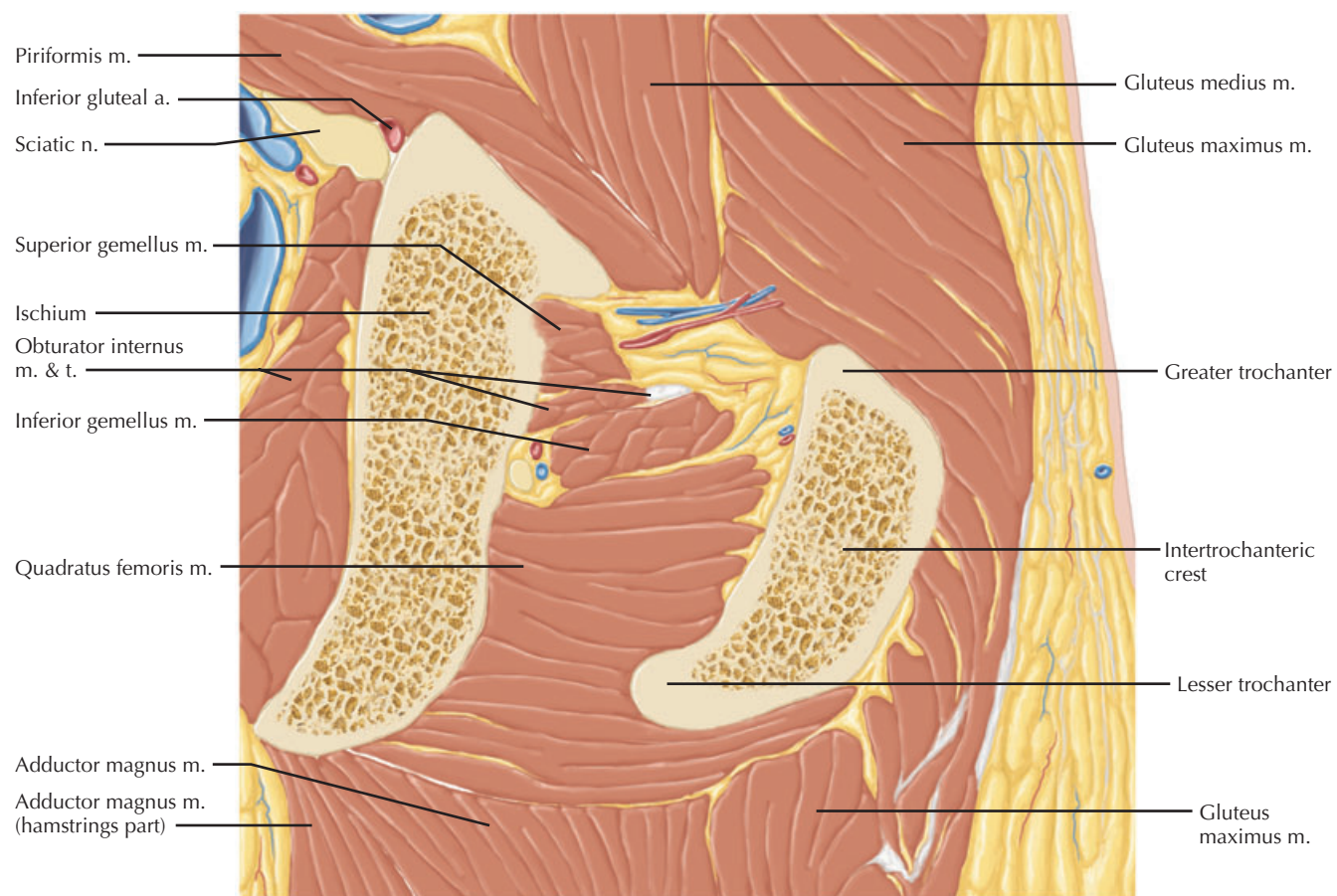


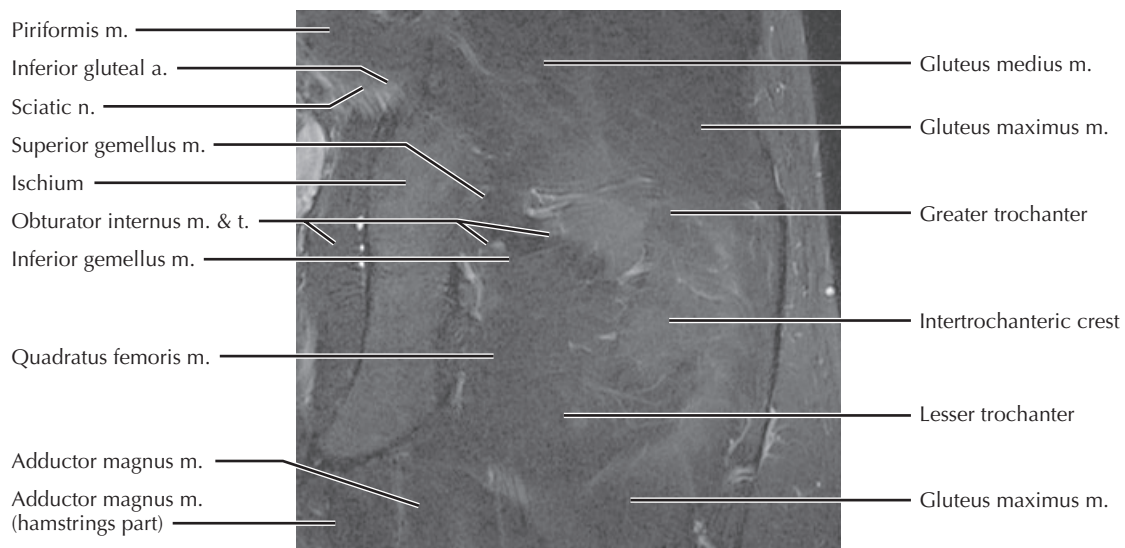
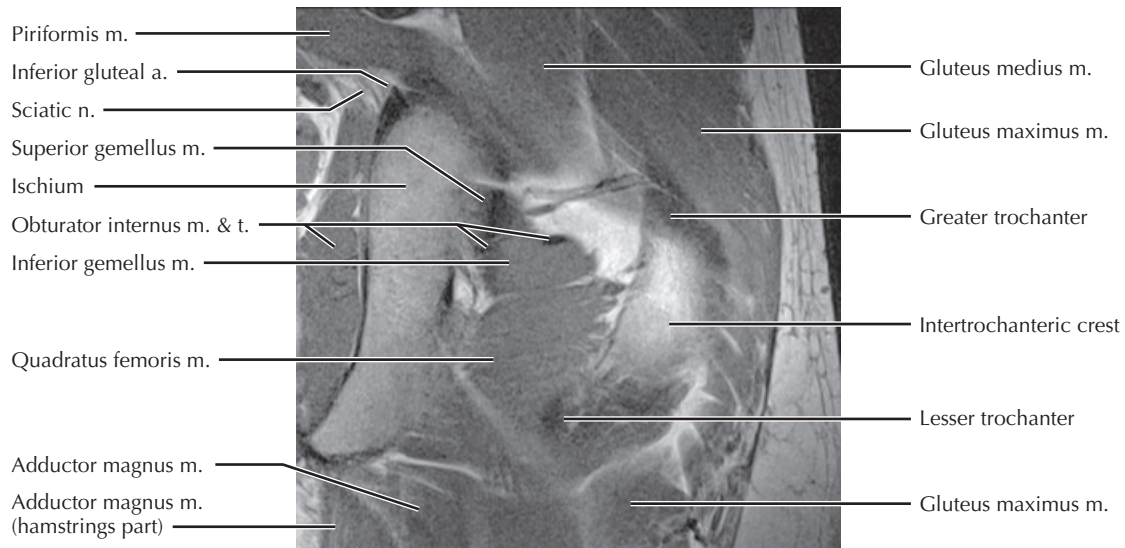
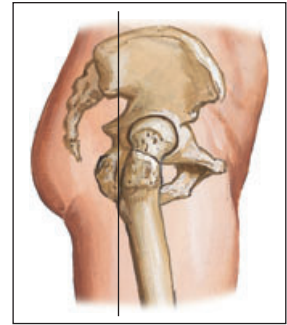


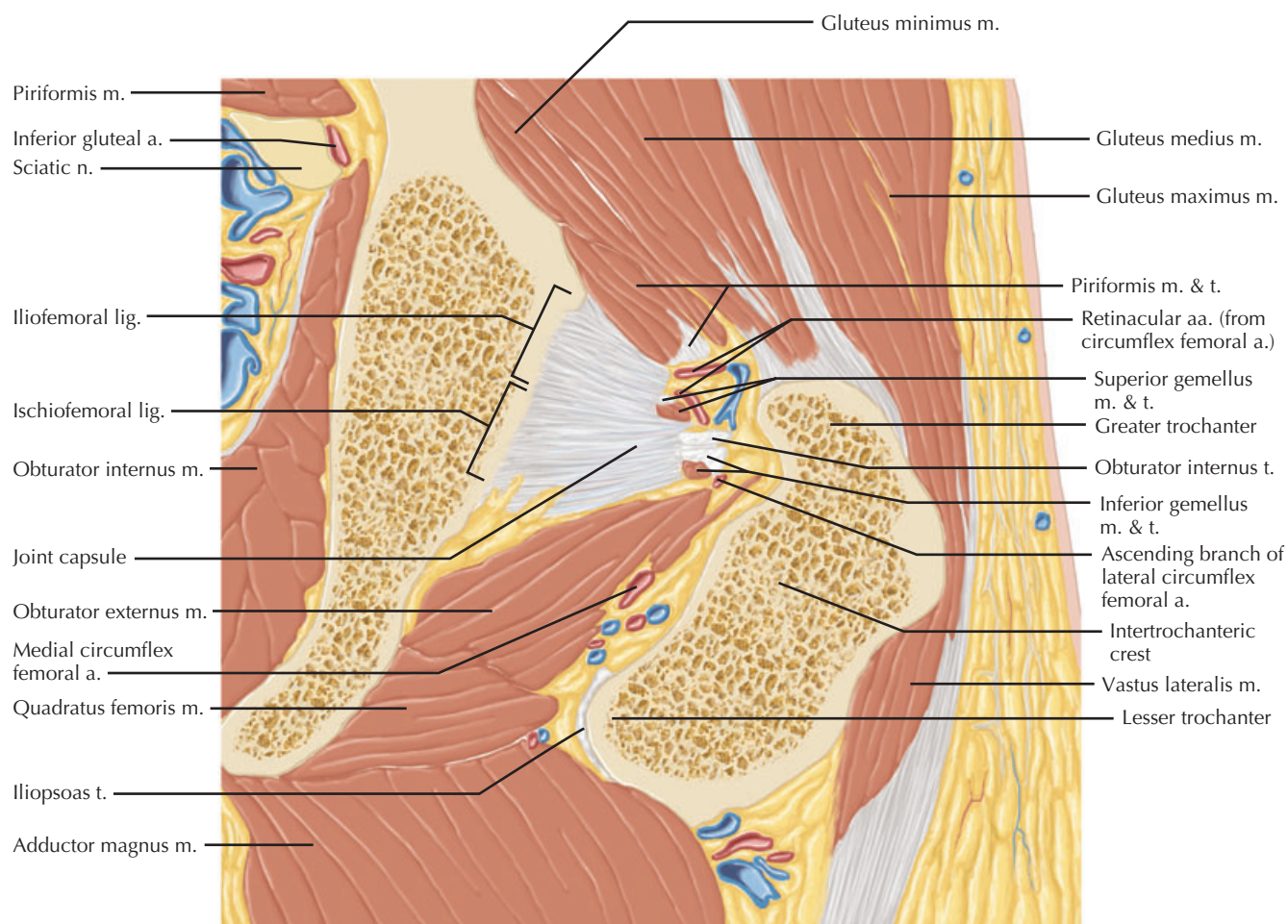






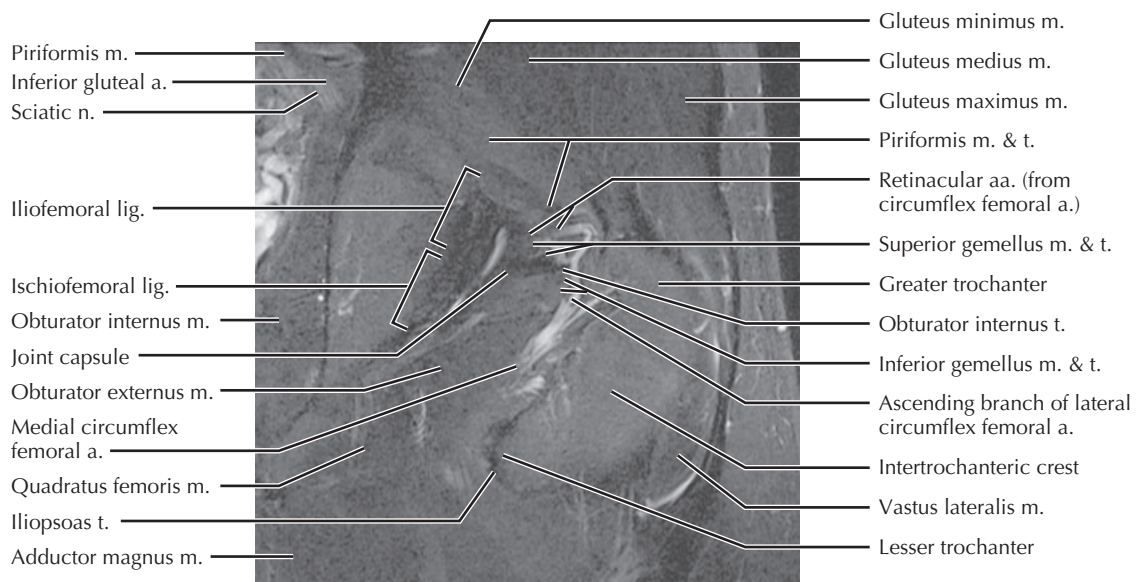
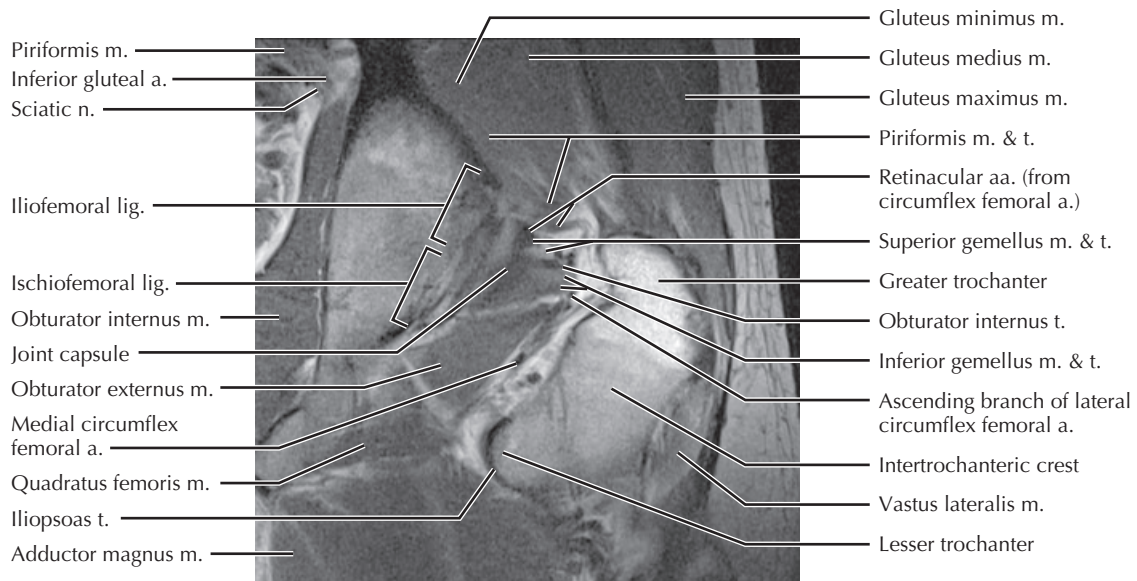
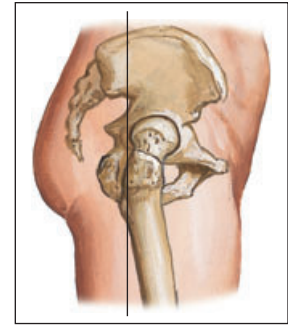


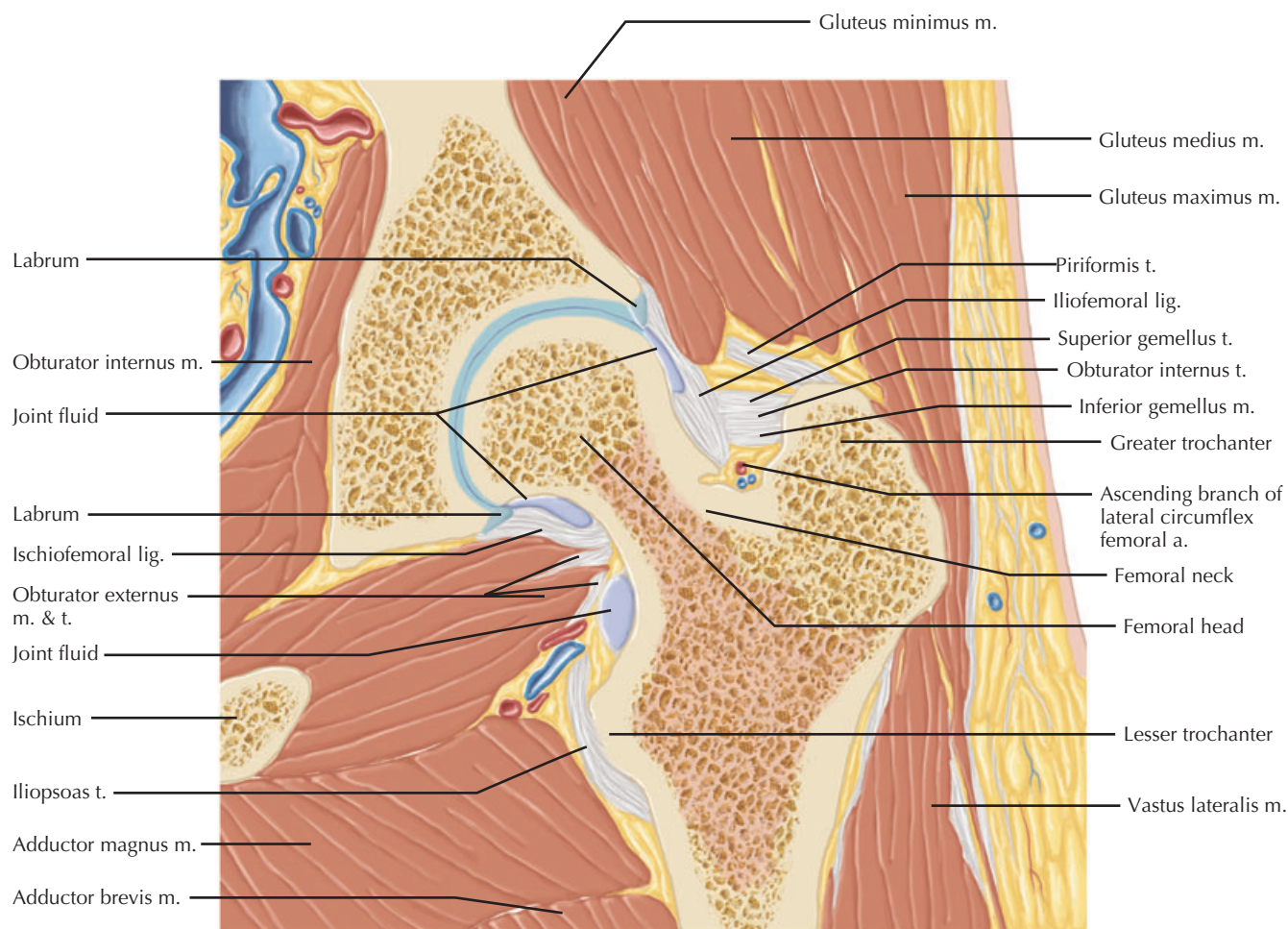




PATHOLOGIC PROCESS

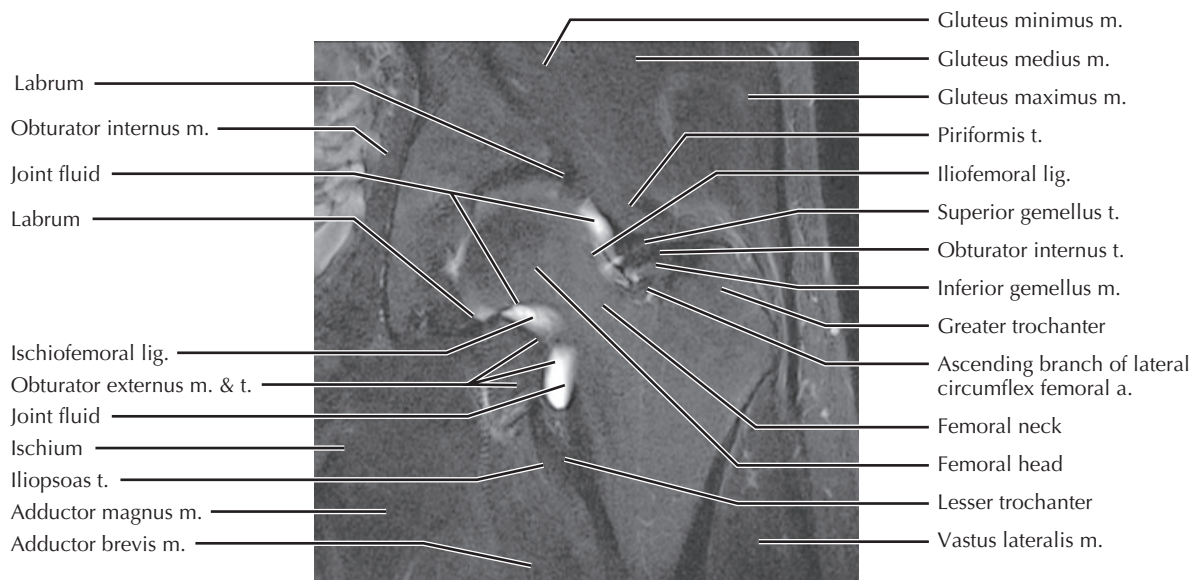
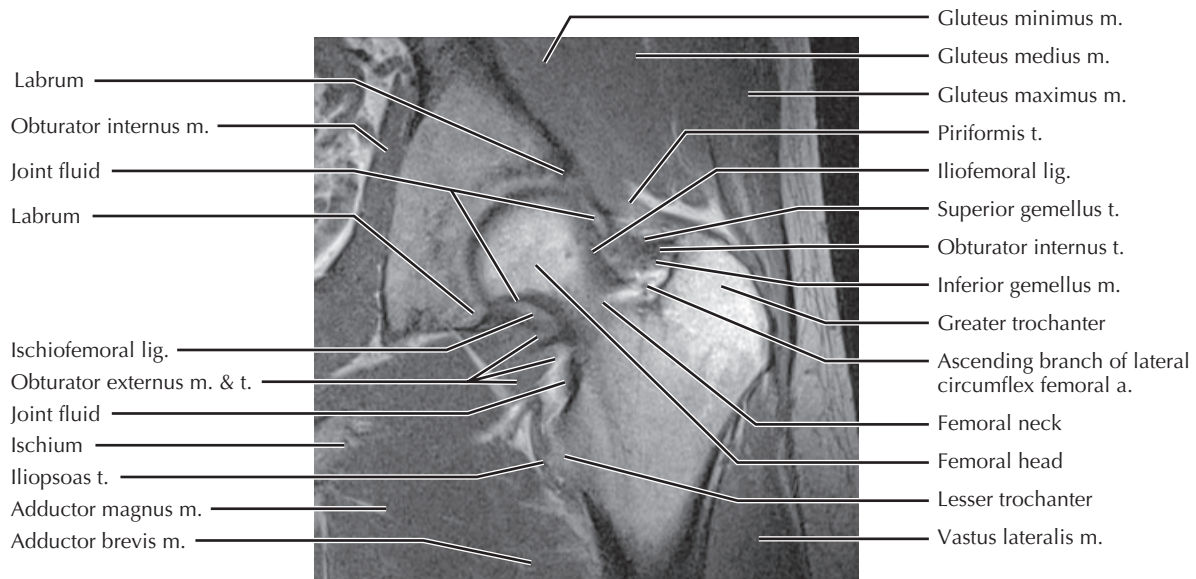
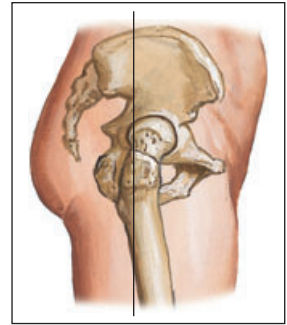
Gluteus medius and gluteus minimus tendon tears are also referred to as "greater trochanteric pain syndrome" or "rotator cuff tear of the hip." Intermediate signal on T2-weighted MR images (tendinopathy), as well as fluid signal (partial tears), can be identified at the insertion site of the tendon. Complete avulsions may also be seen. This process is believed to be degenerative in nature, most often affecting middle-aged women.

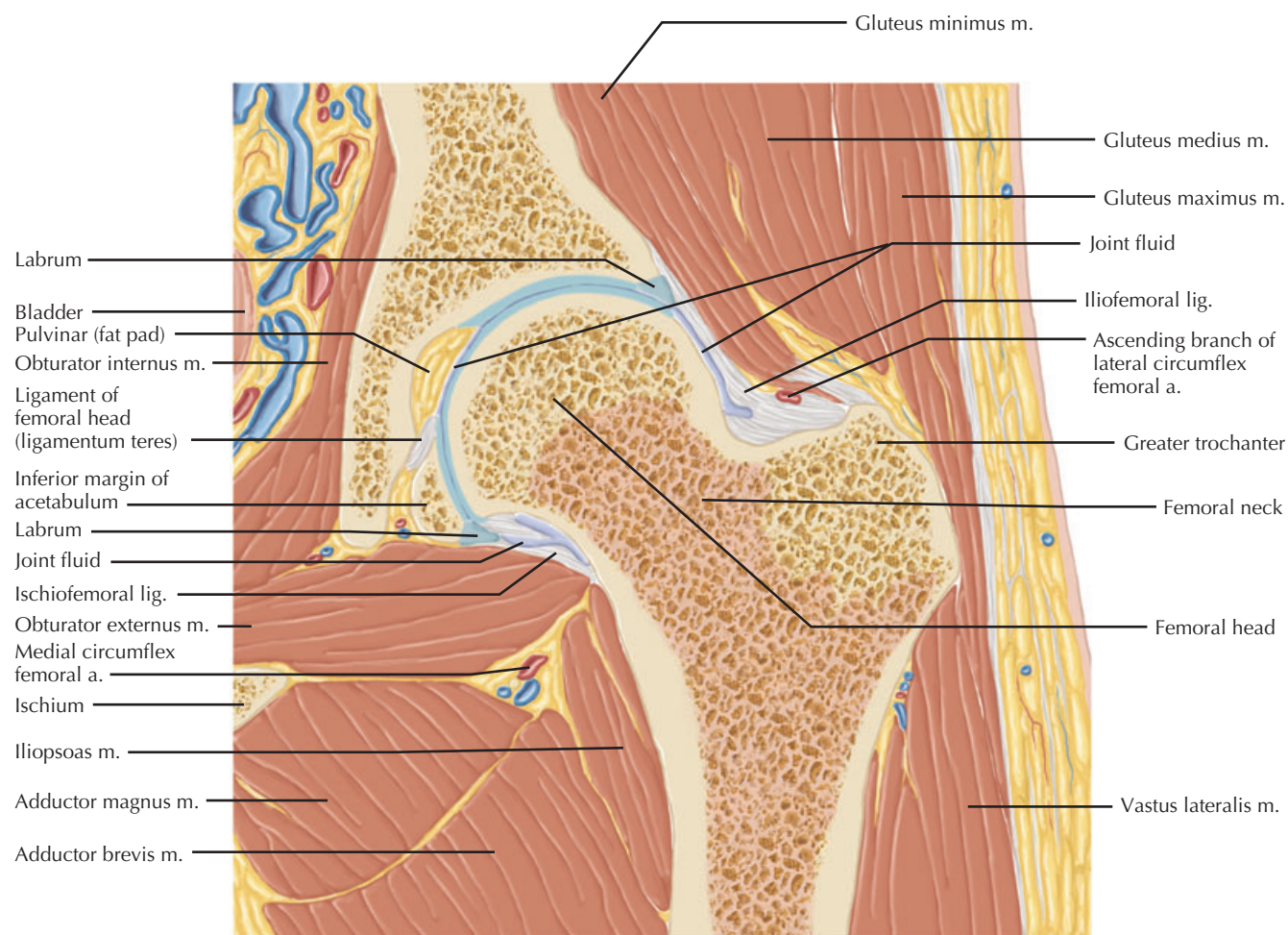


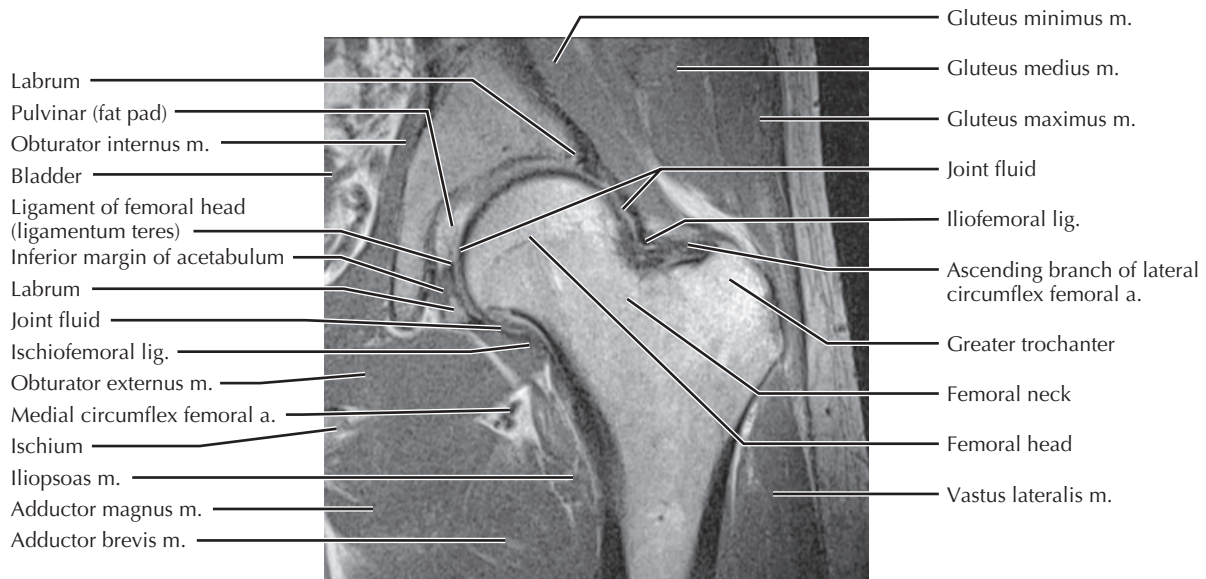
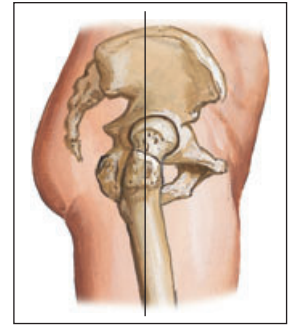


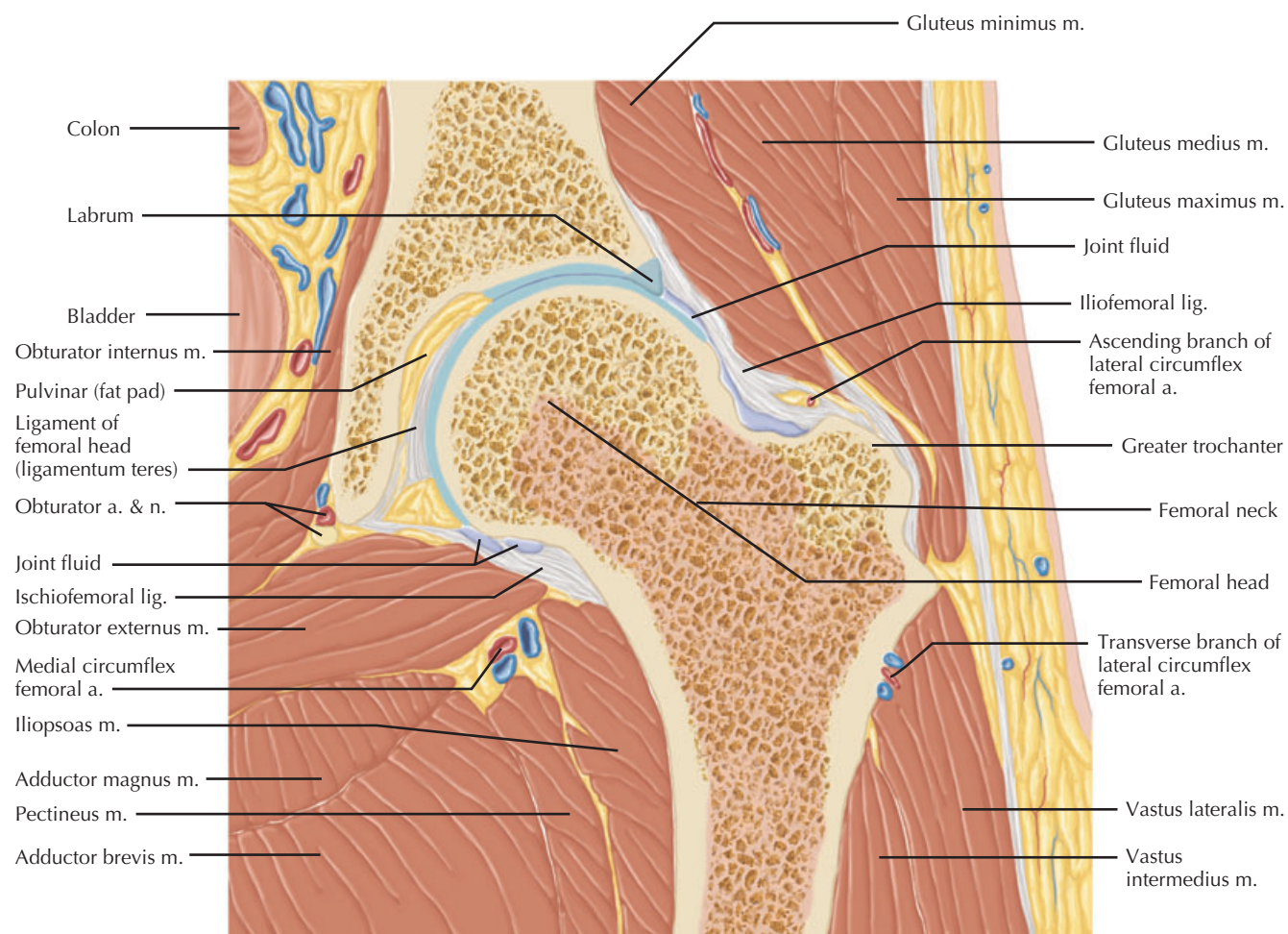
PATHOLOGIC PROCESS

Greater trochanteric bursitis is demonstrated as high signal in the soft tissues adjacent to the trochanter on T2-weighted MR images. It does not need to be a well-defined collection of fluid located superficial to the trochanter. A small amount of fluid is often present bilaterally in patients who have no symptoms of bursitis. A diagnosis of bursitis is reserved for significant asymmetry of the high signal in this region.



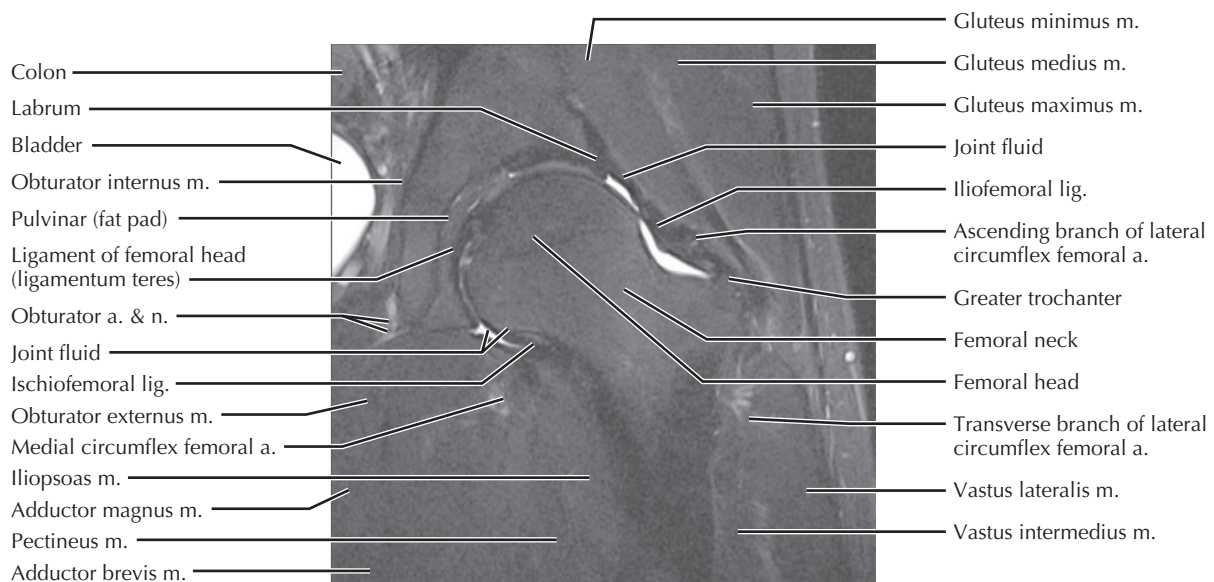
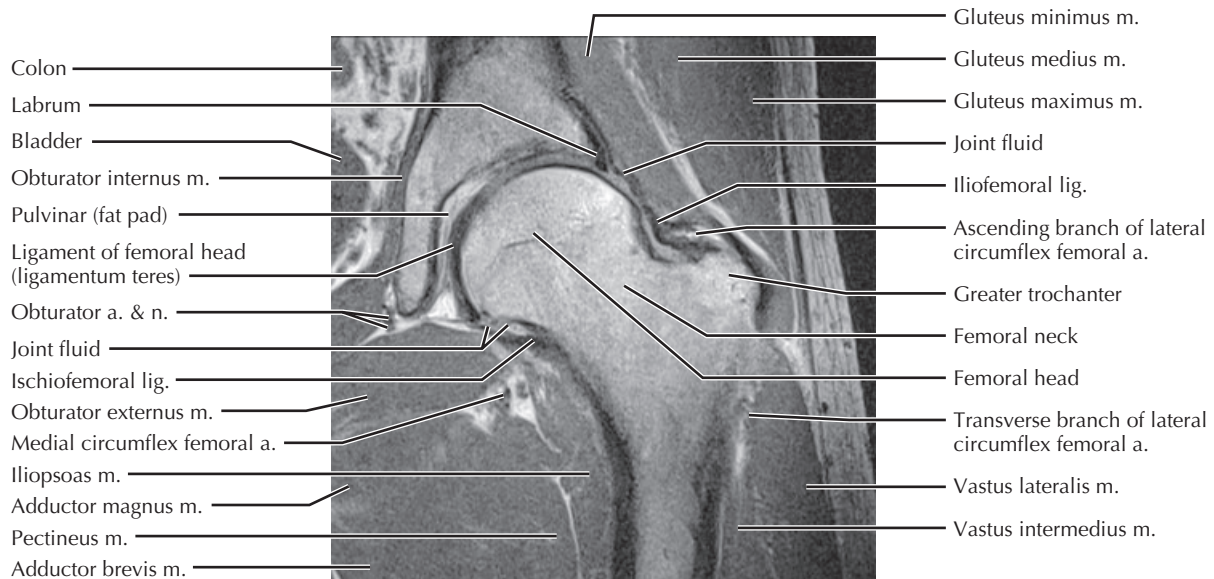
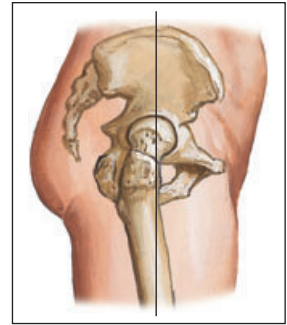


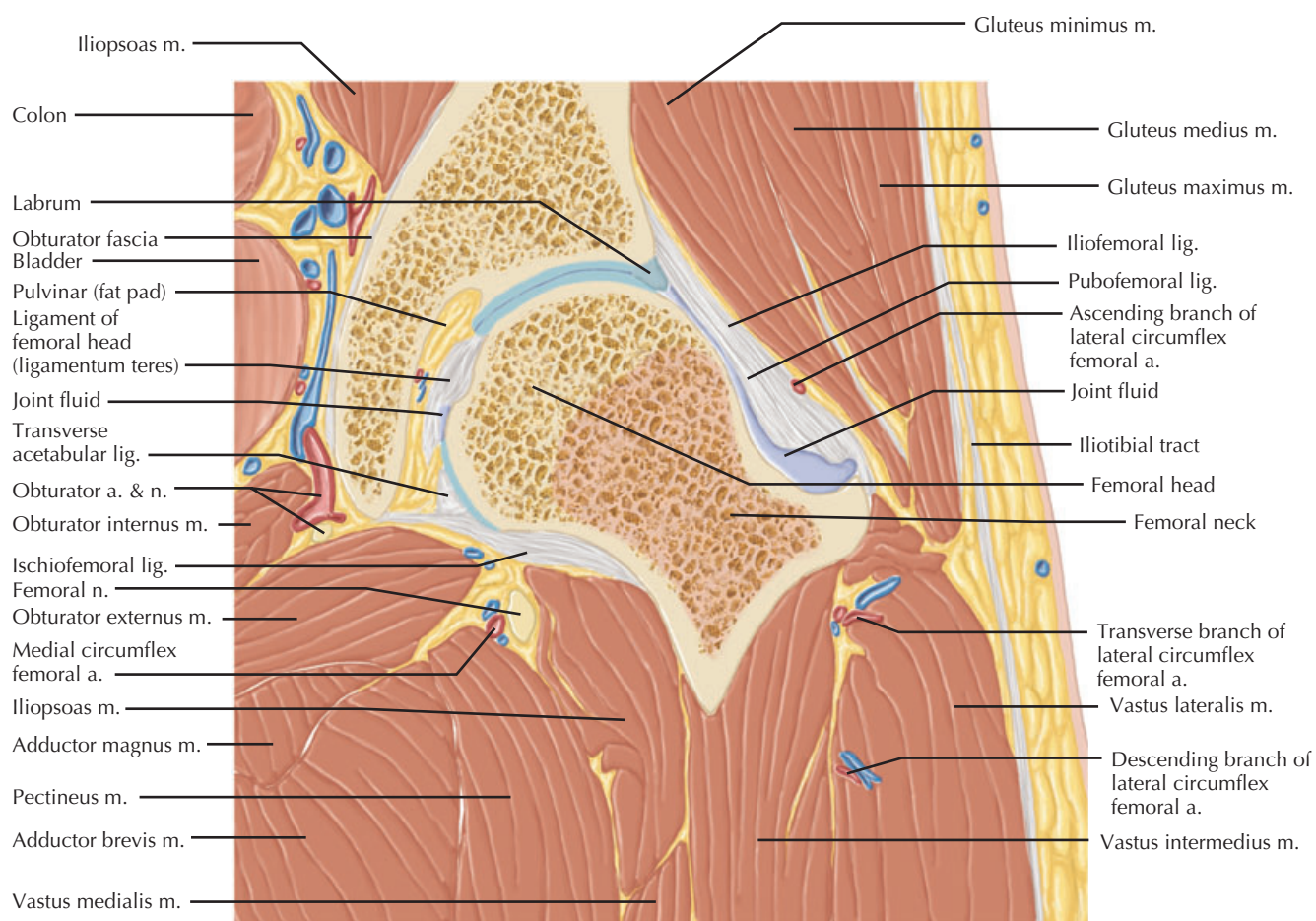


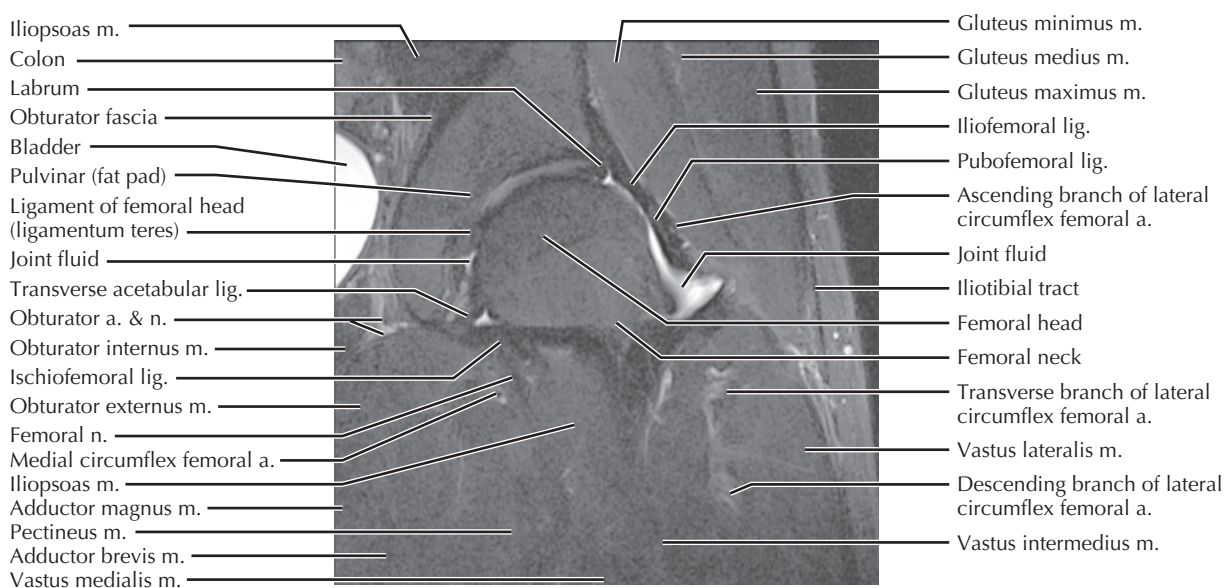
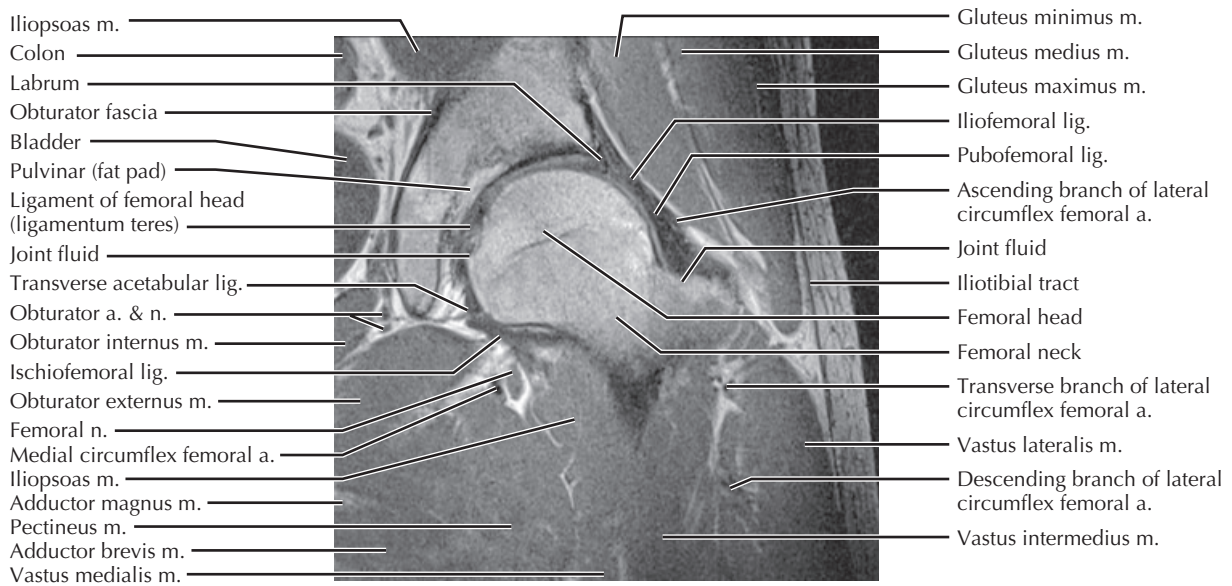
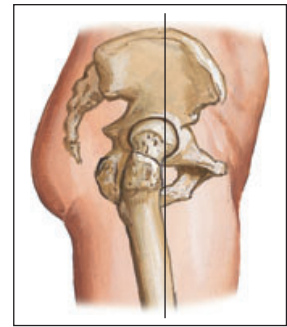


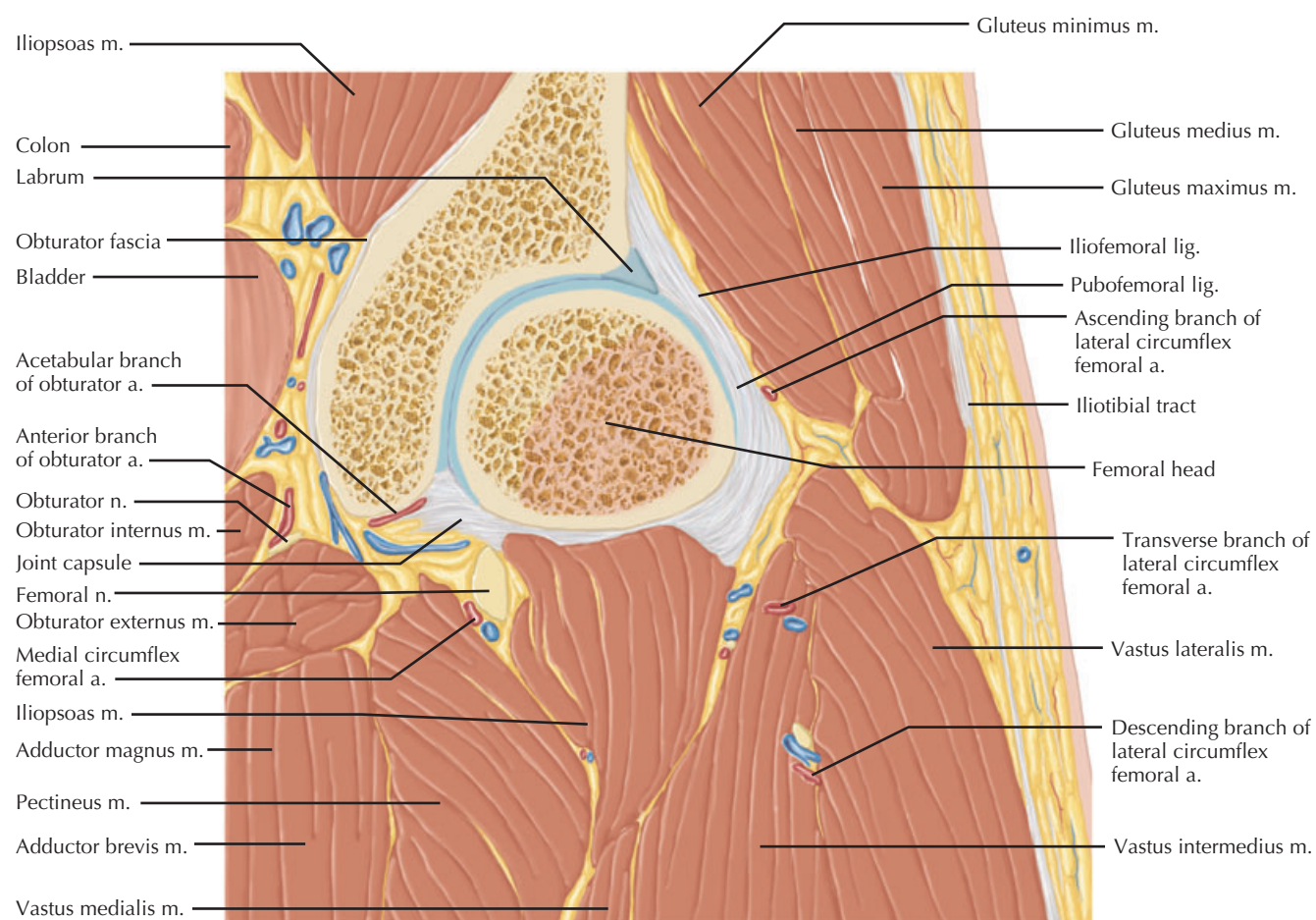
NORMAL VARIANT

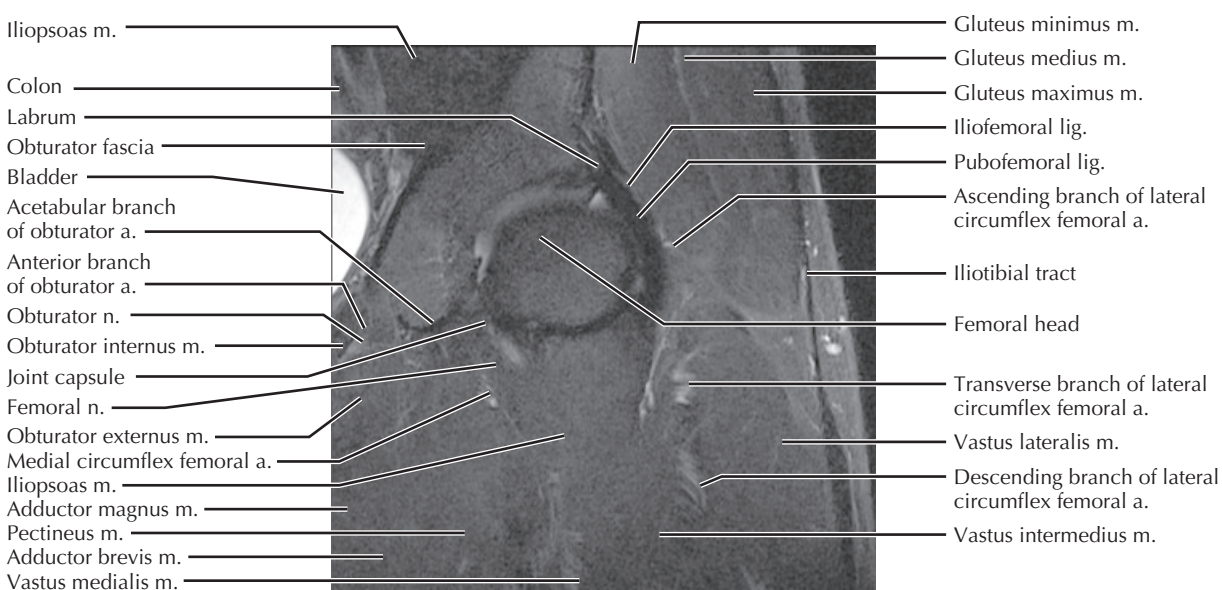
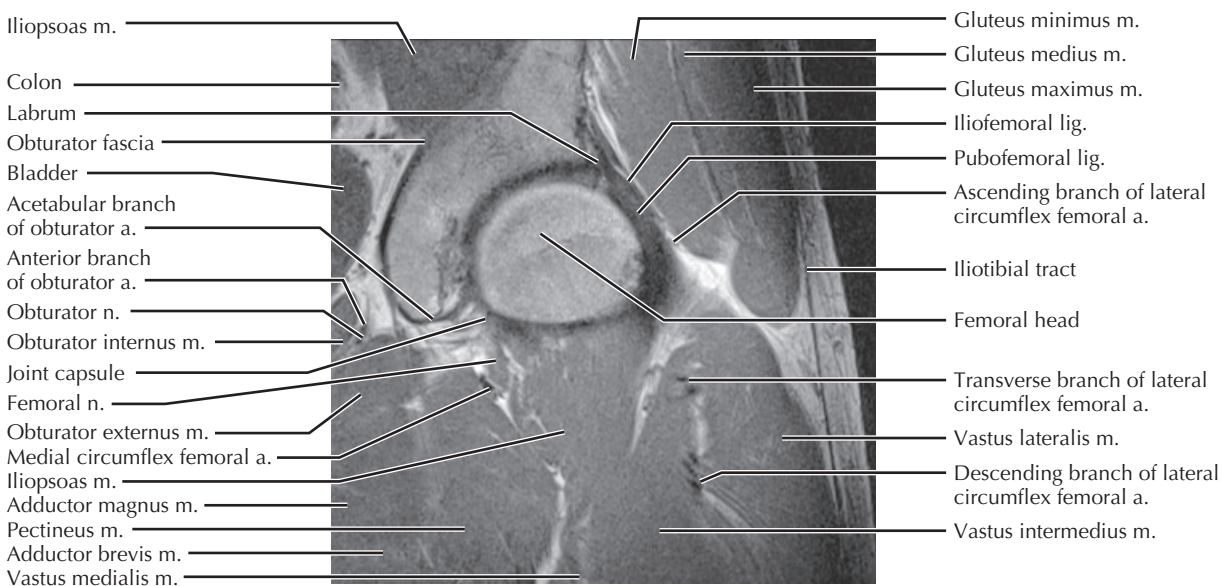
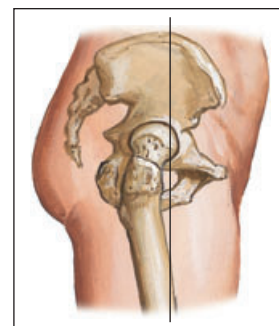
The epiphyses and apophyses should contain fatty marrow. However, a small rim of red marrow can persist in the femoral epiphysis and is a normal finding, as evidenced by red marrow being higher in signal than muscle on the T1-weighted MR image.

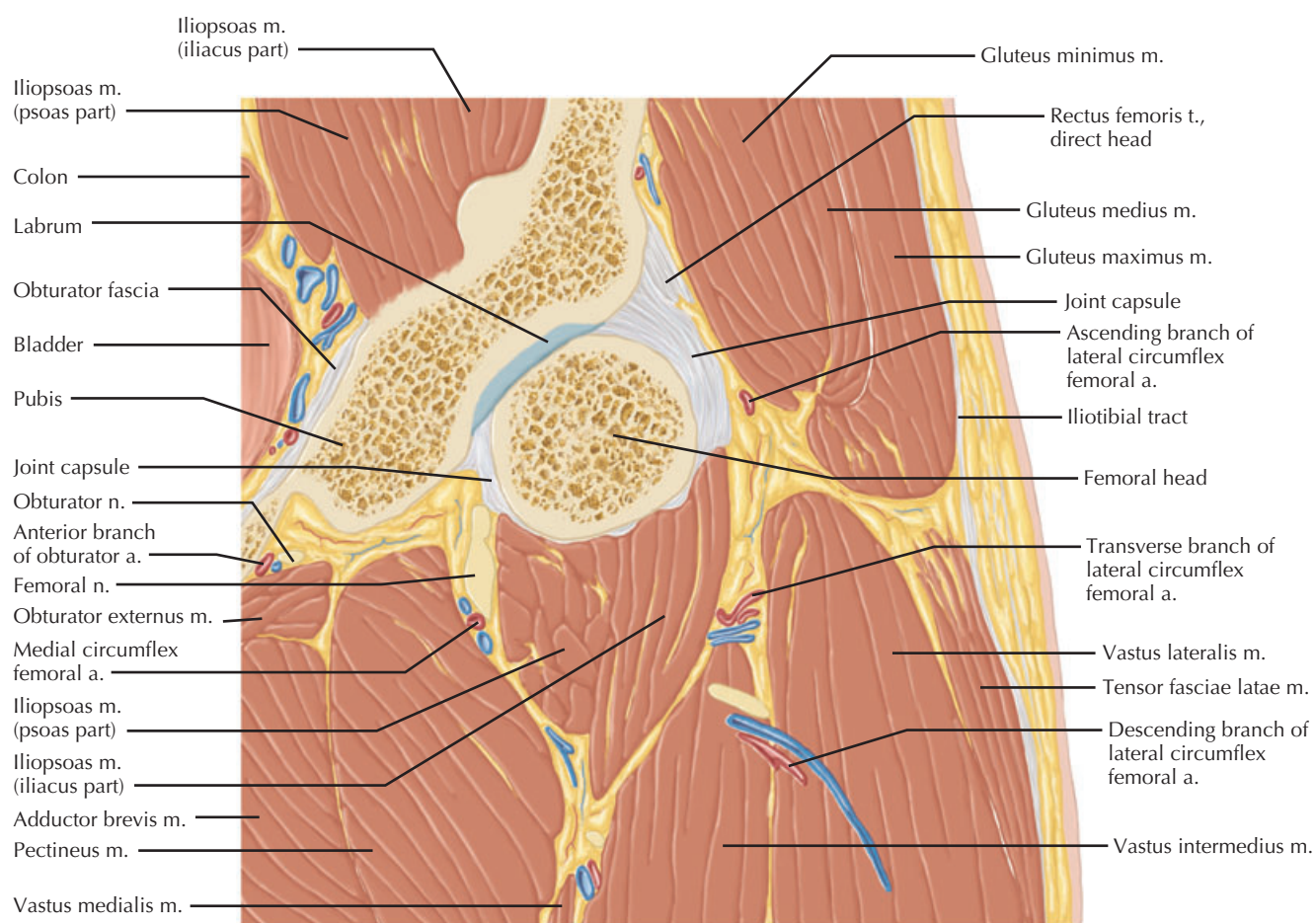


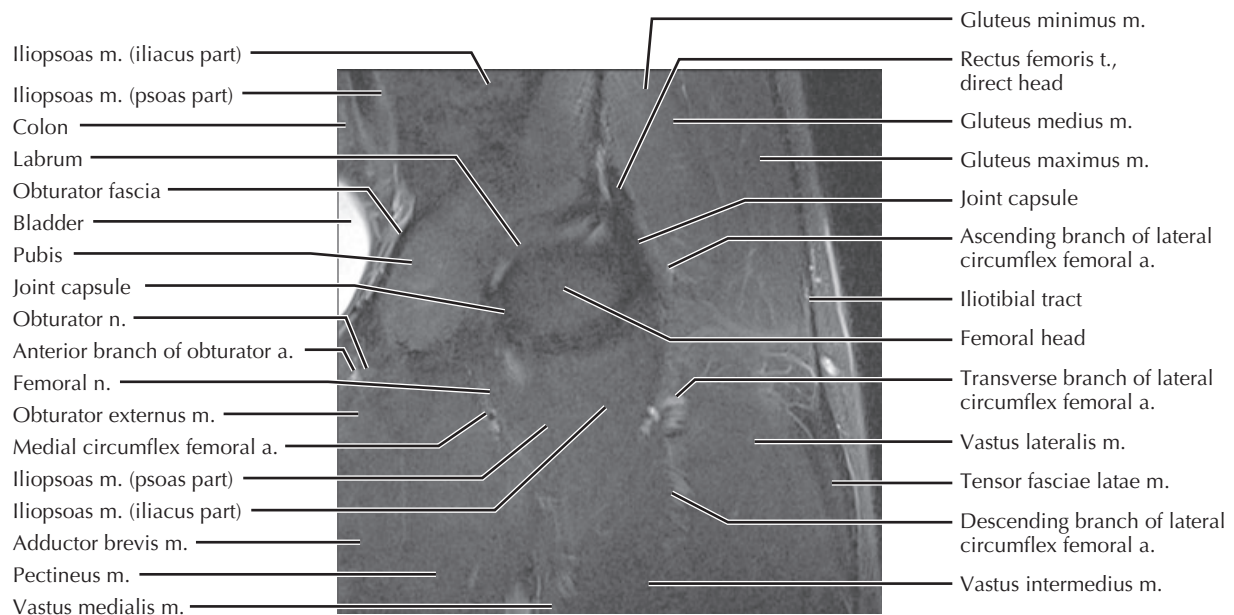
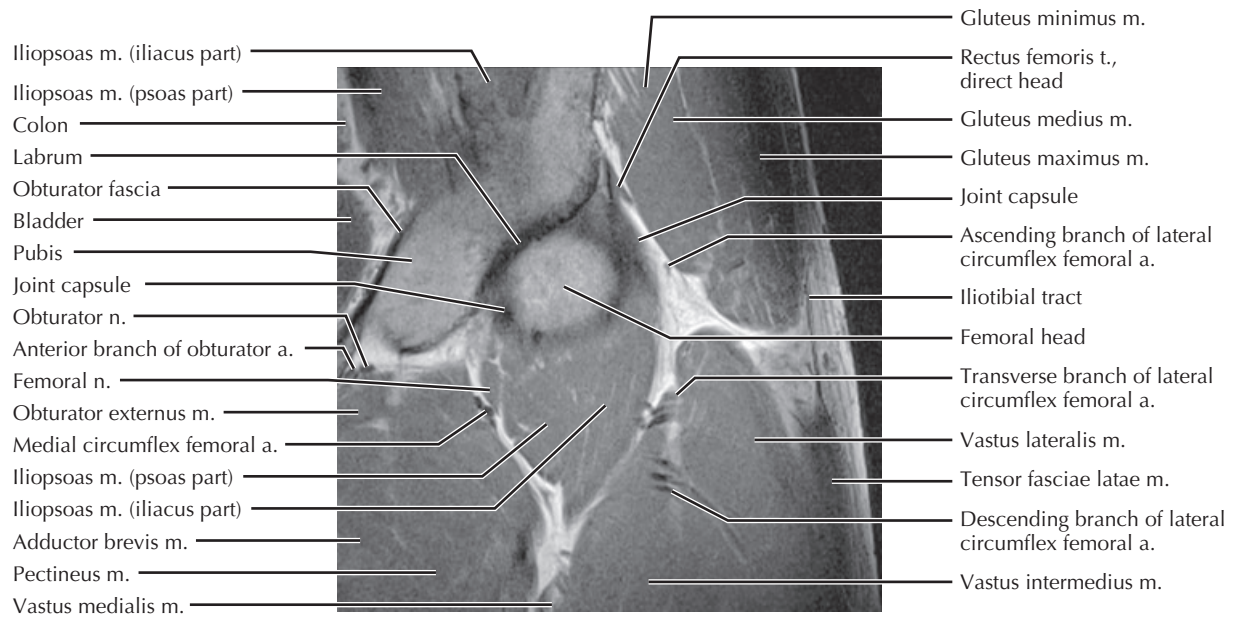
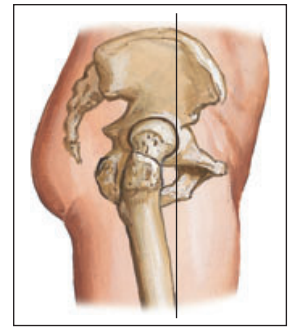


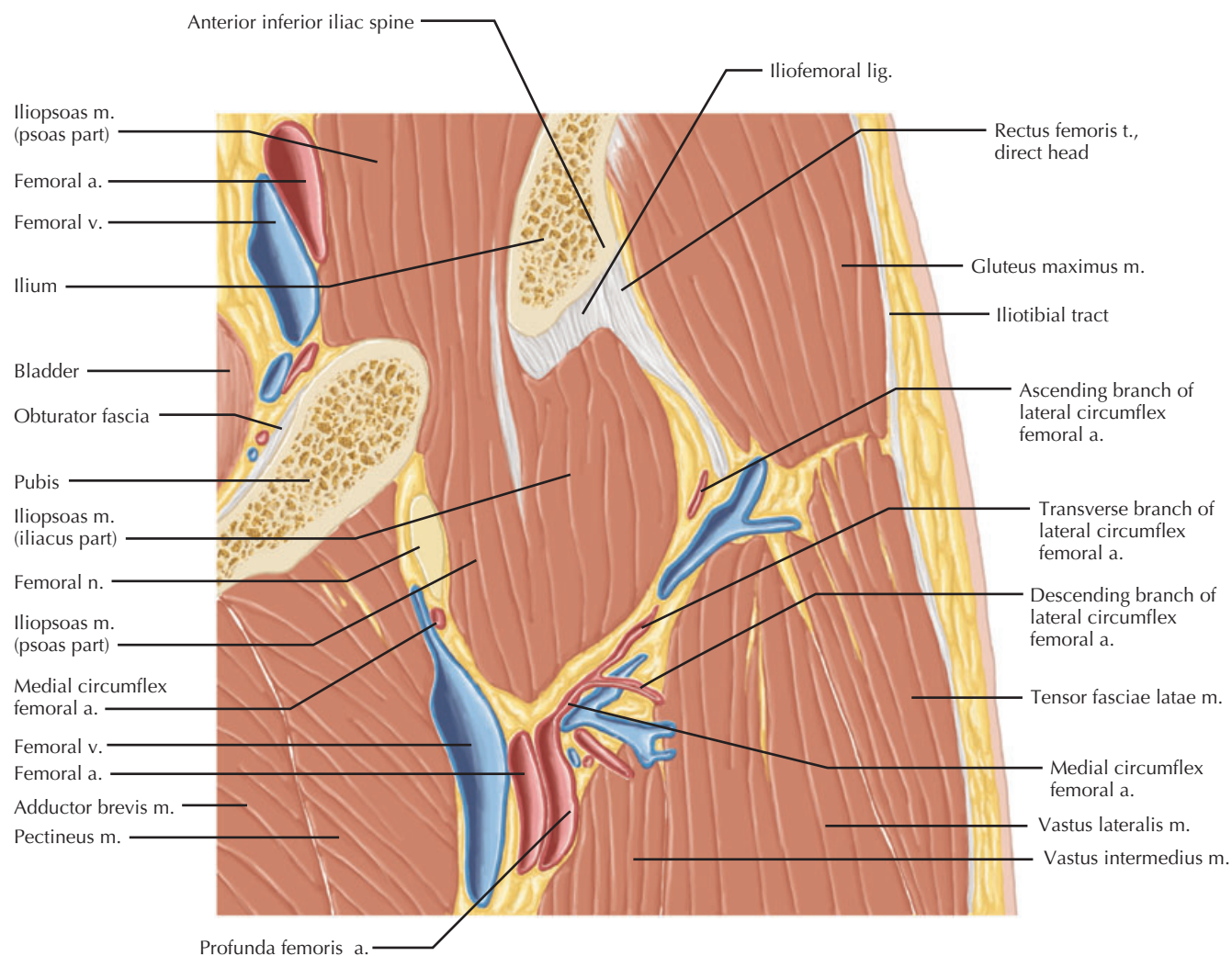


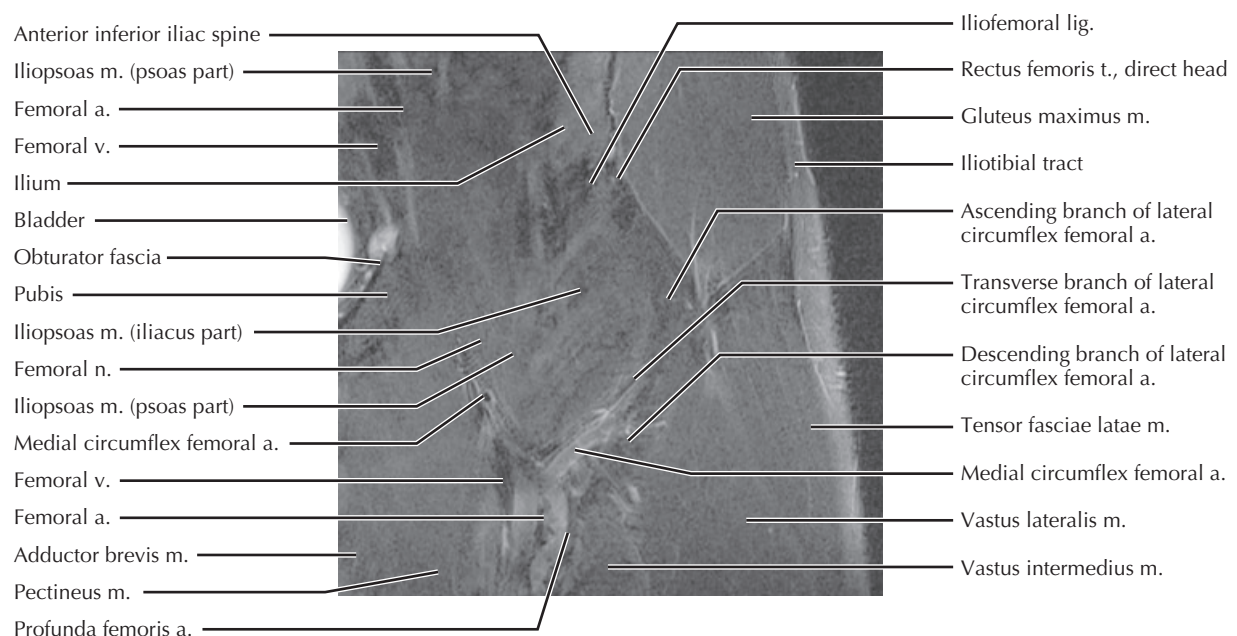
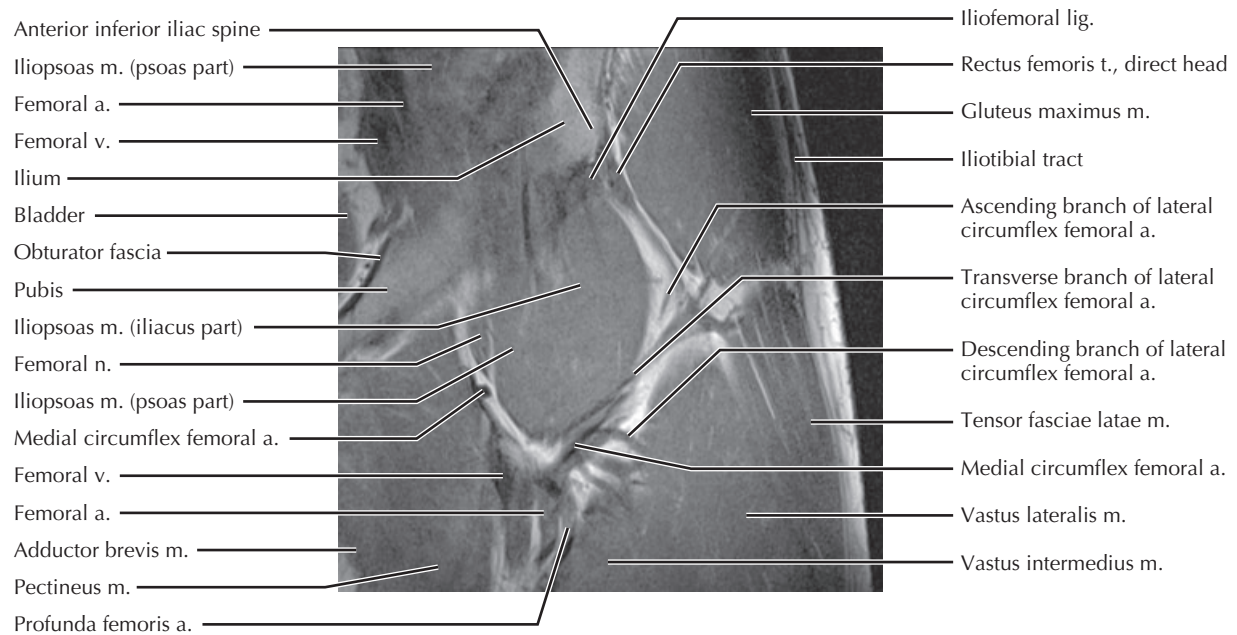
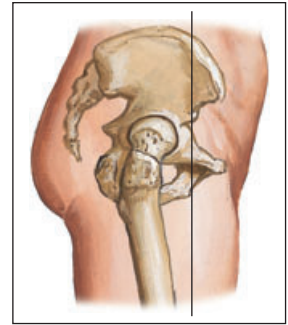




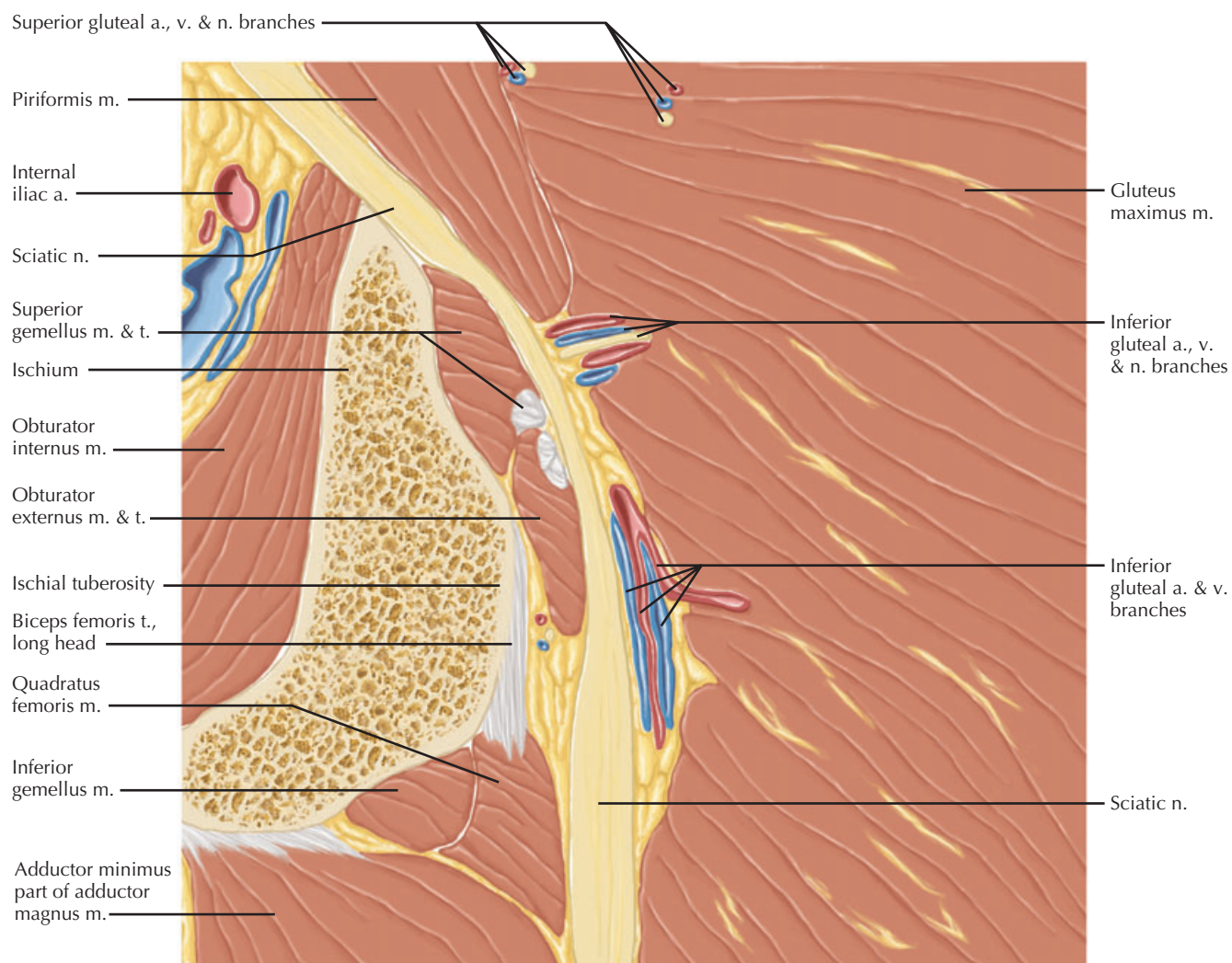


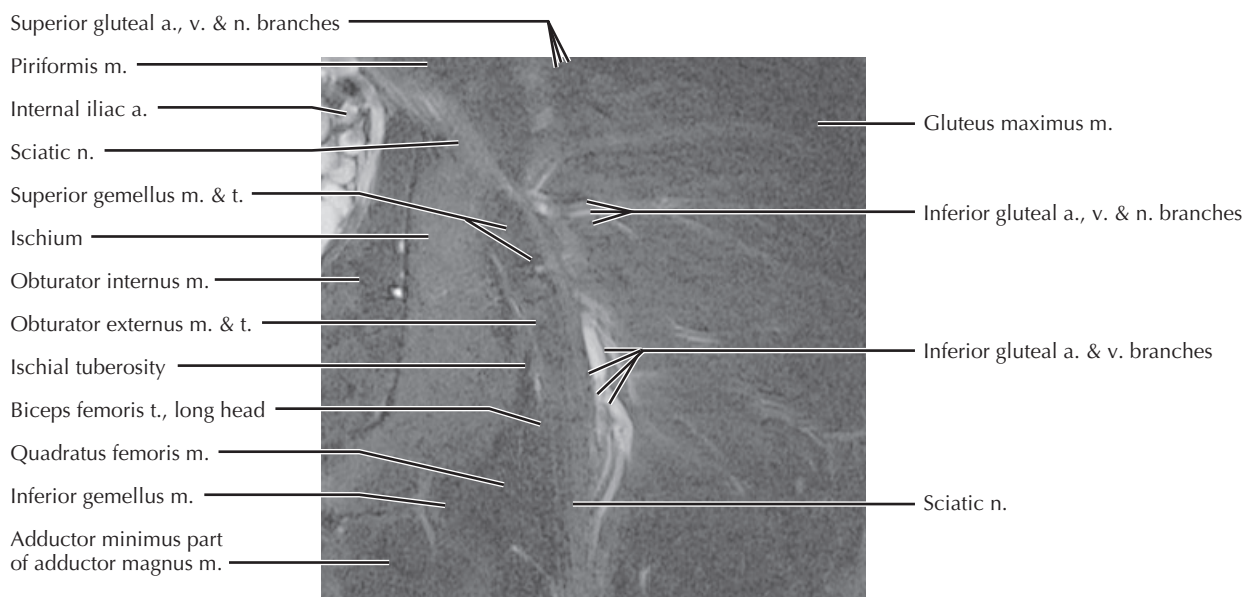
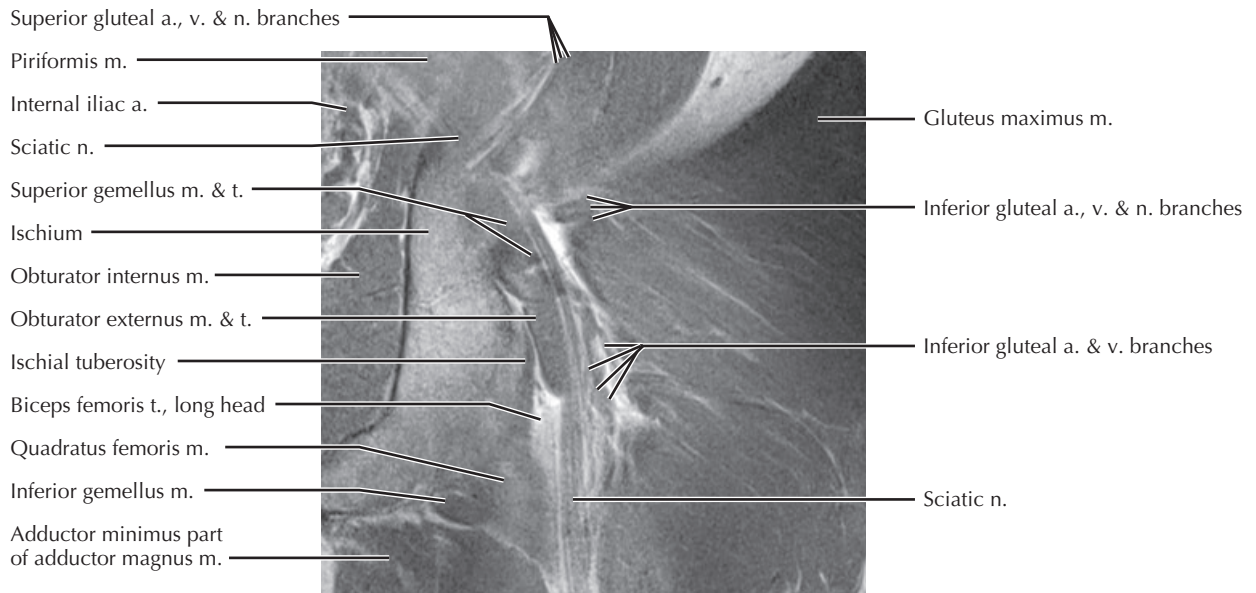
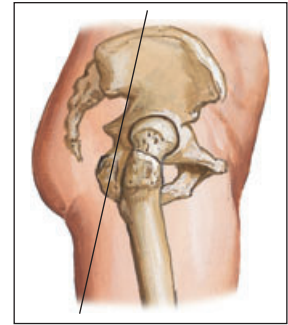


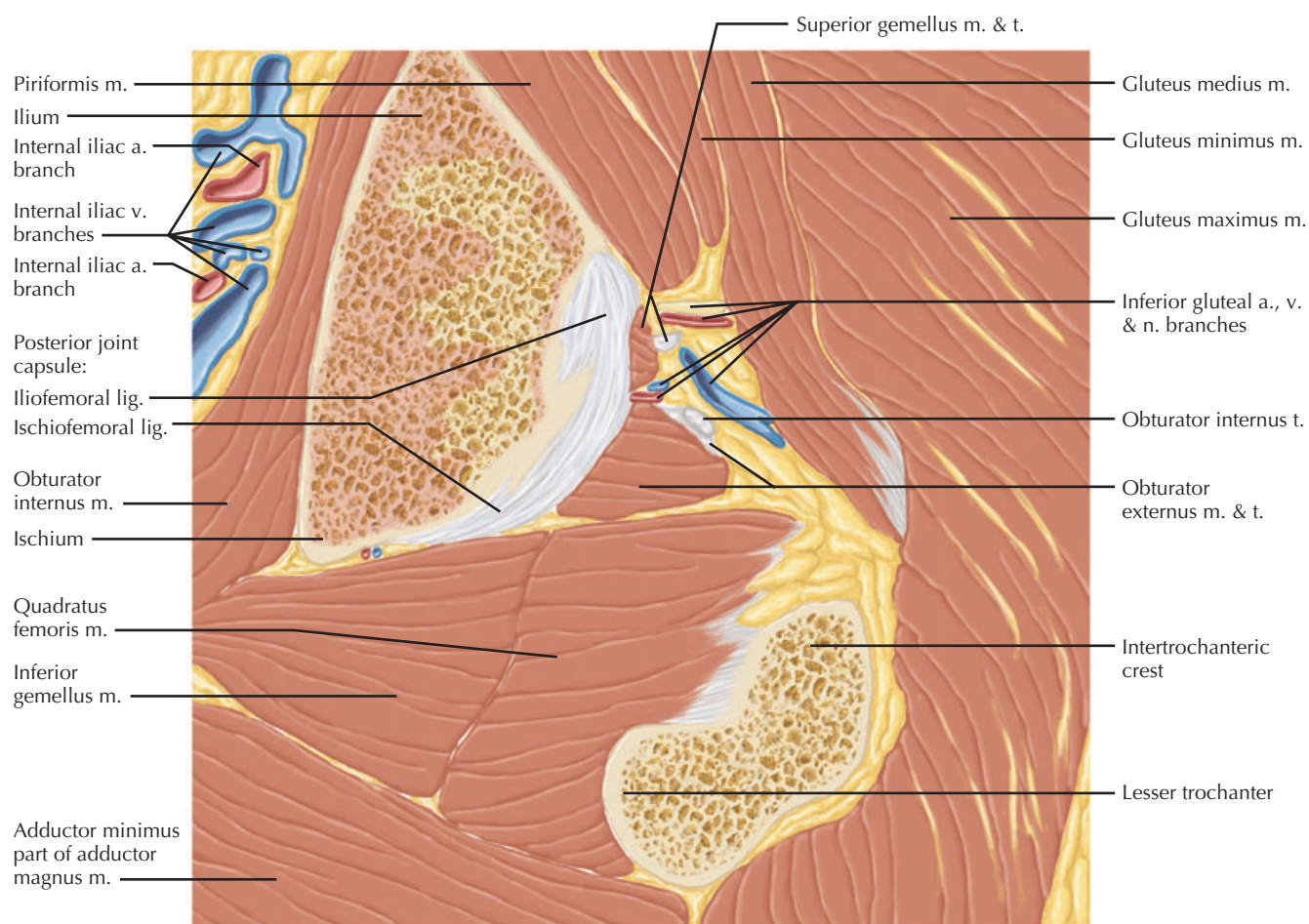


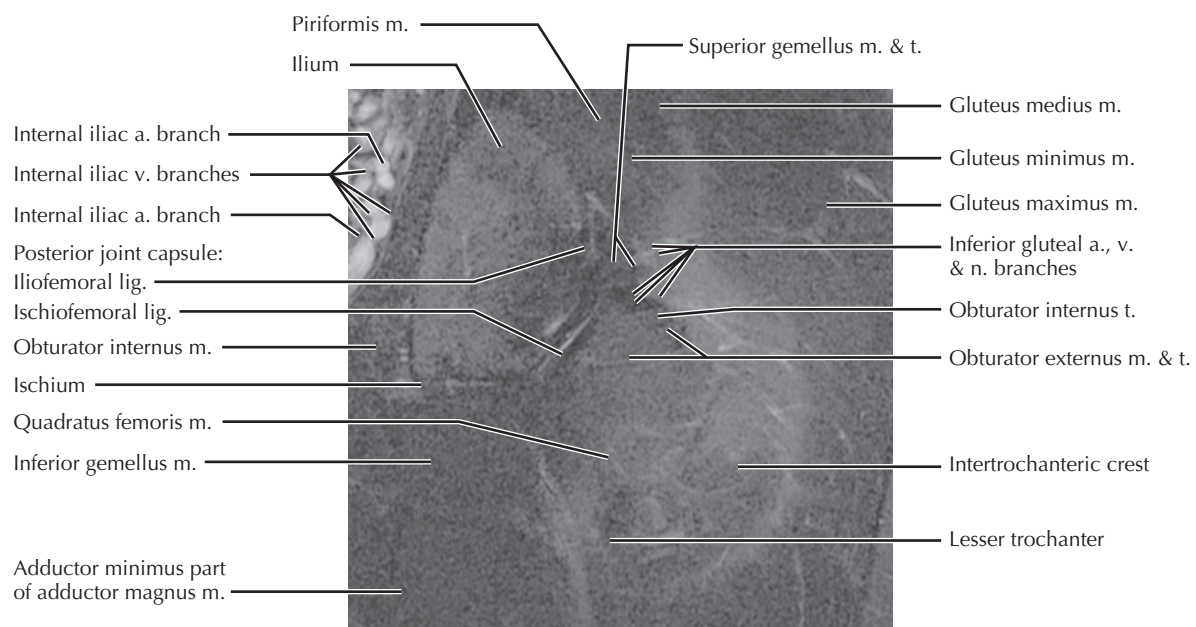
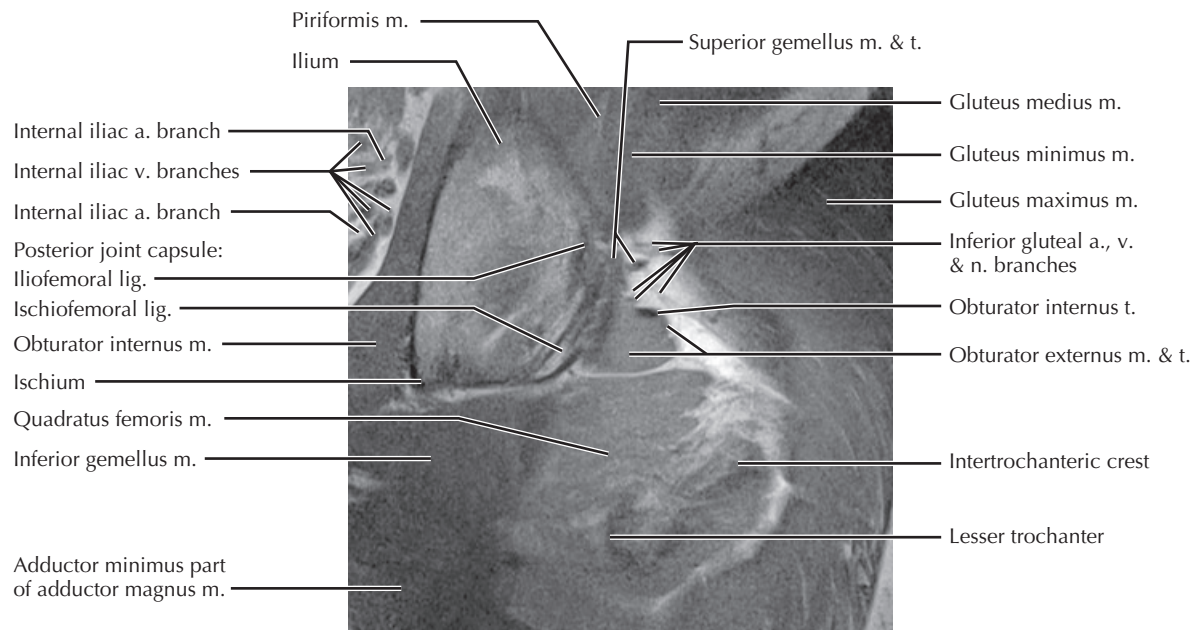
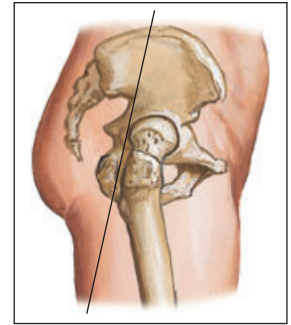


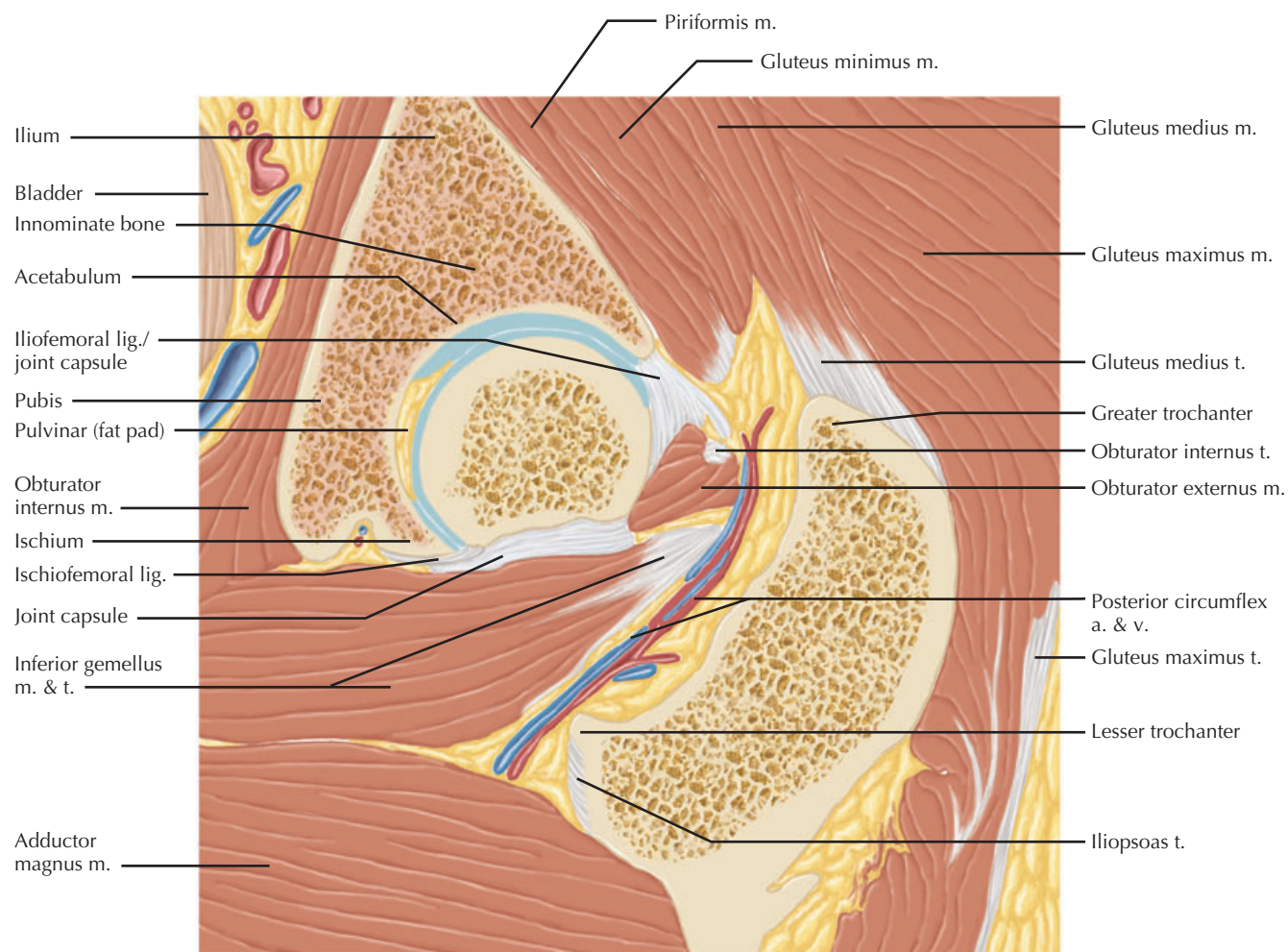
HIP CORONAL OBLIQUE 1

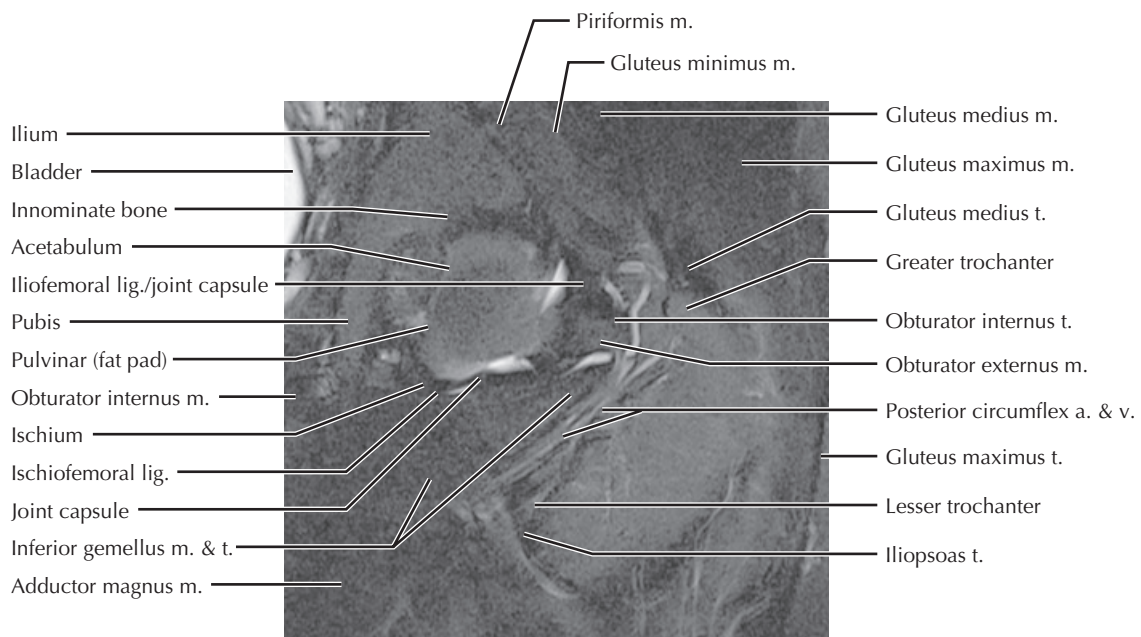
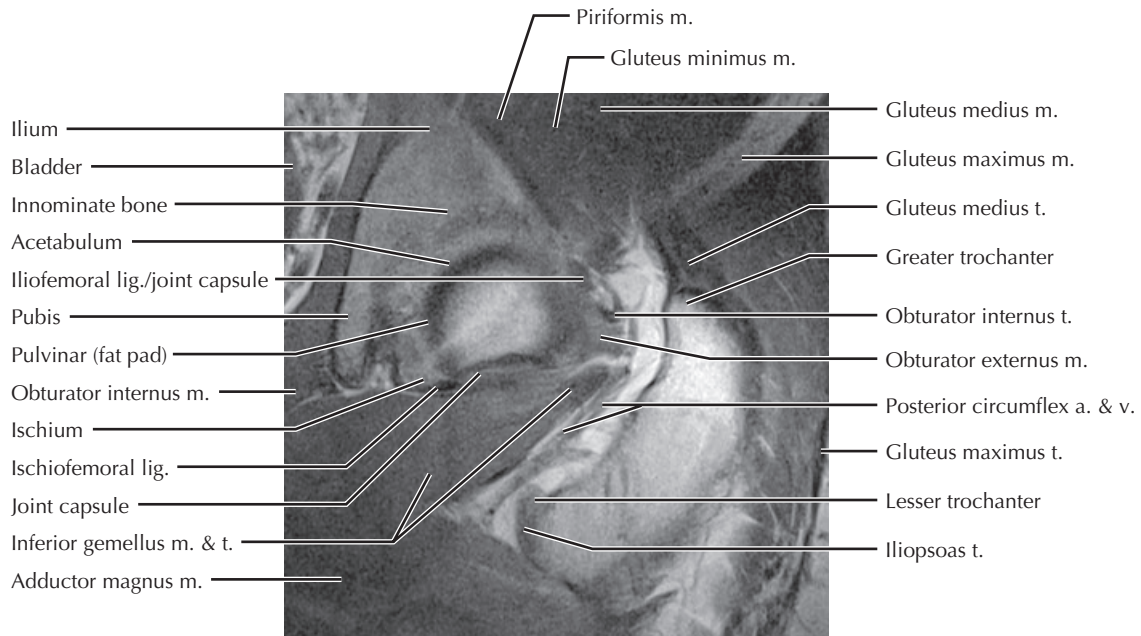
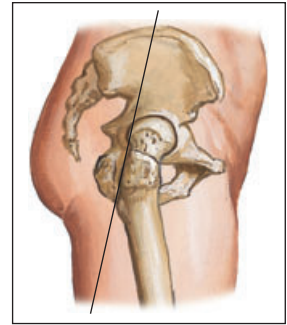


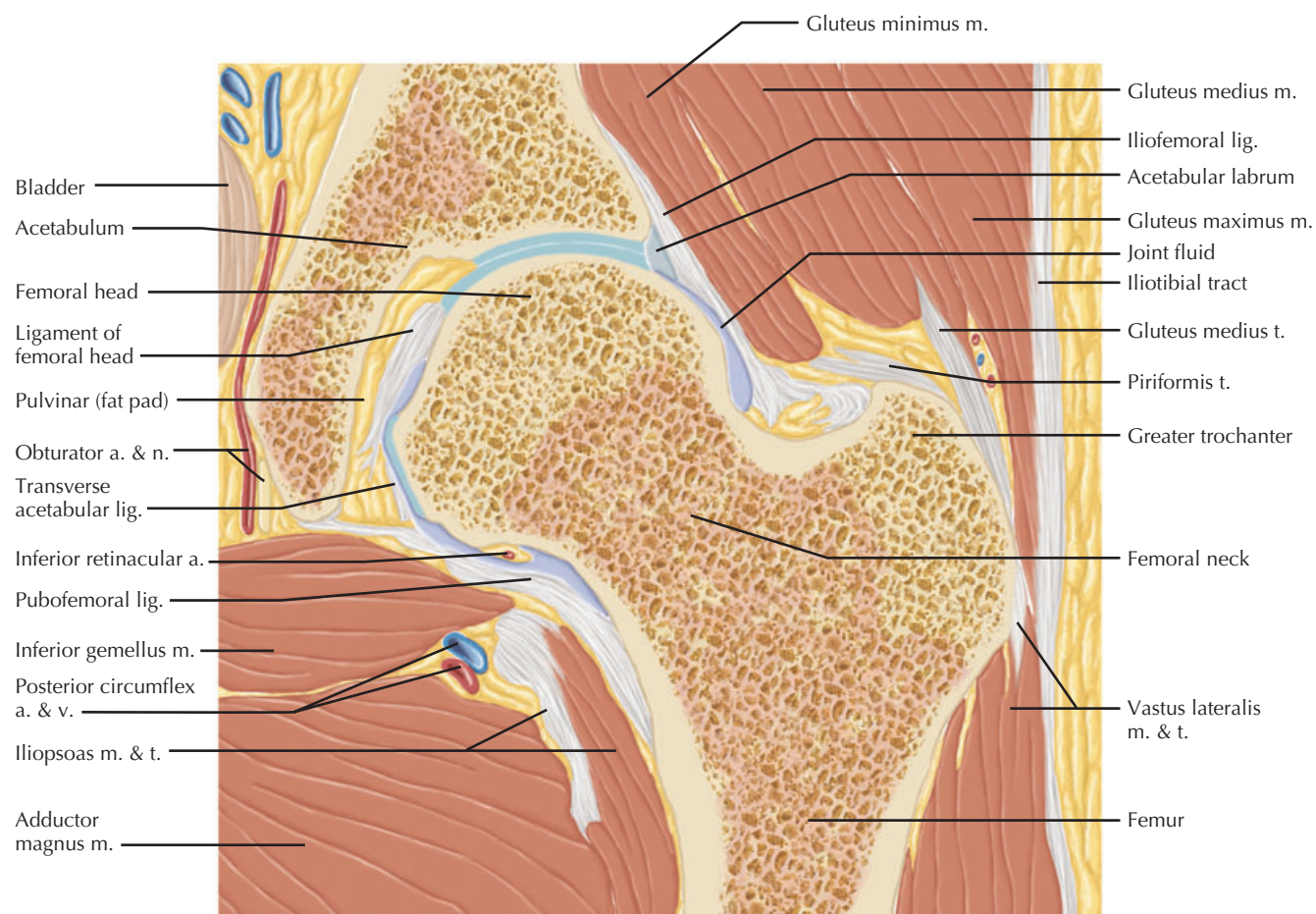






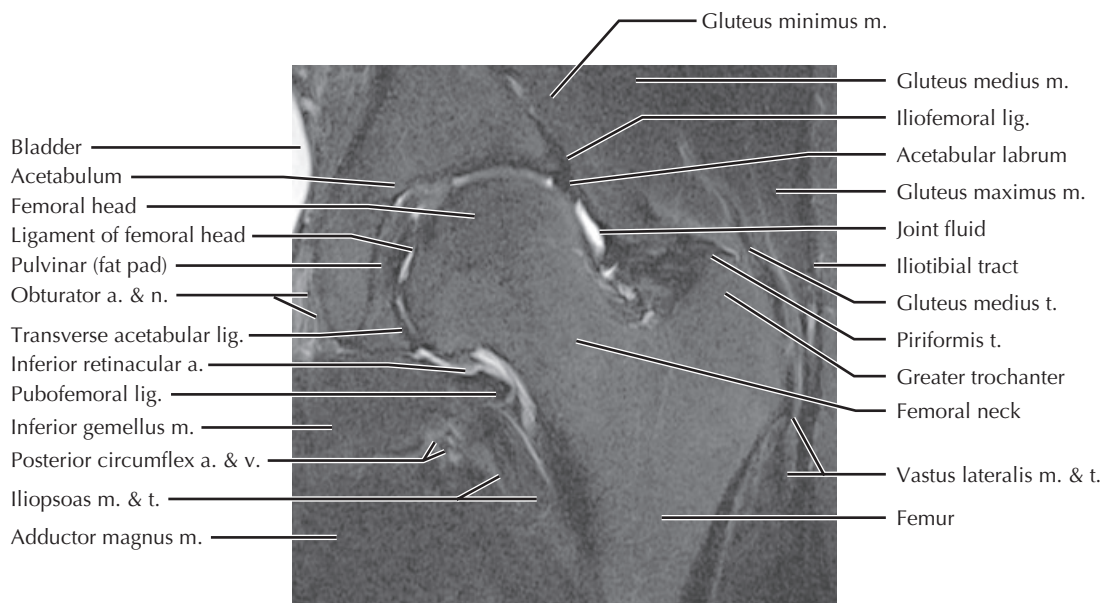
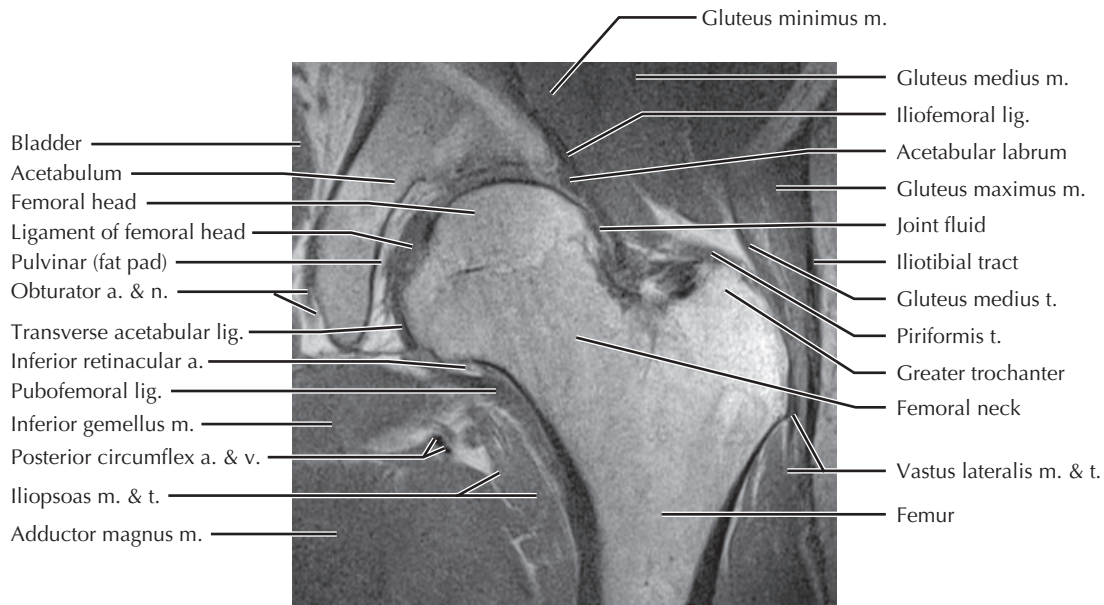
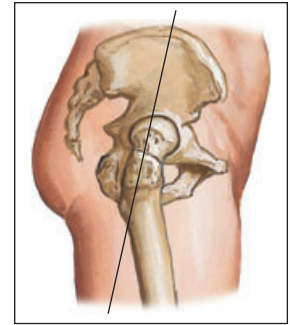


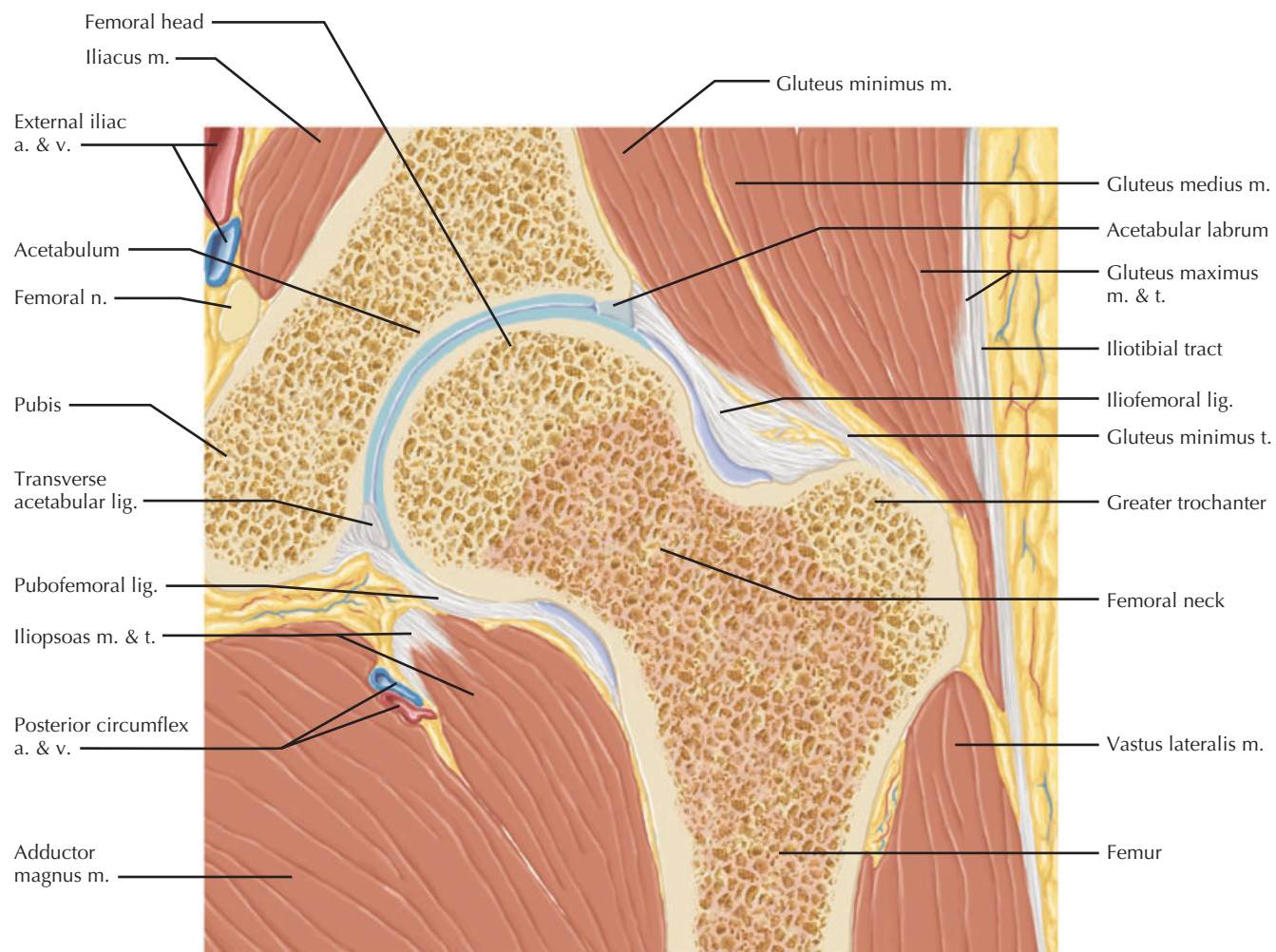


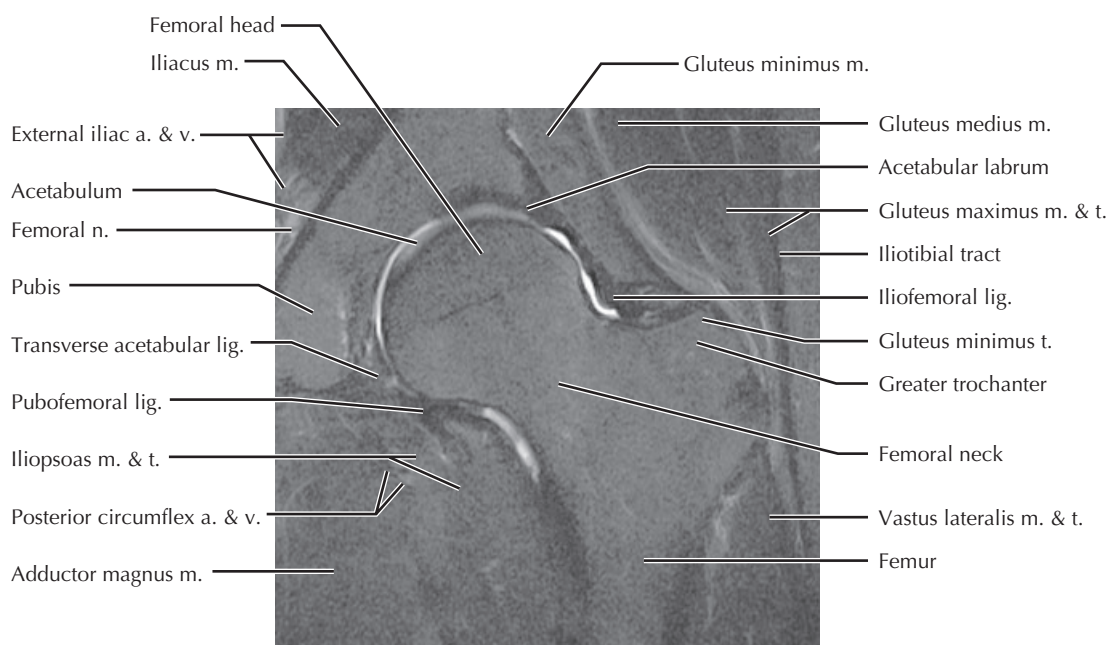
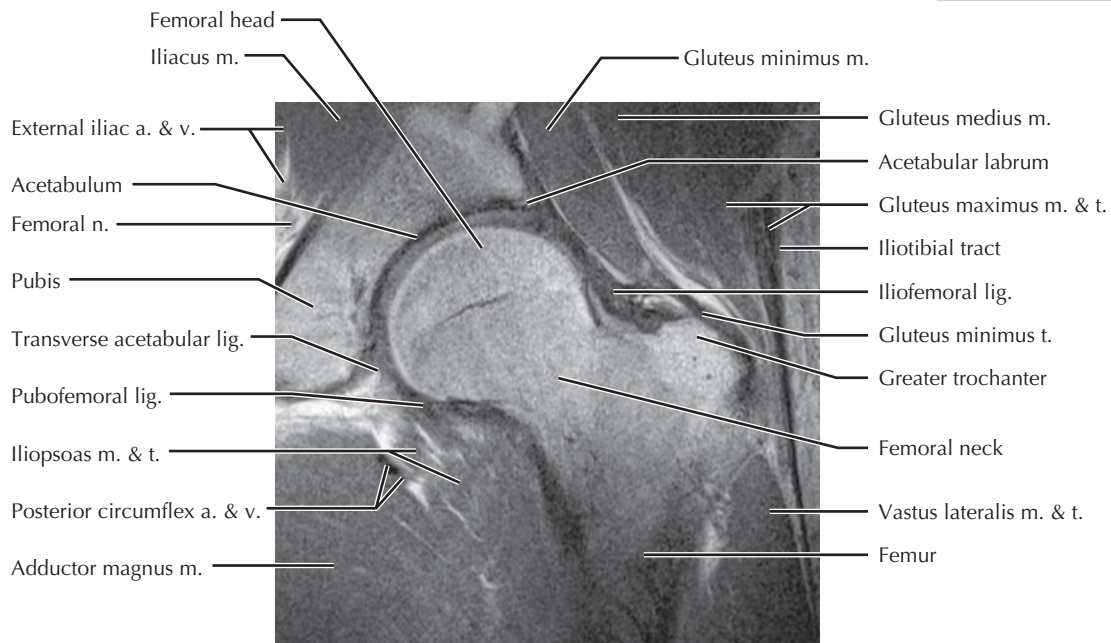
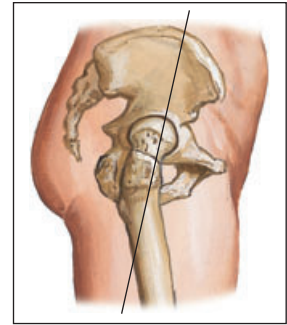


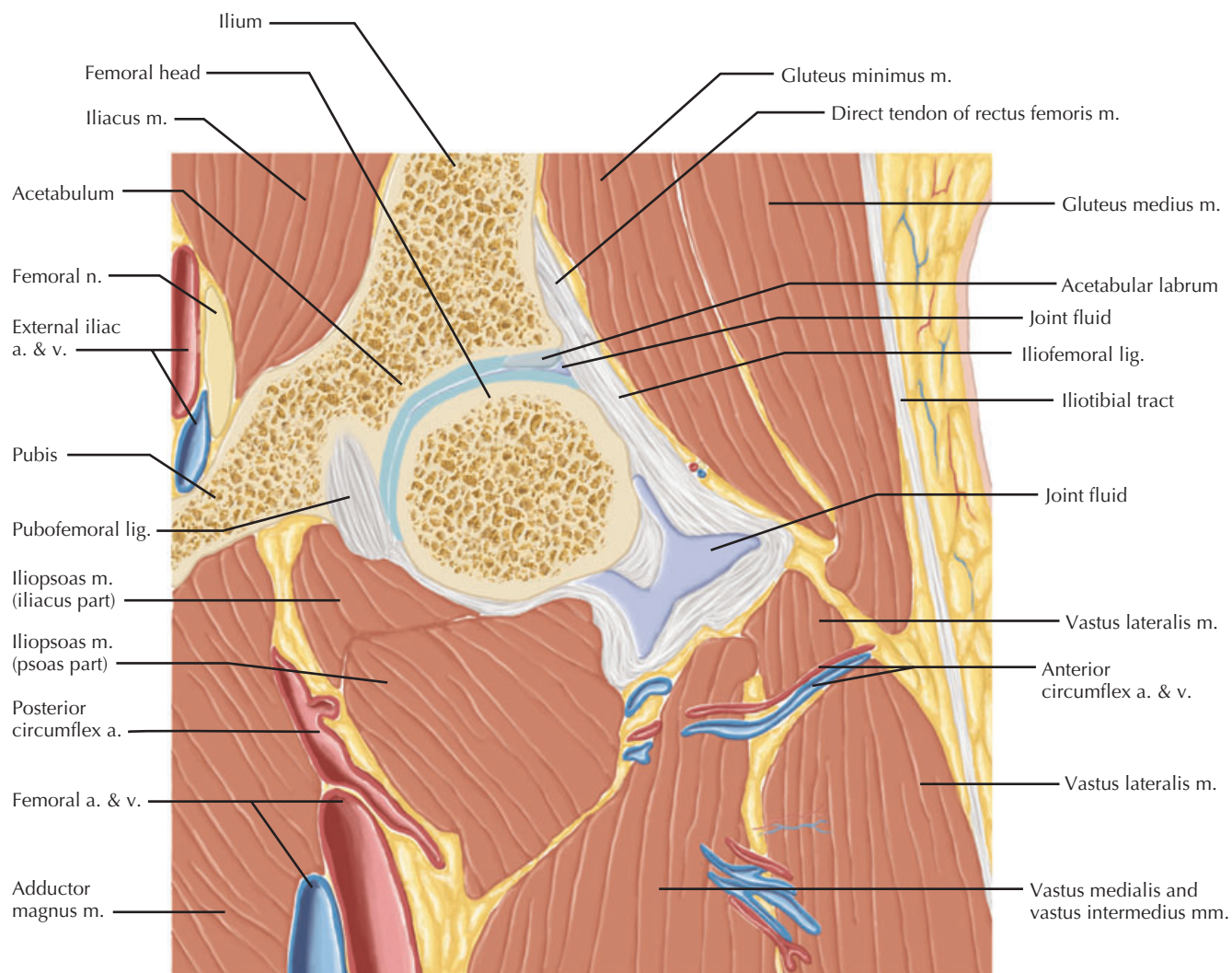
DIAGNOSTIC CONSIDERATION

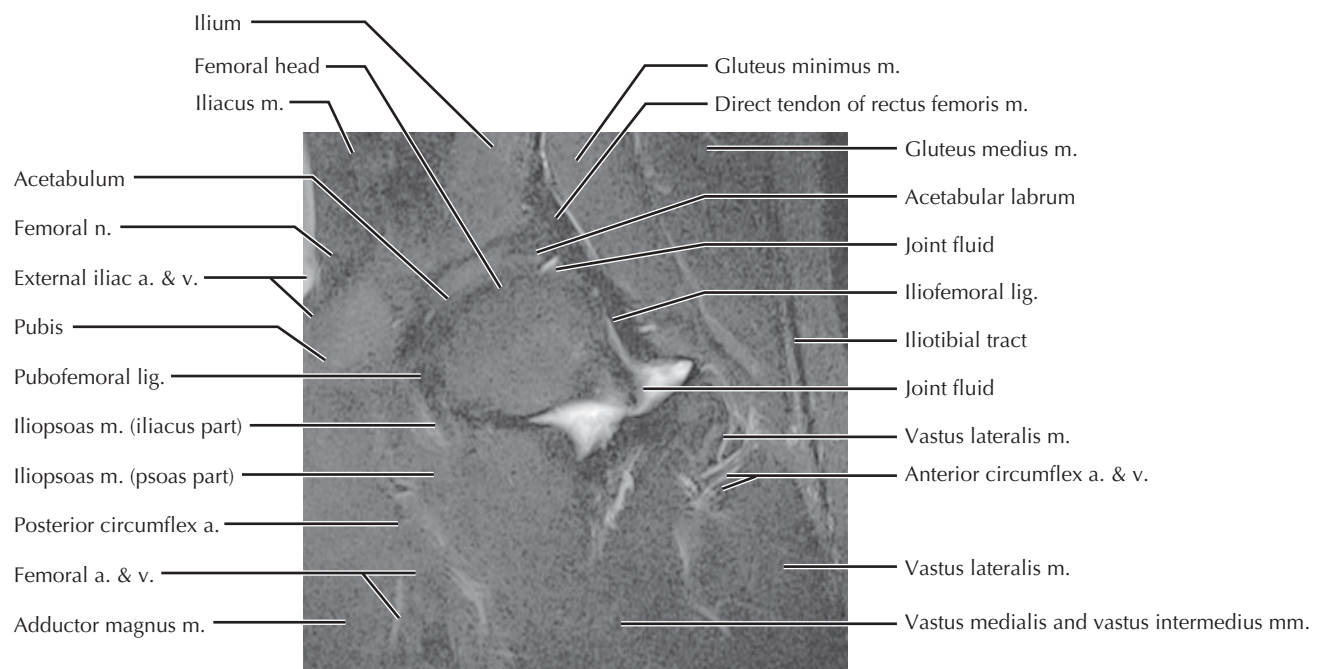
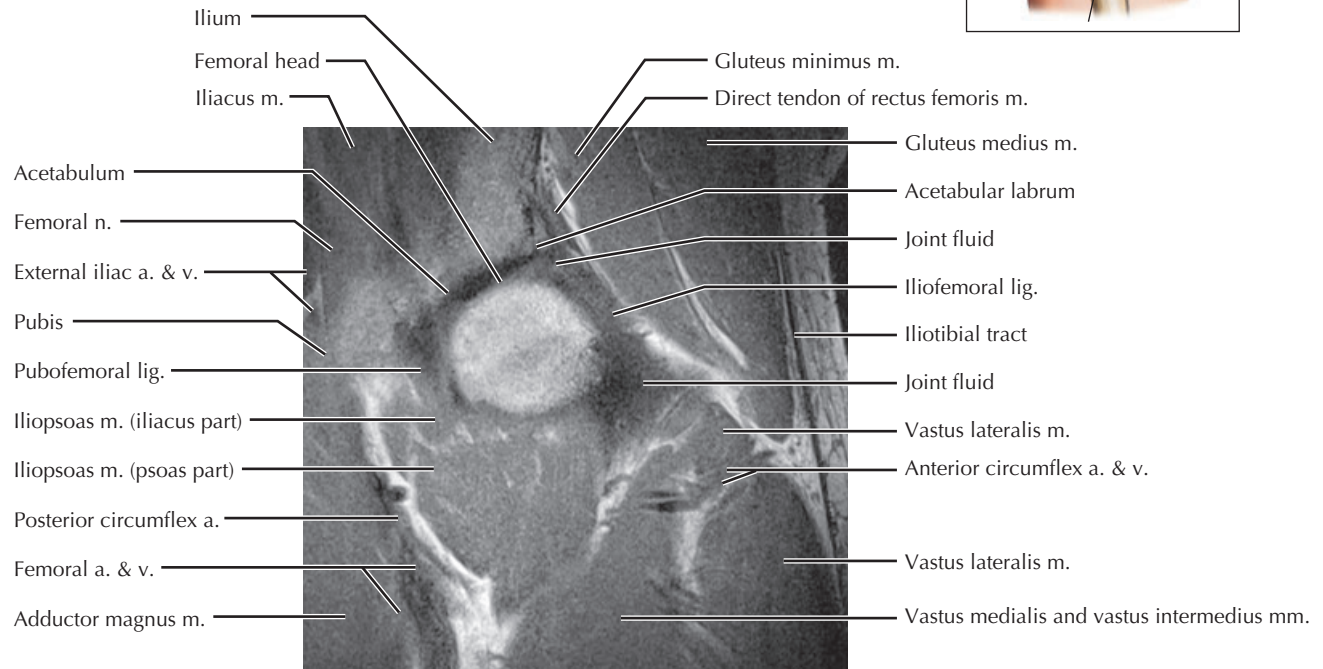
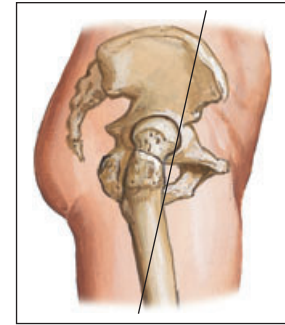
Oblique coronal and oblique axial MR images oriented along the plane of the femoral neck allow for evaluation of labrum pathology and femoroacetabular impingement.

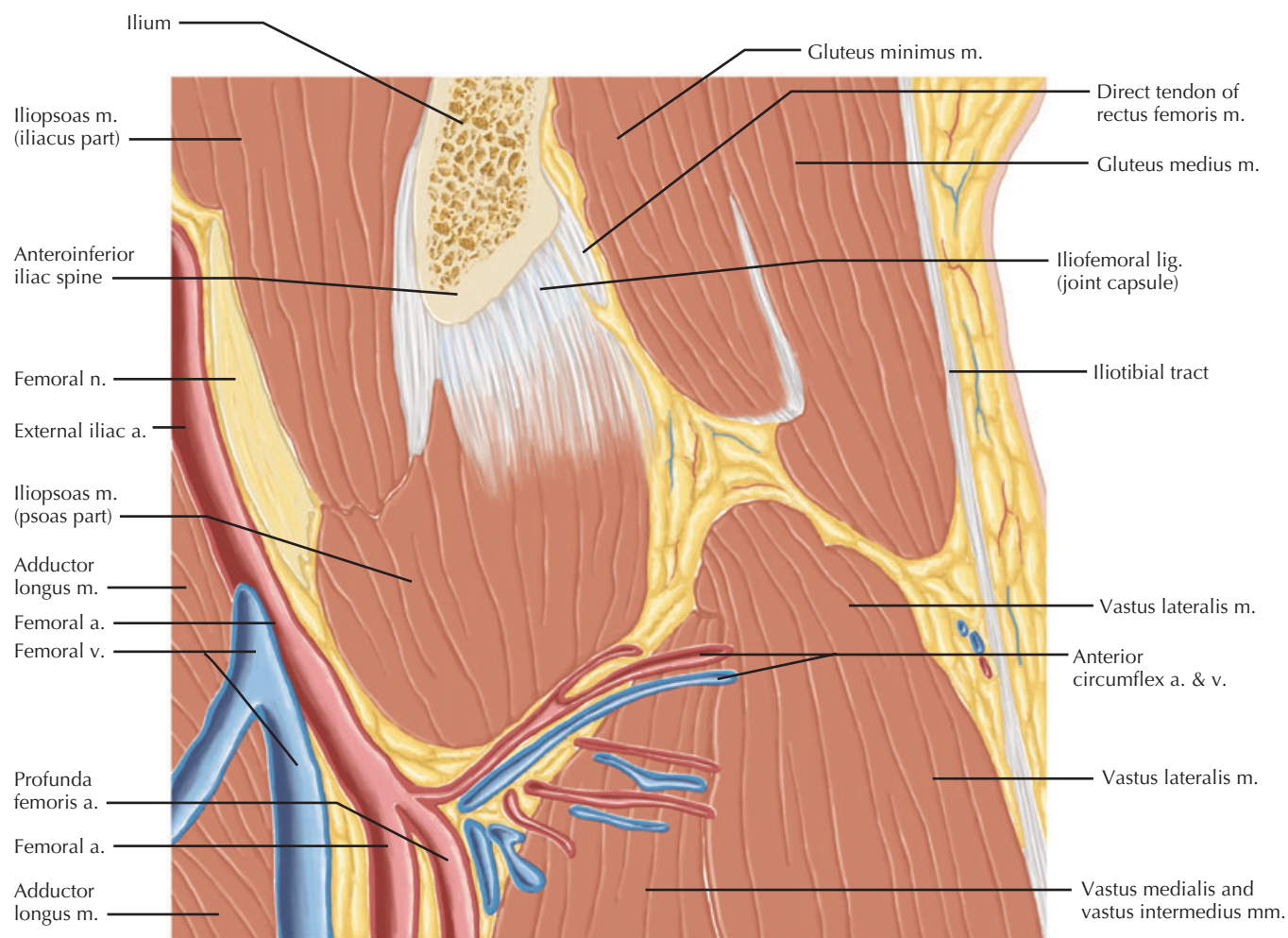


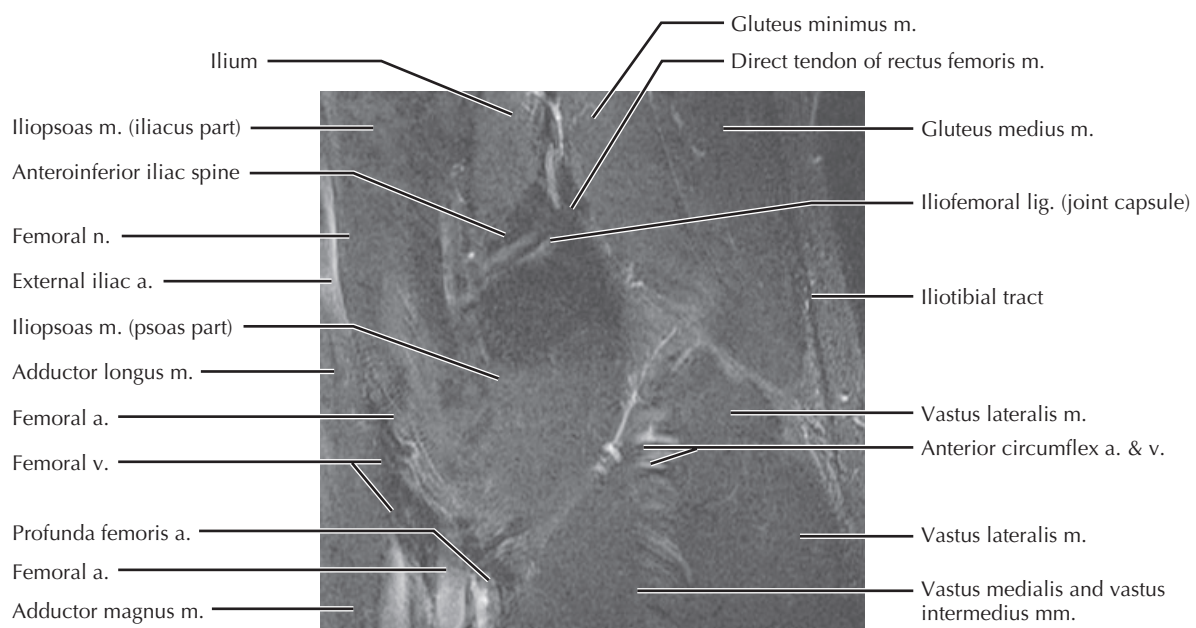
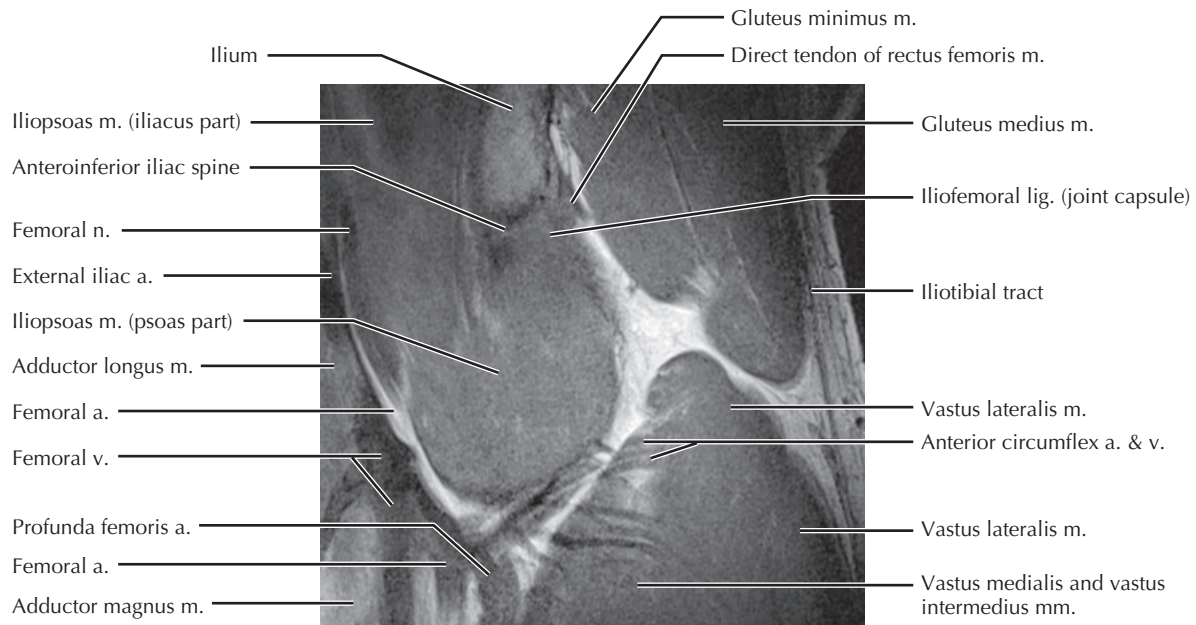
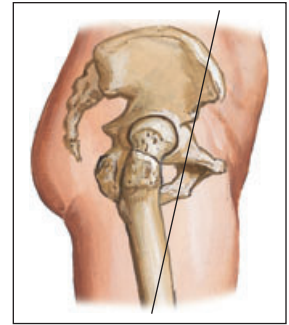


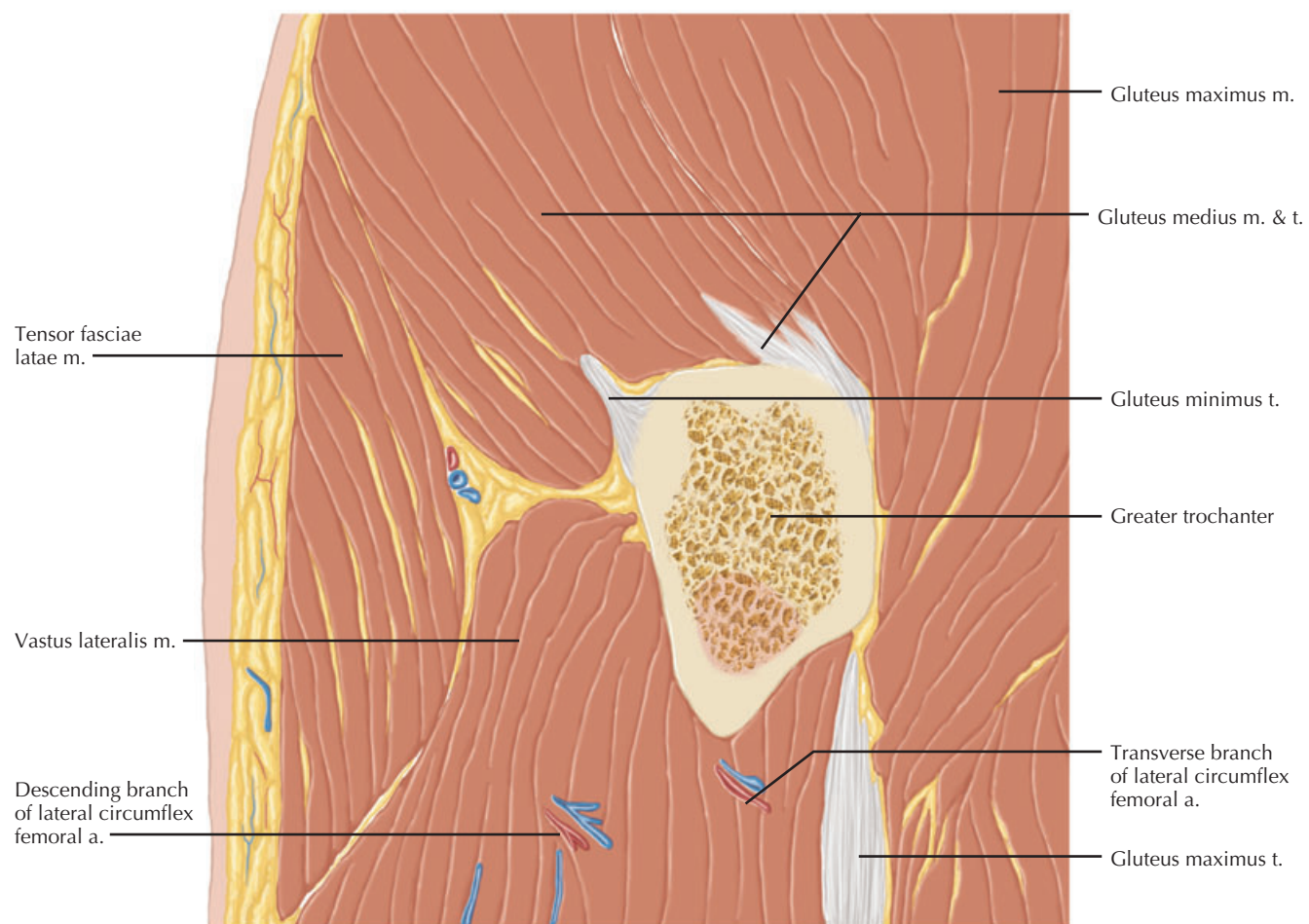


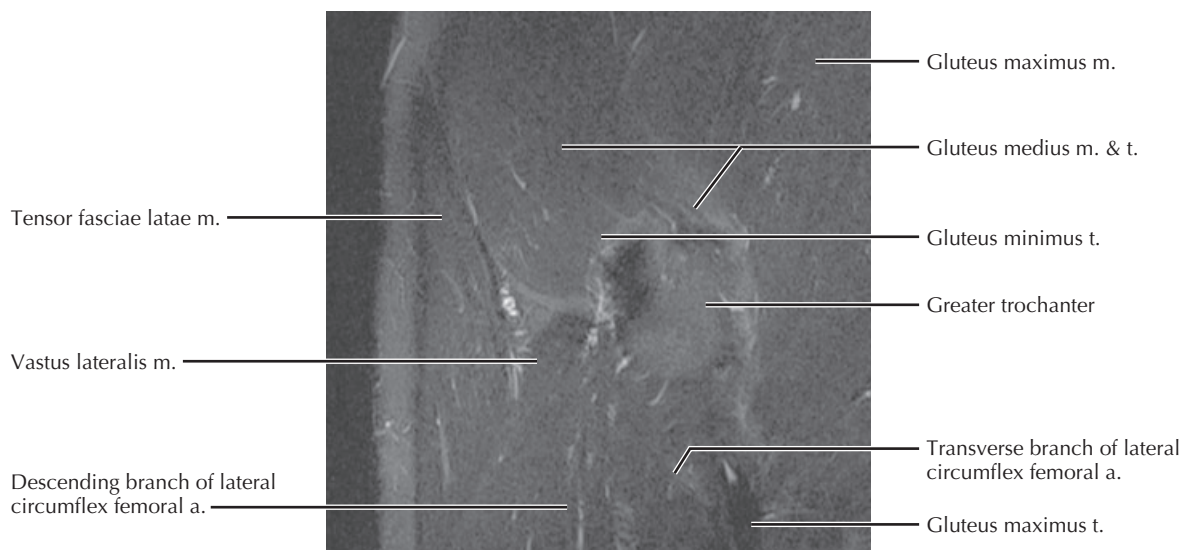
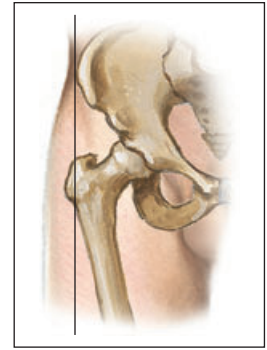


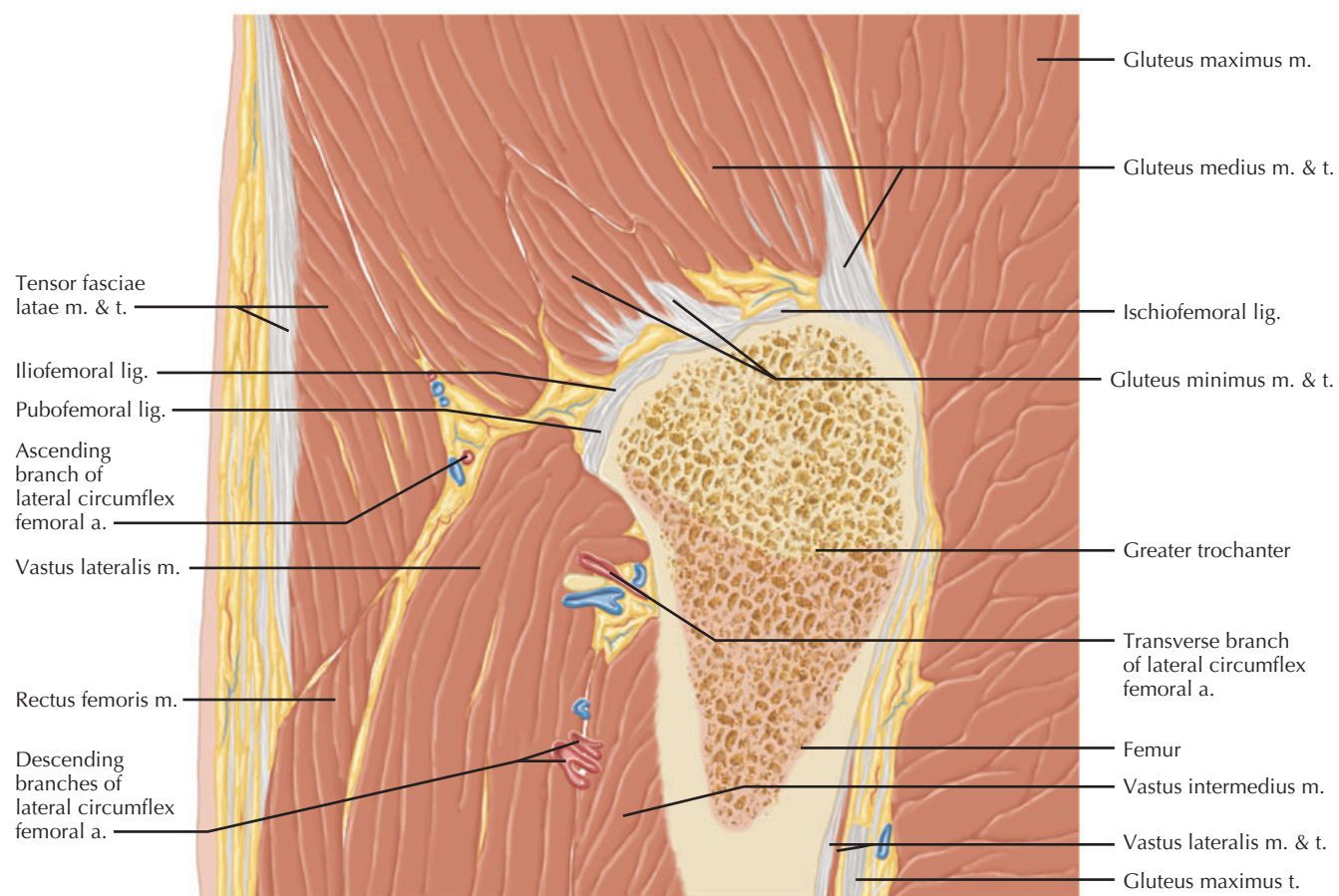


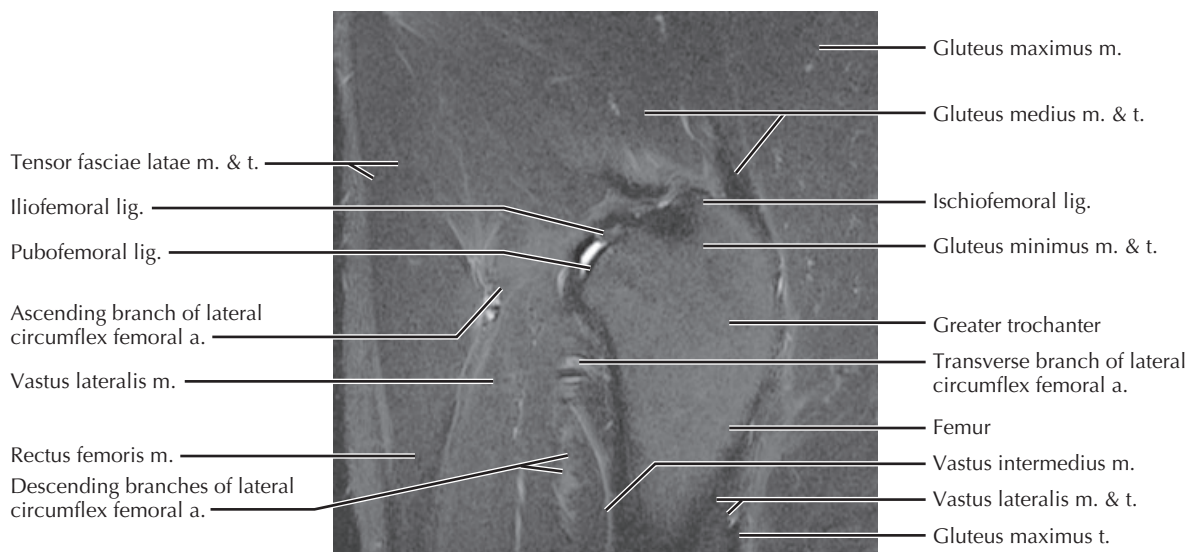
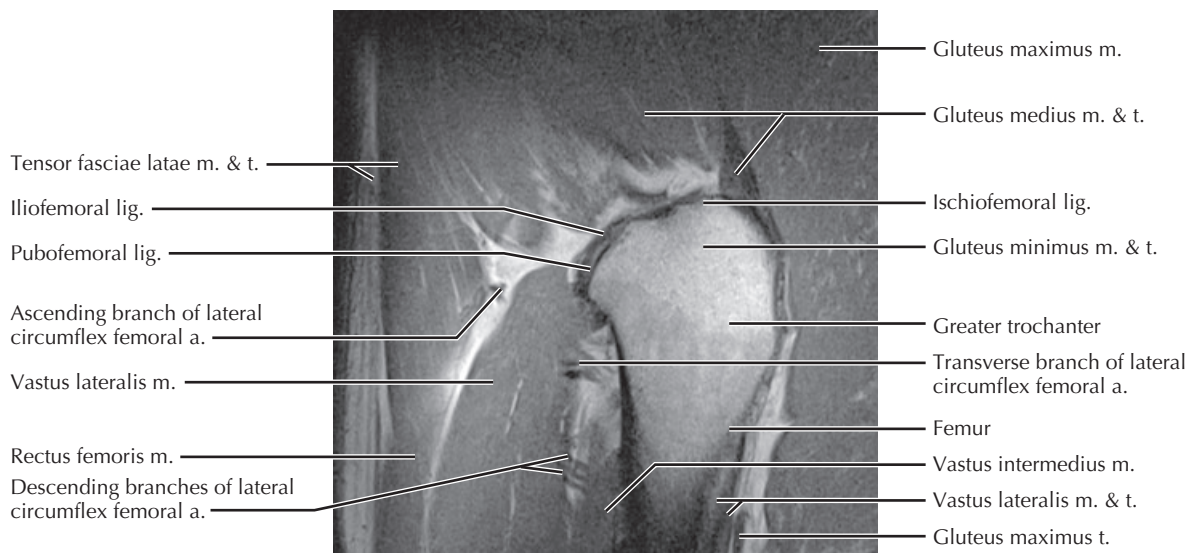
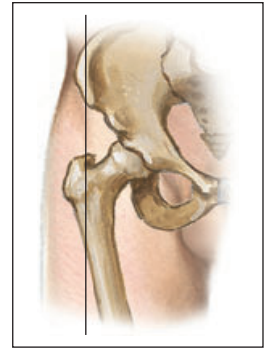


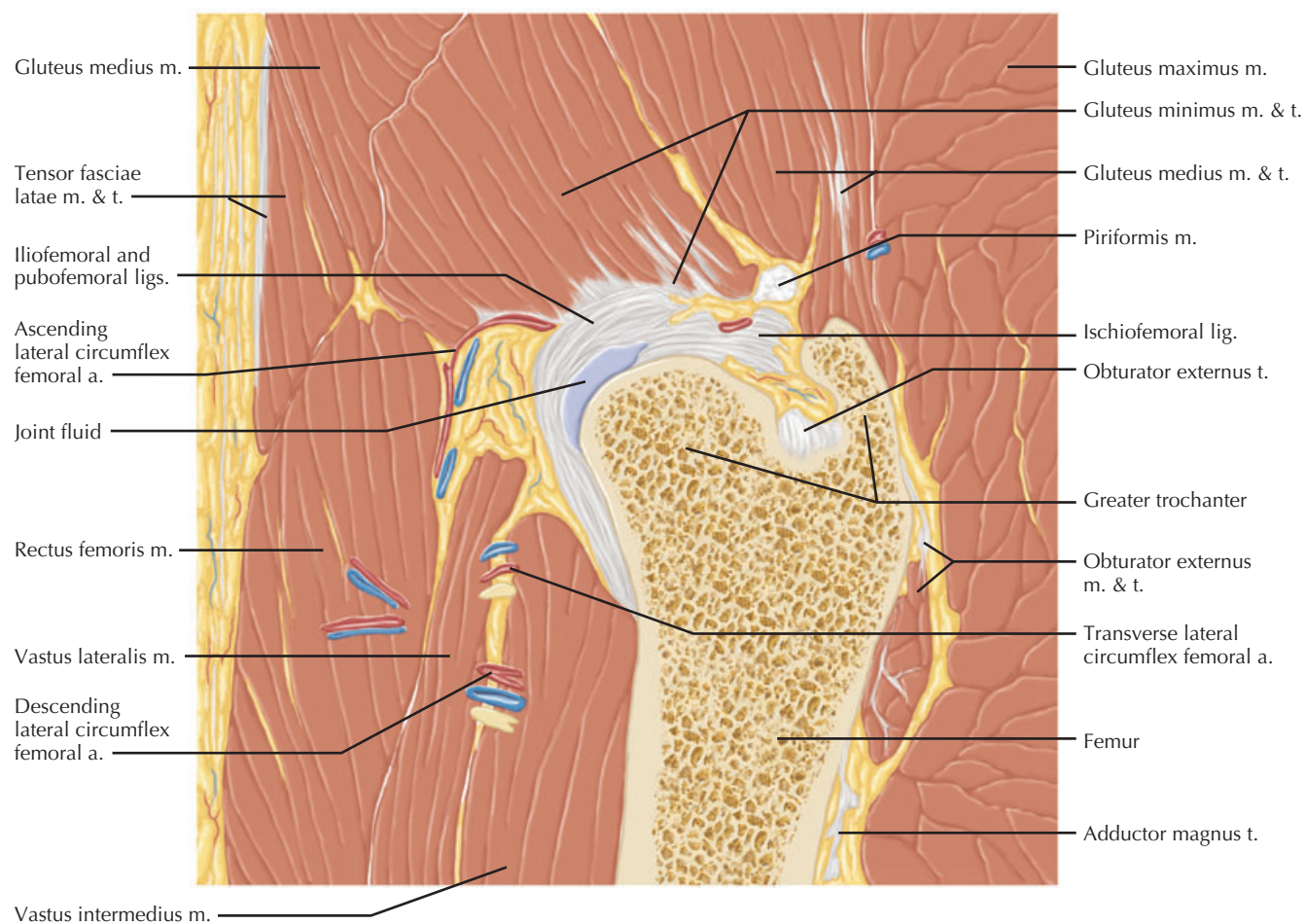


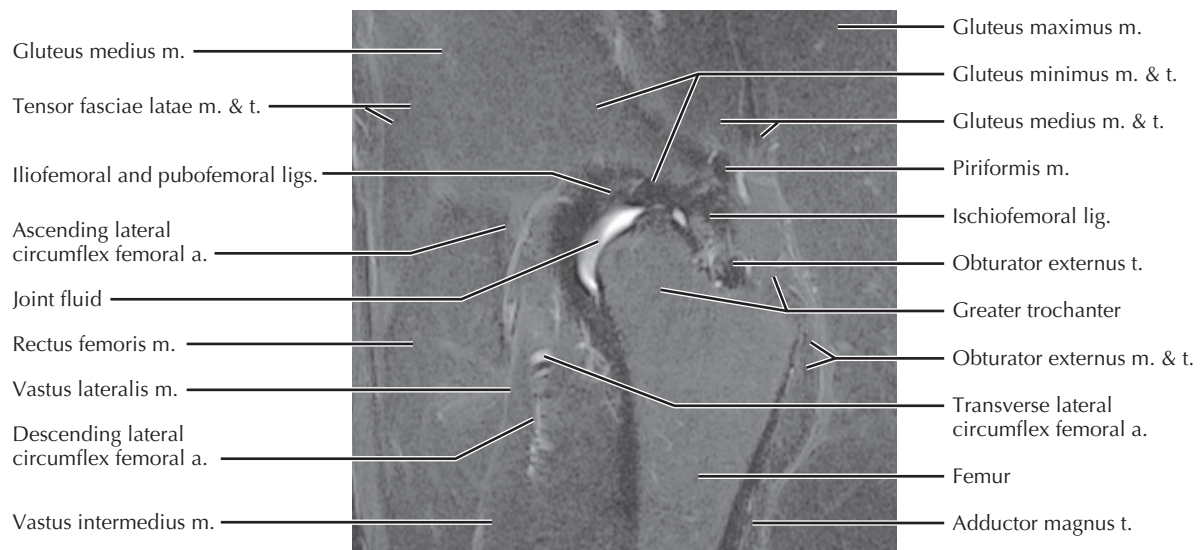
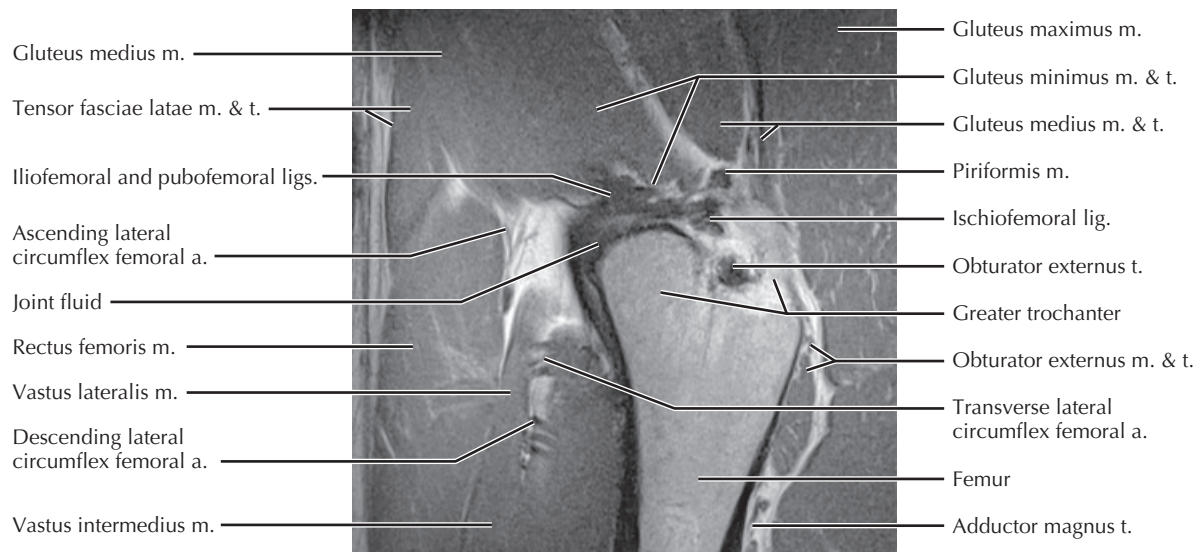
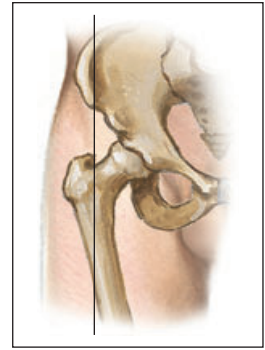


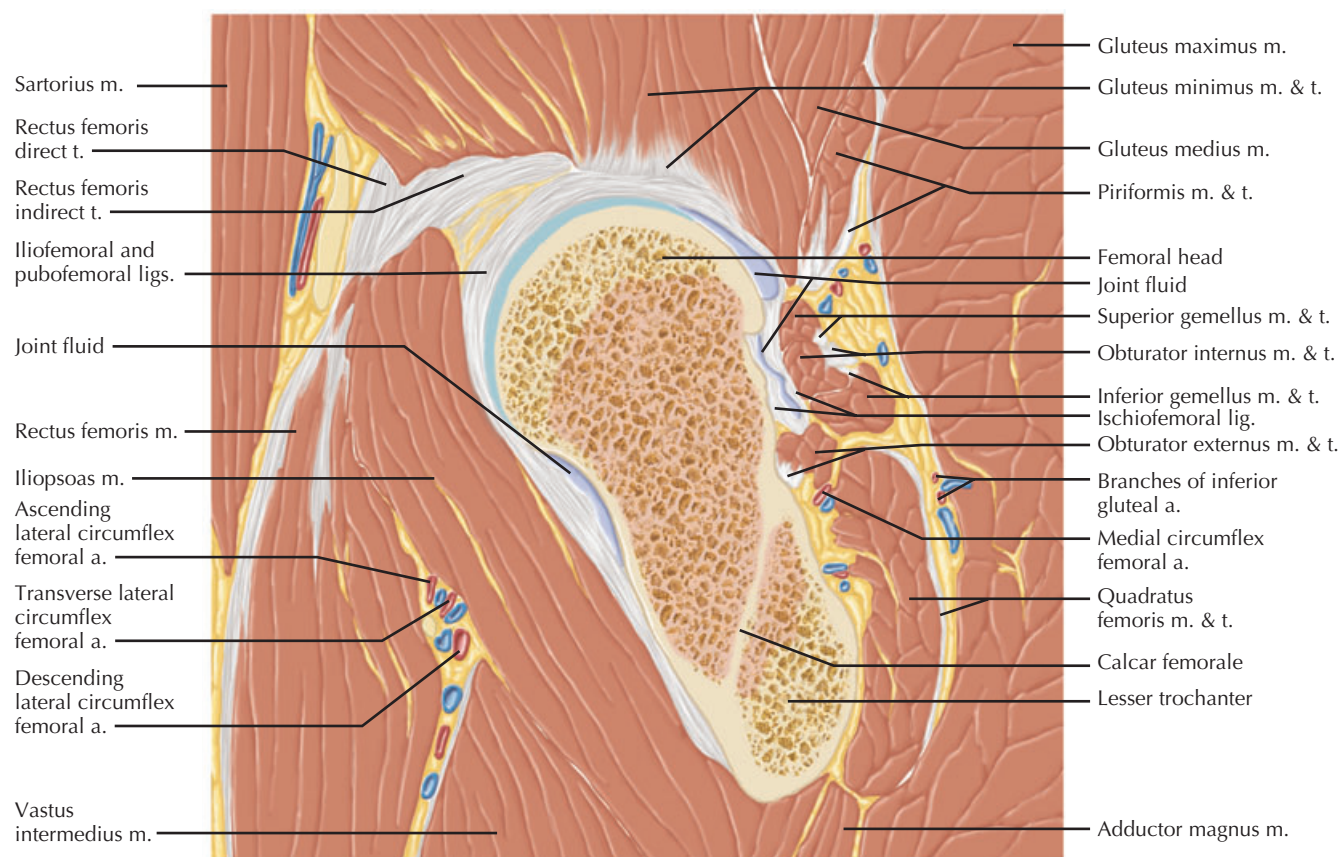


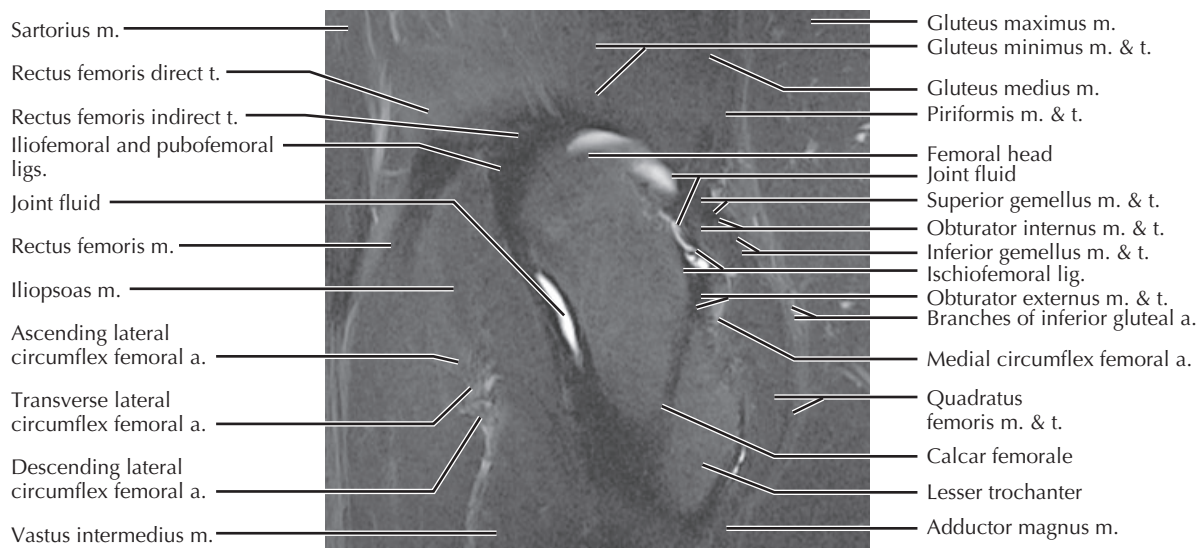
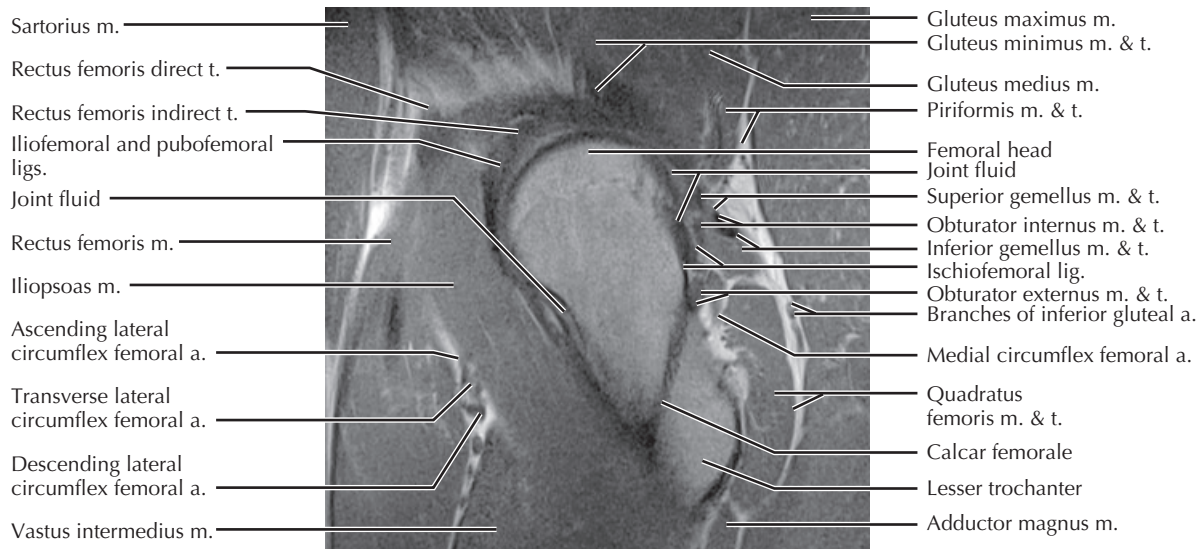
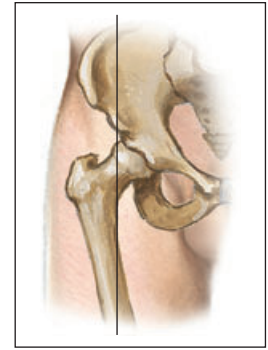


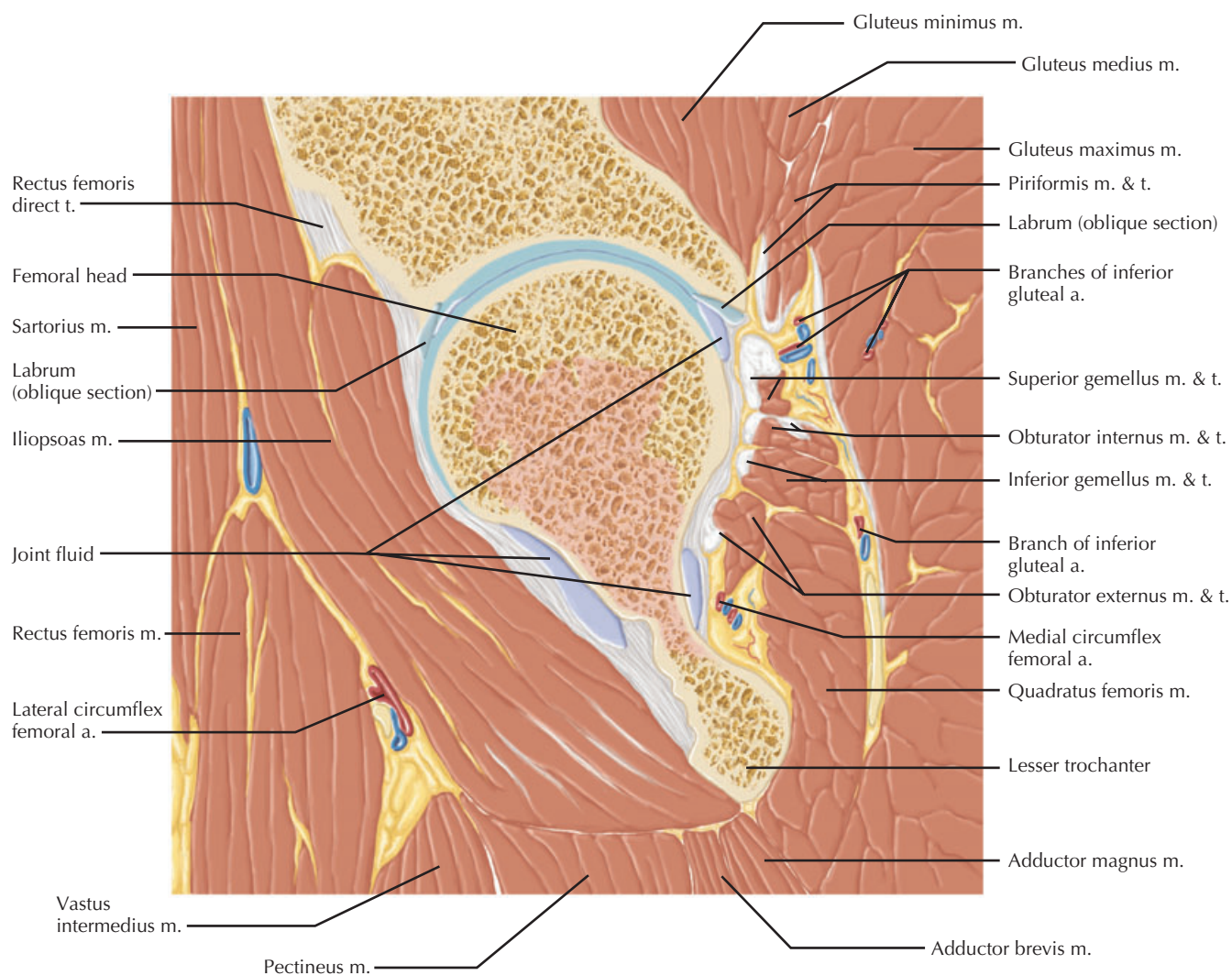






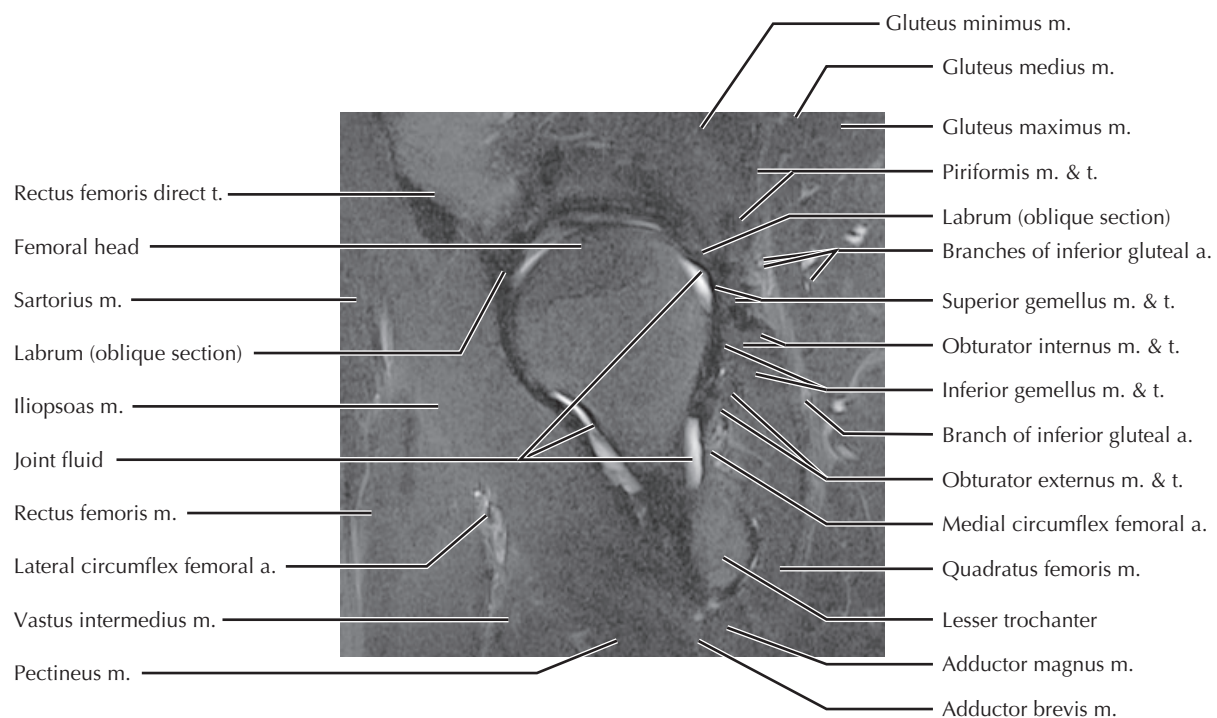
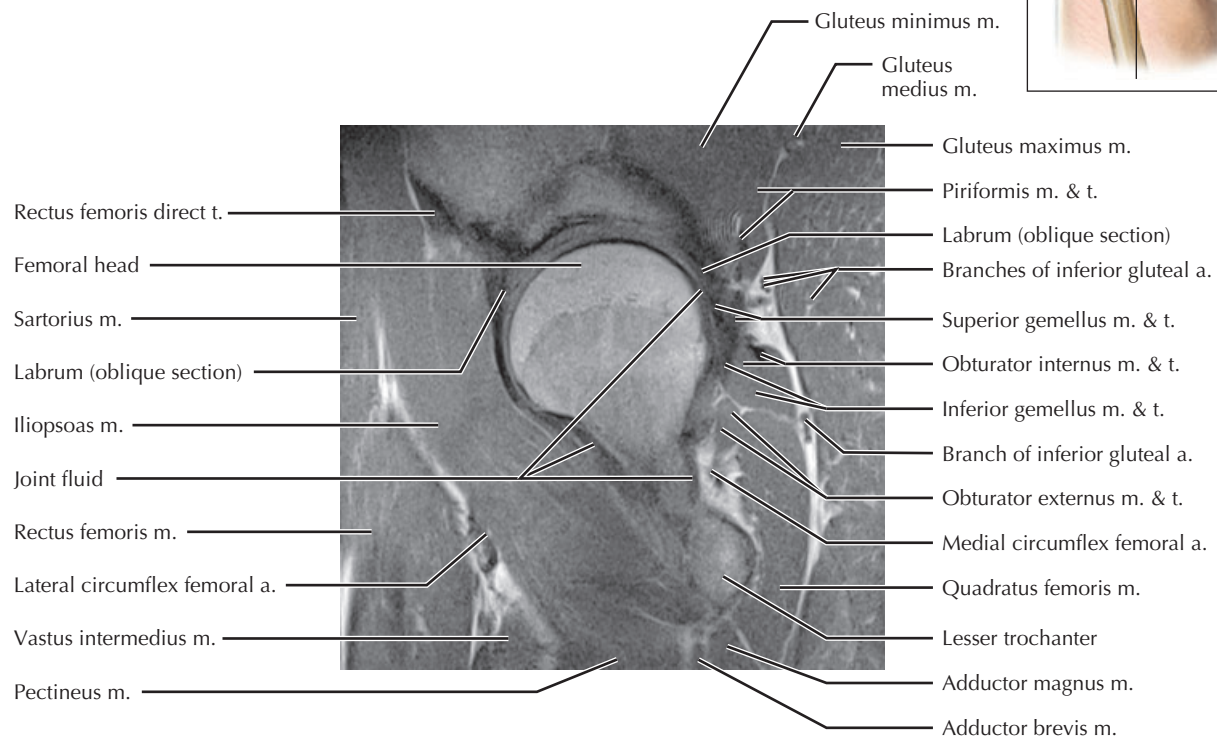
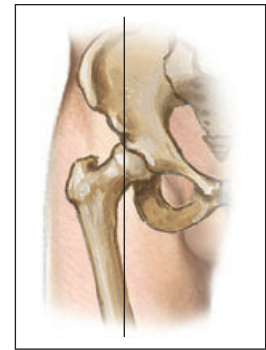


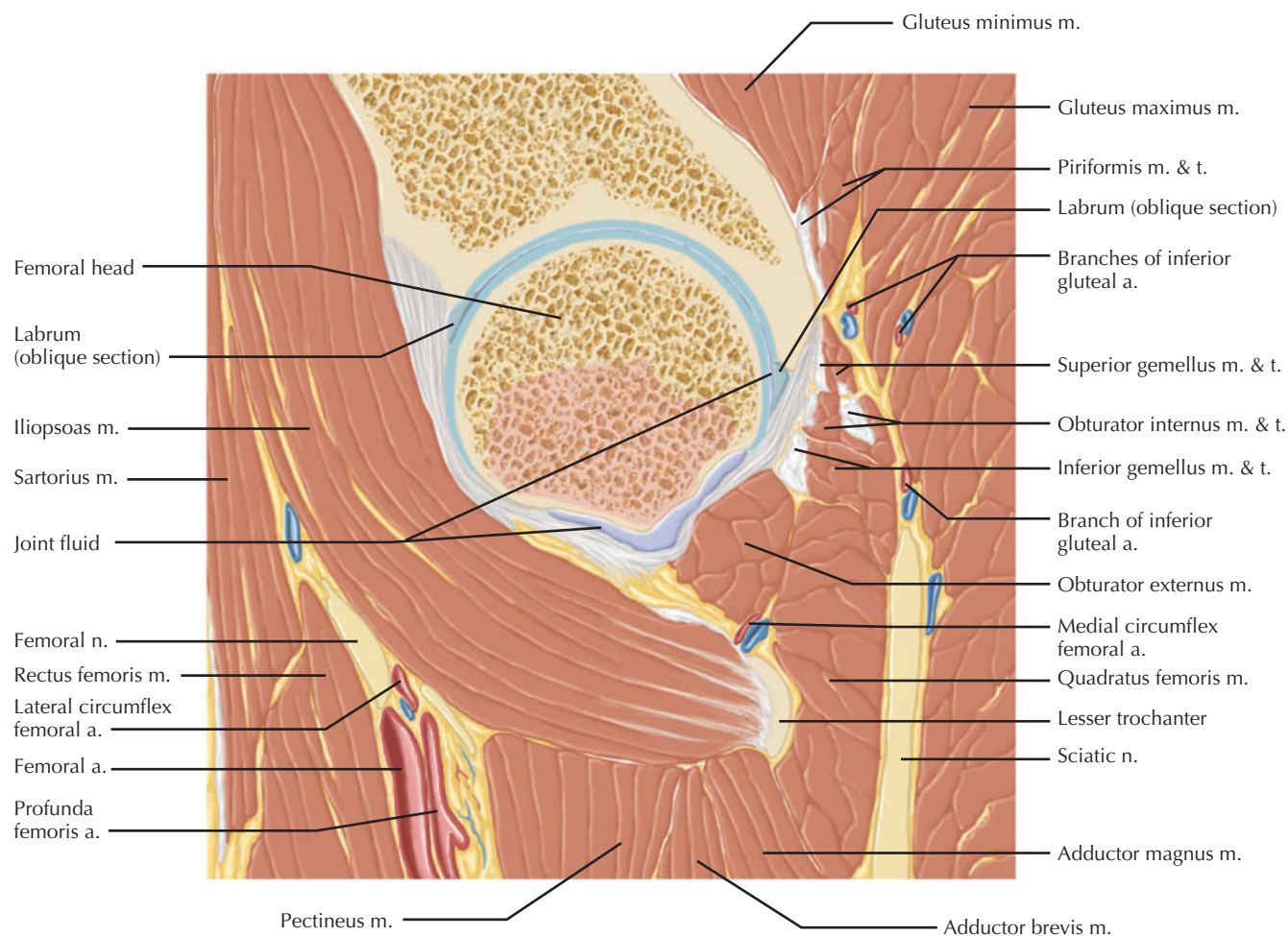




NORMAL ANATOMY

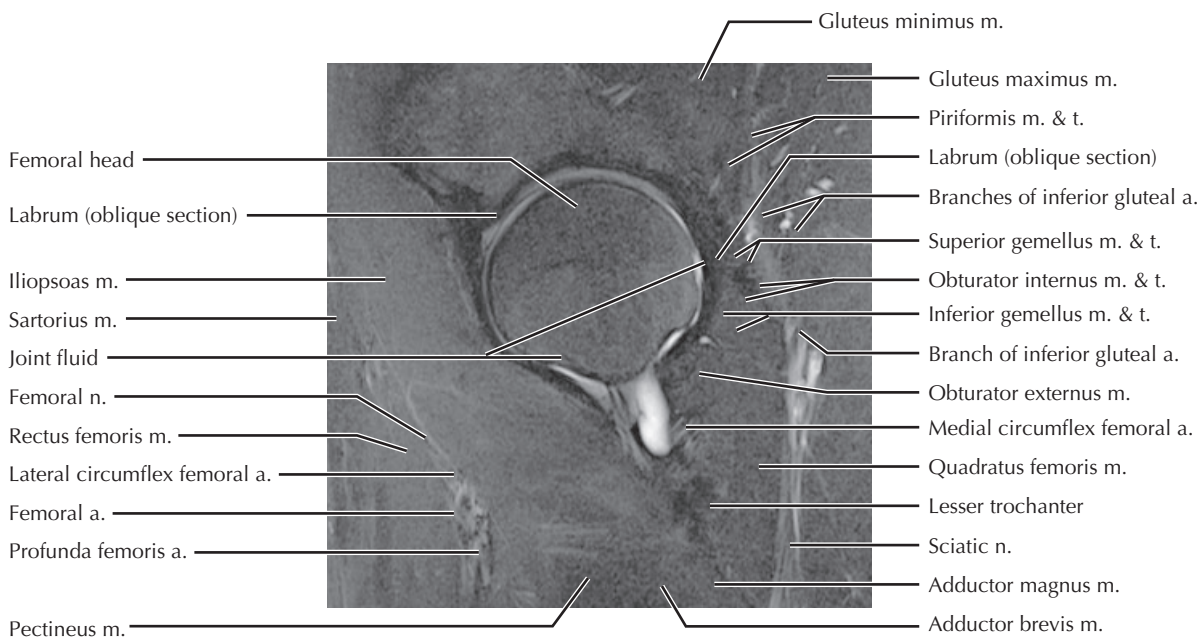
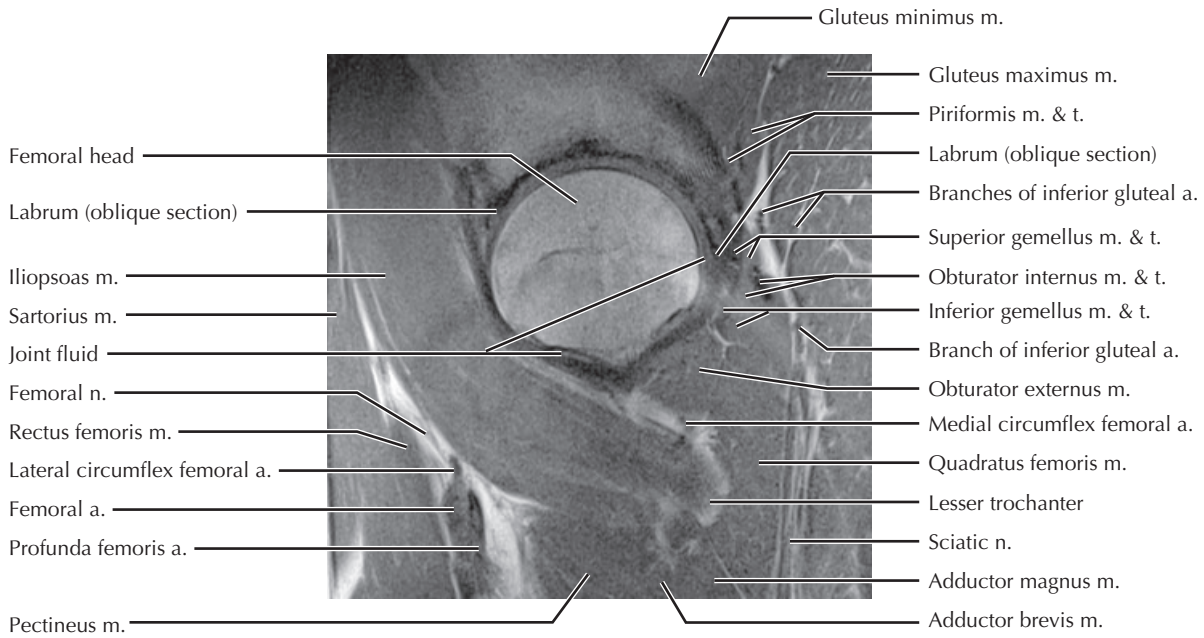
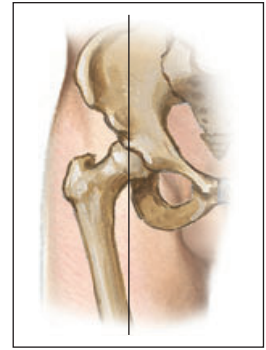
Articular cartilage covers the entire femoral head to the level of the physeal scar, with the exception of the fovea.

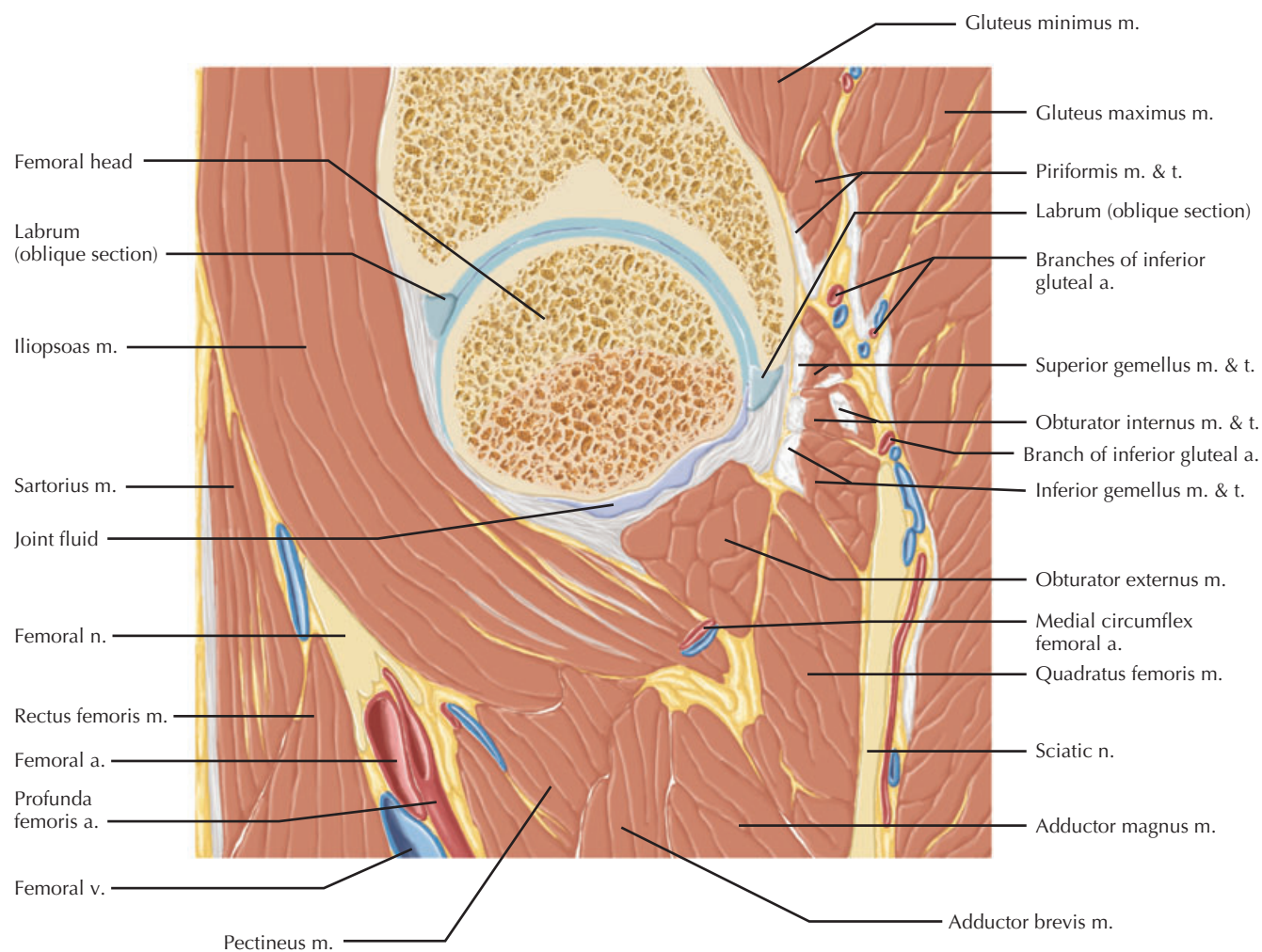


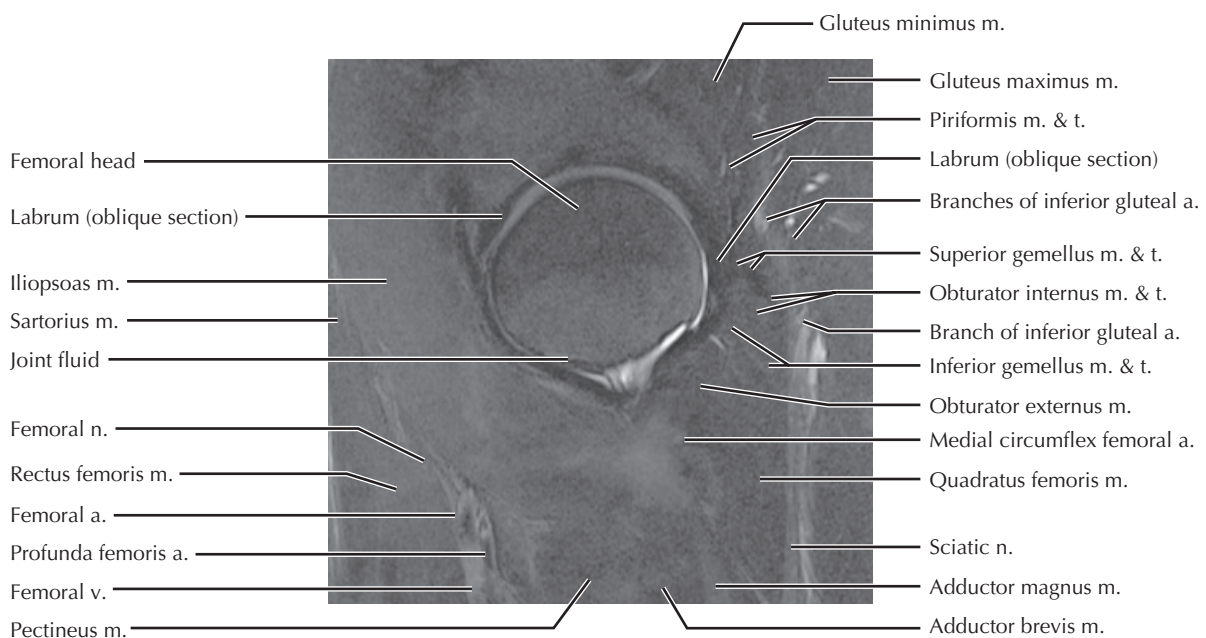
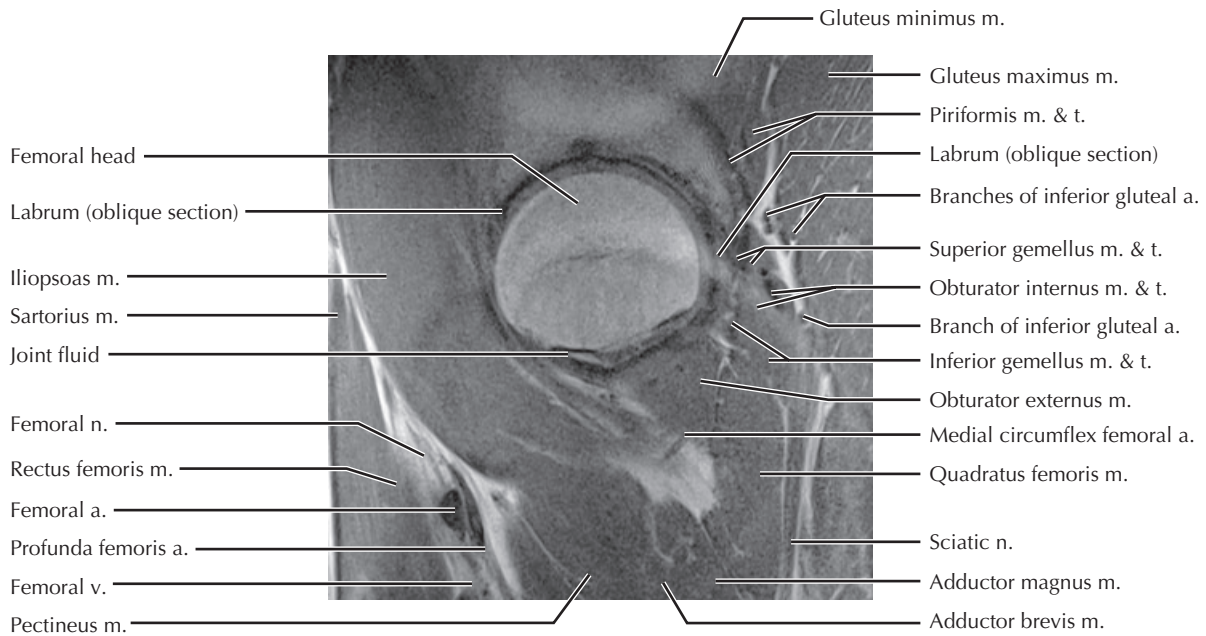
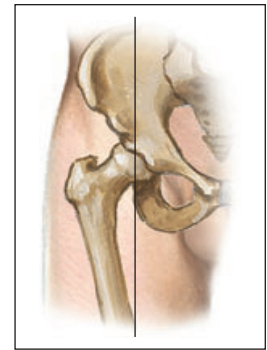


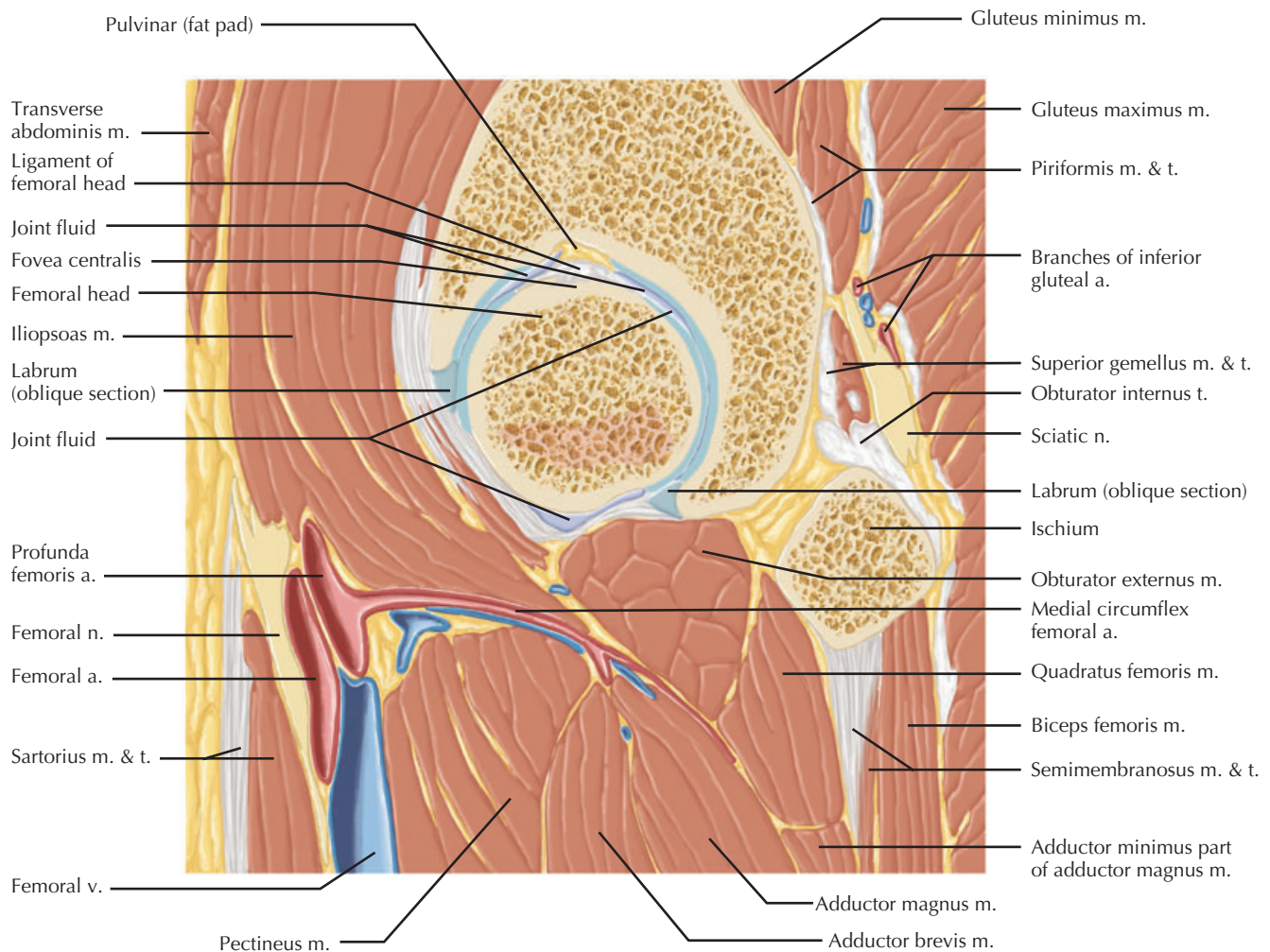
PATHOLOGIC PROCESS

A small para-articular cyst is a strong indicator of an associated labral tear.



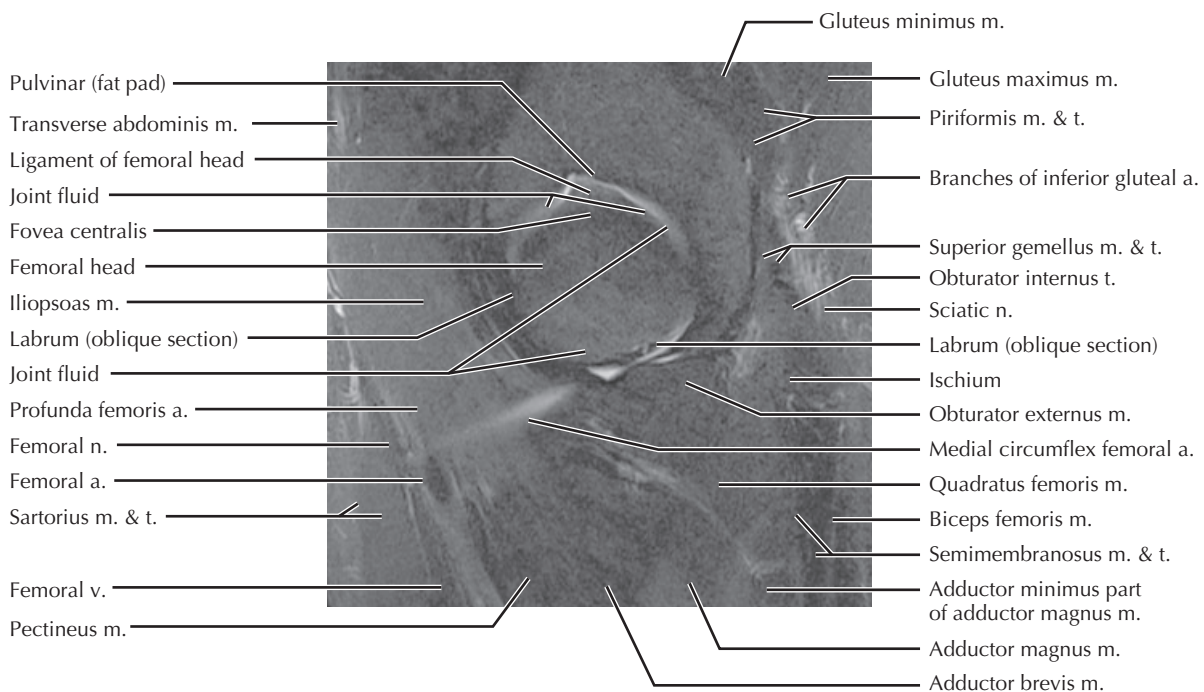
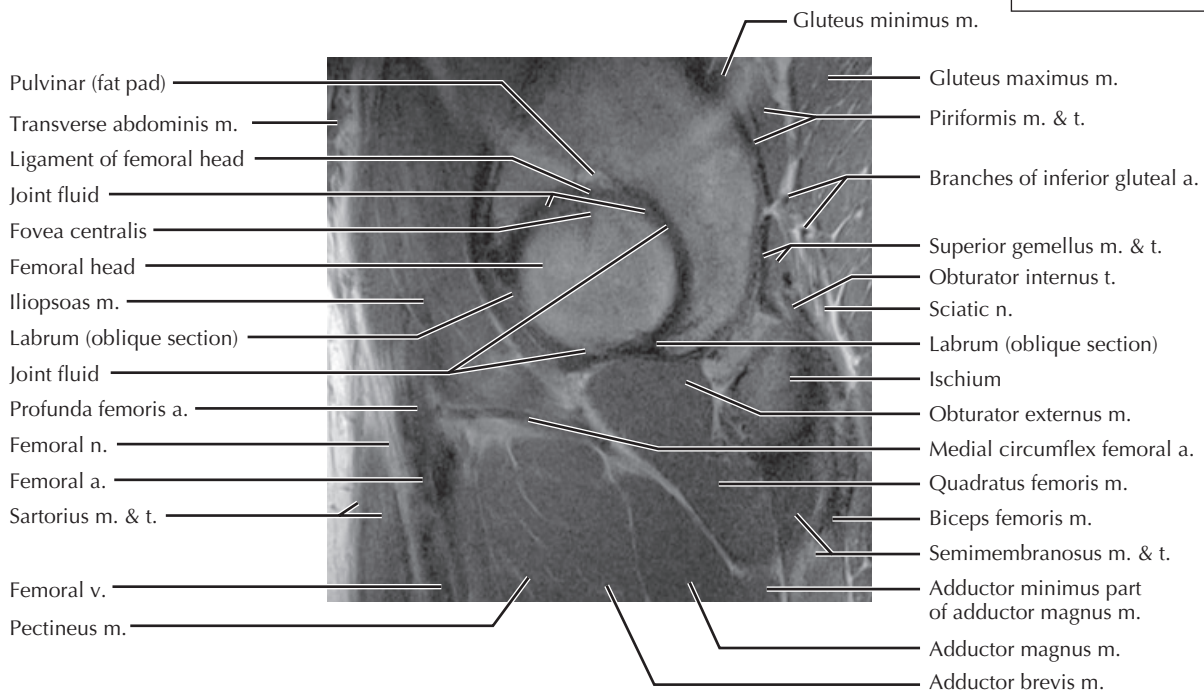
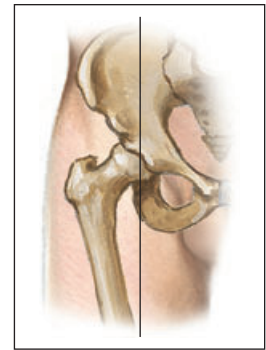


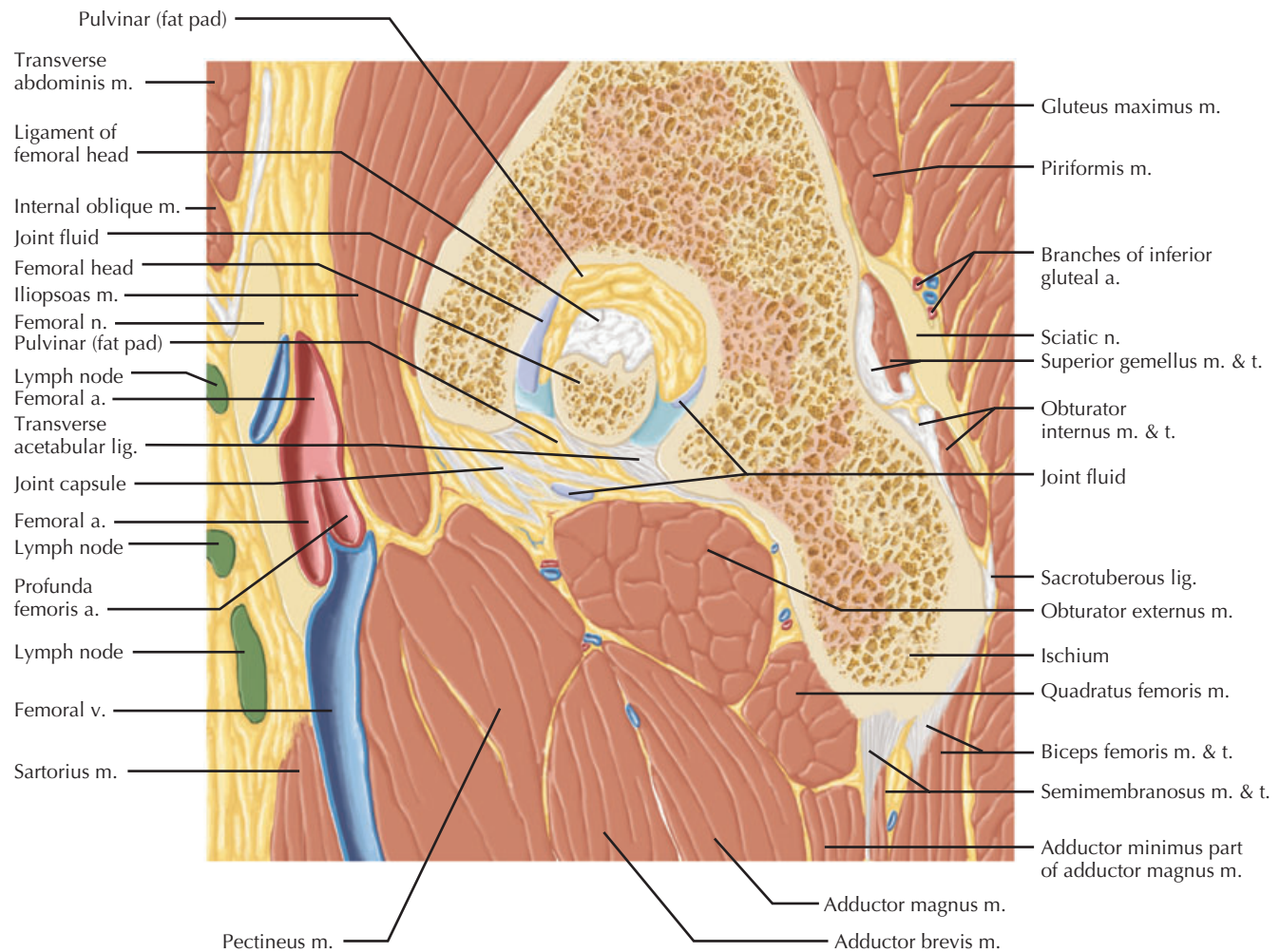


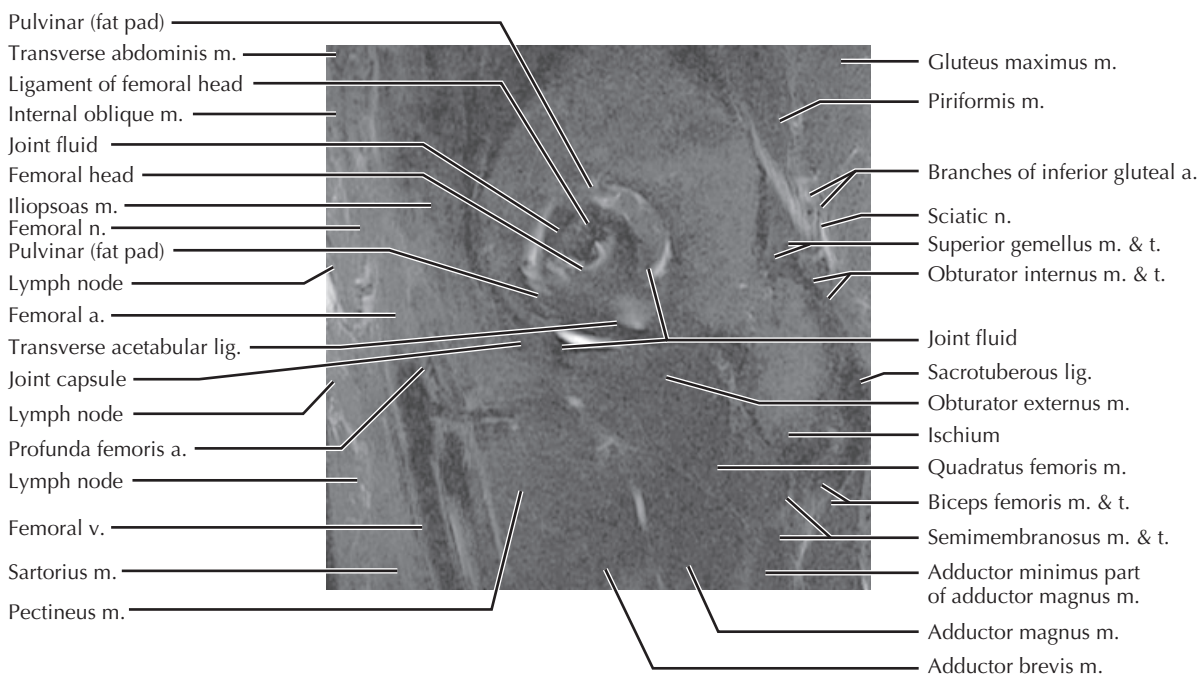
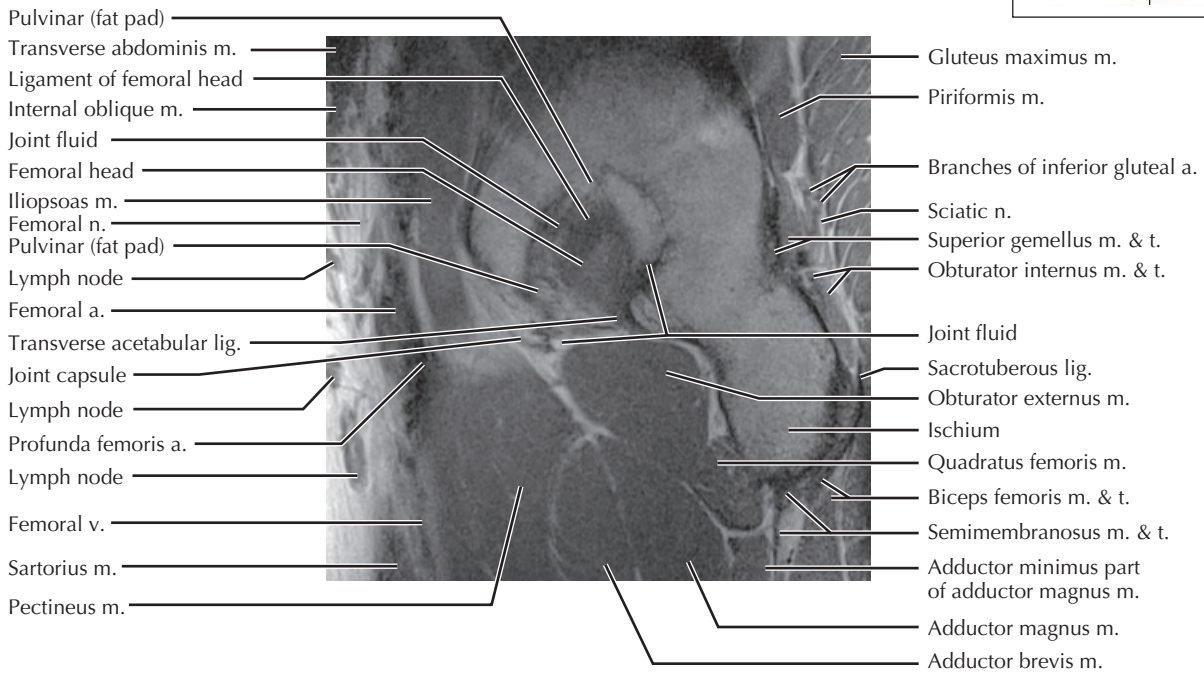
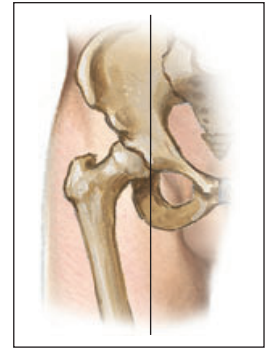


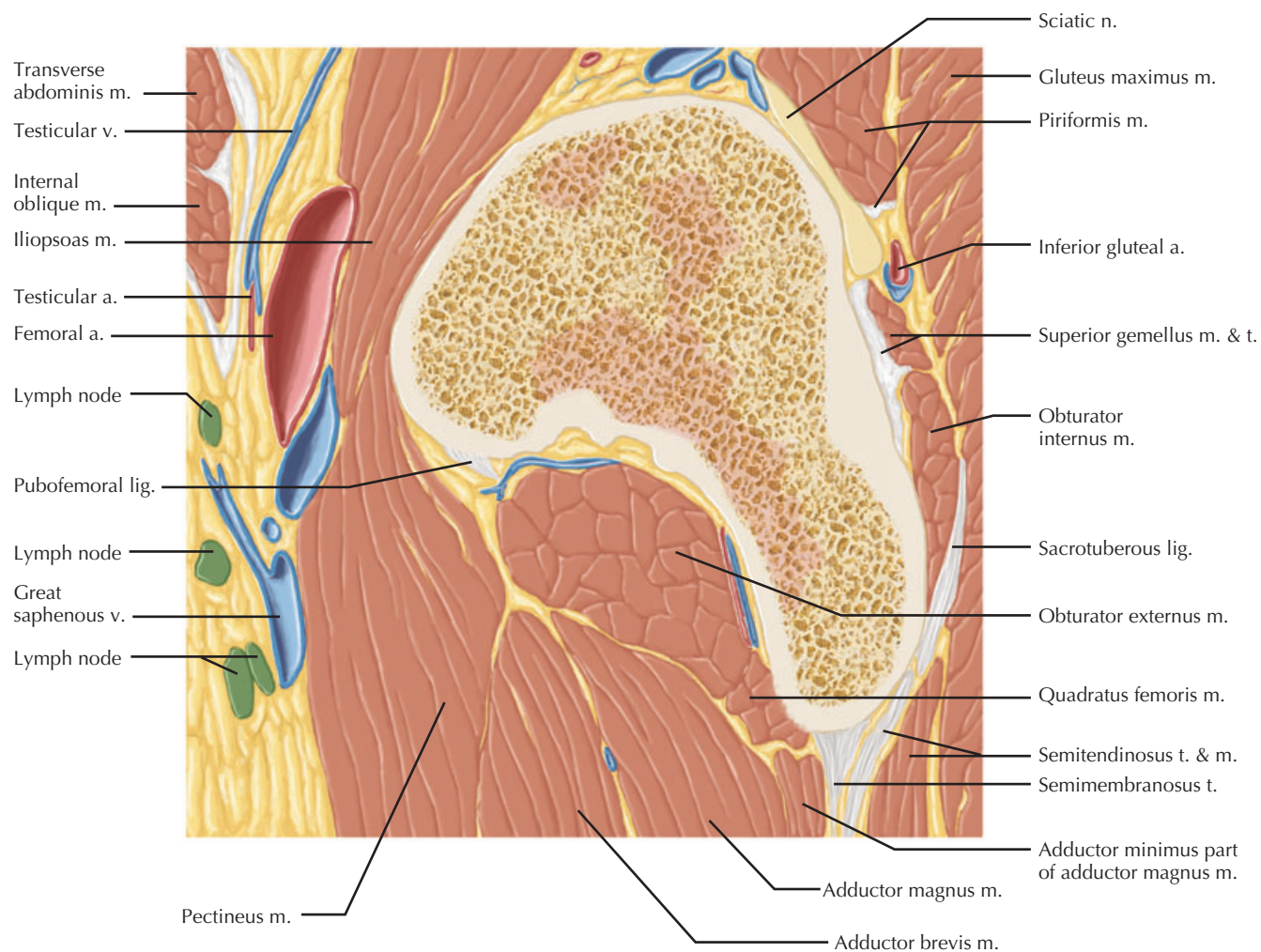
PATHOLOGIC PROCESS

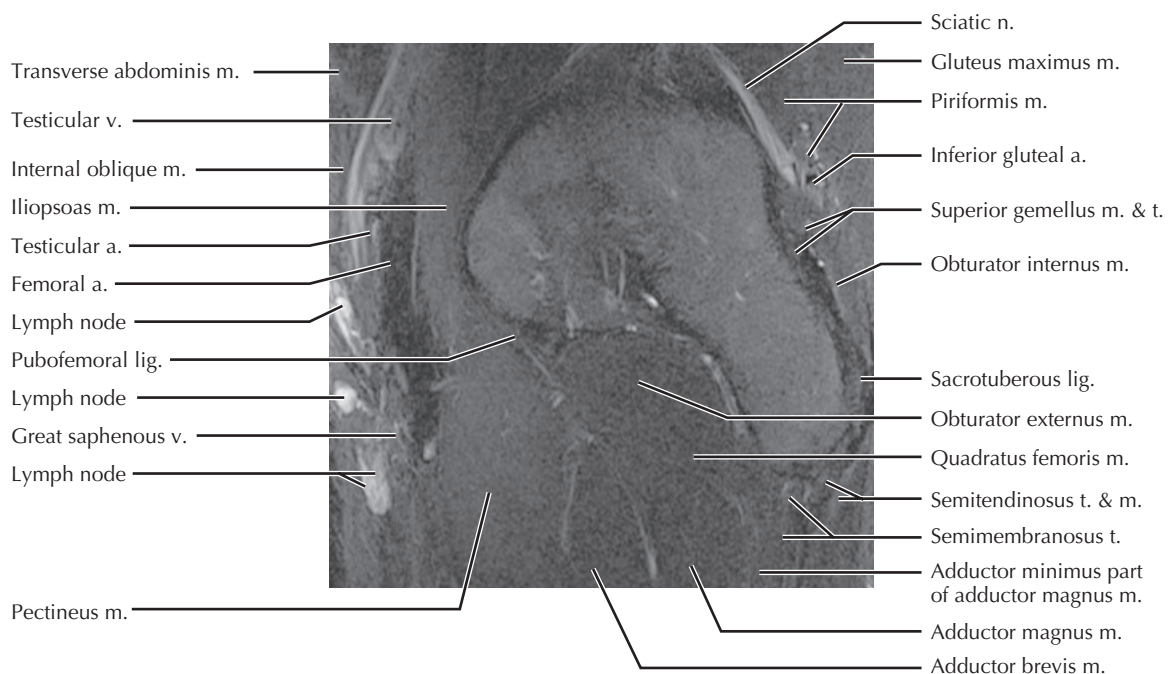
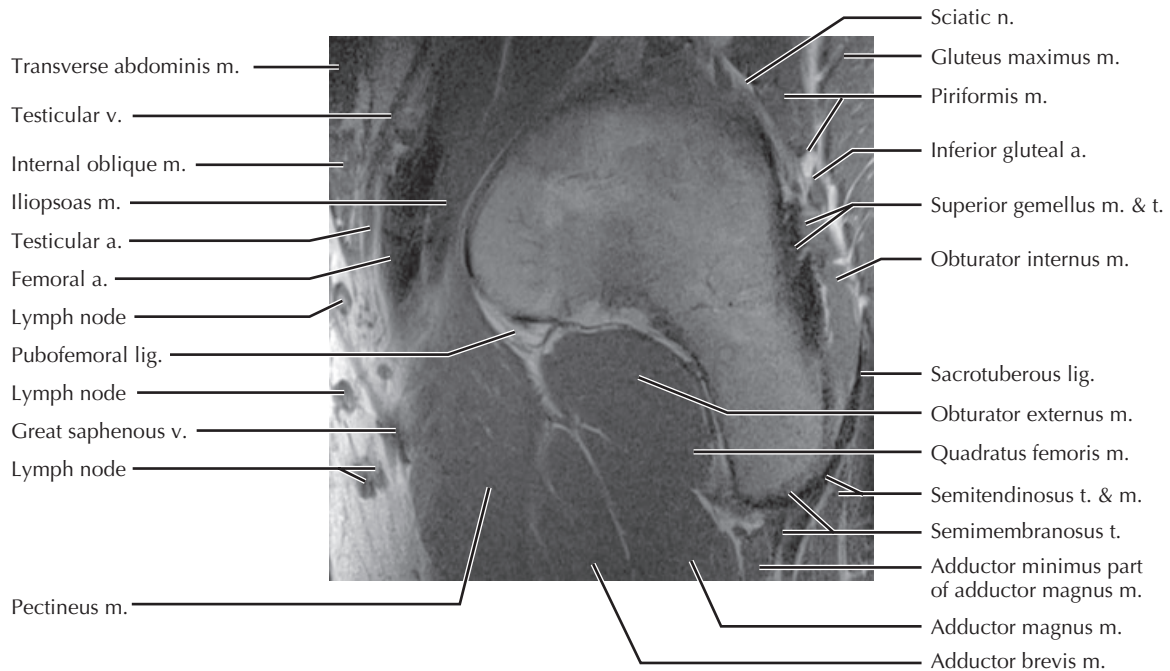
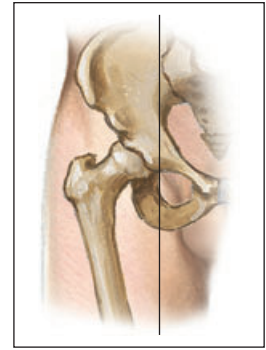
Osteonecrosis is seen as an area of curvilinear, low-signal lines in the epiphyses. Misinterpretation of osteonecrosis may occur if the examiner is unfamiliar with the presence of red marrow, a synovial herniation pit, or the fovea centralis.









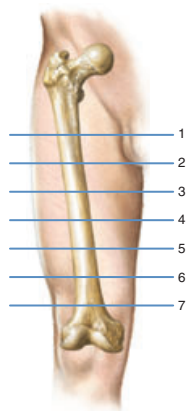


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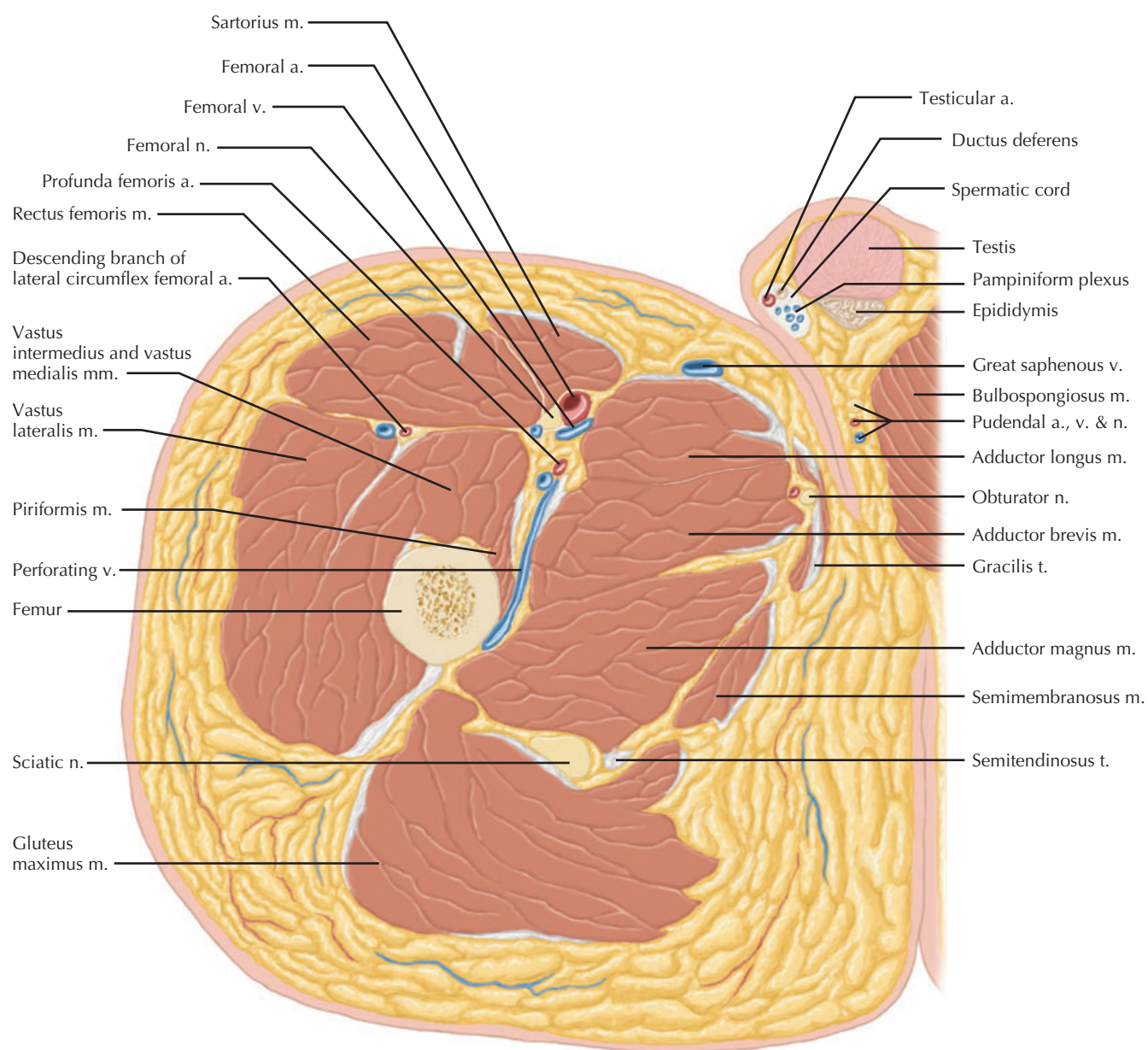
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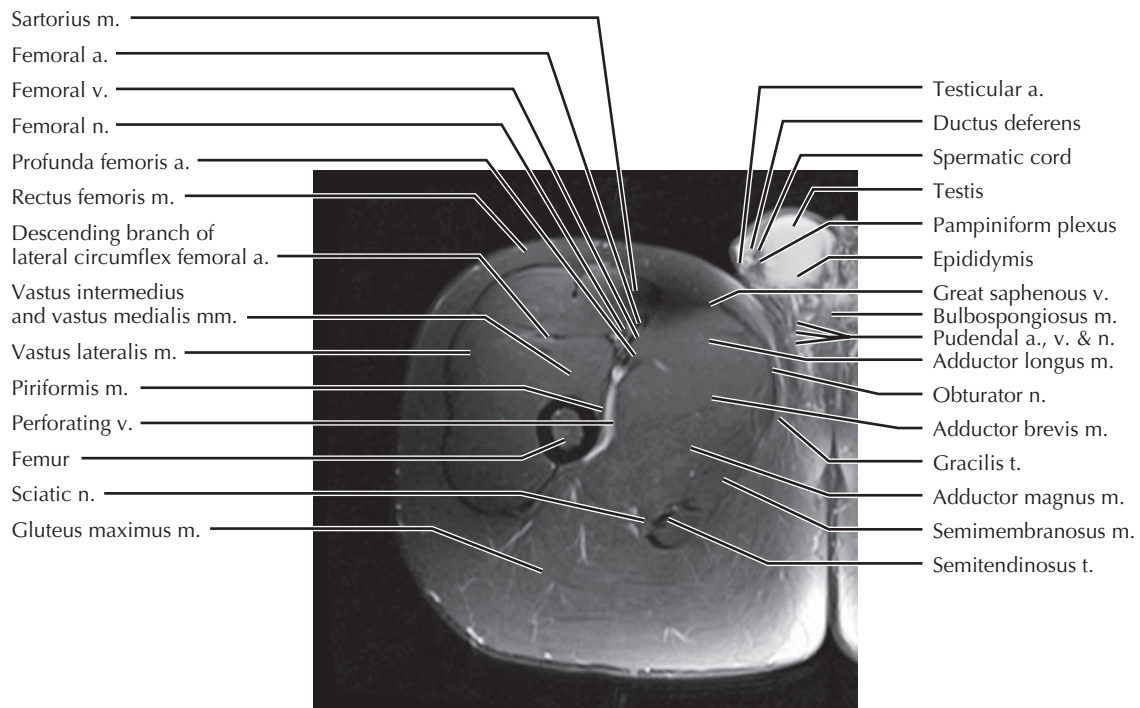
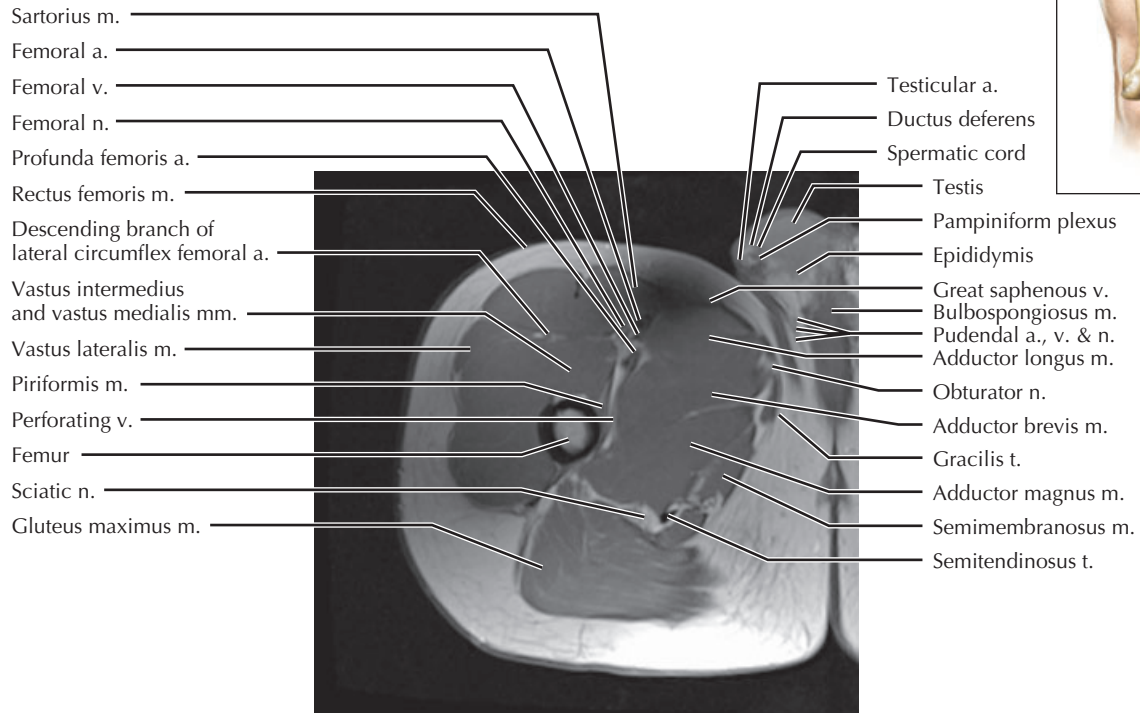
11

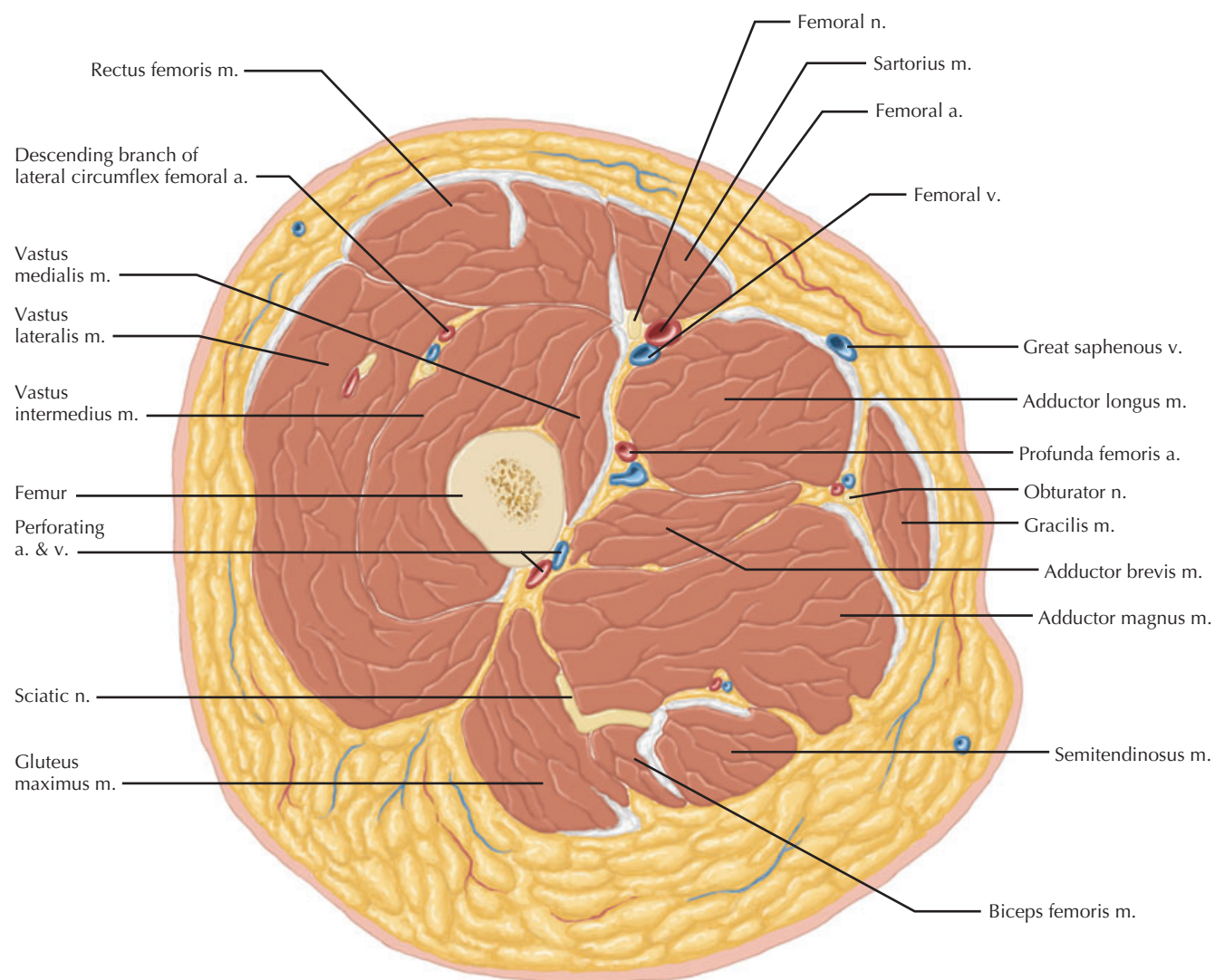
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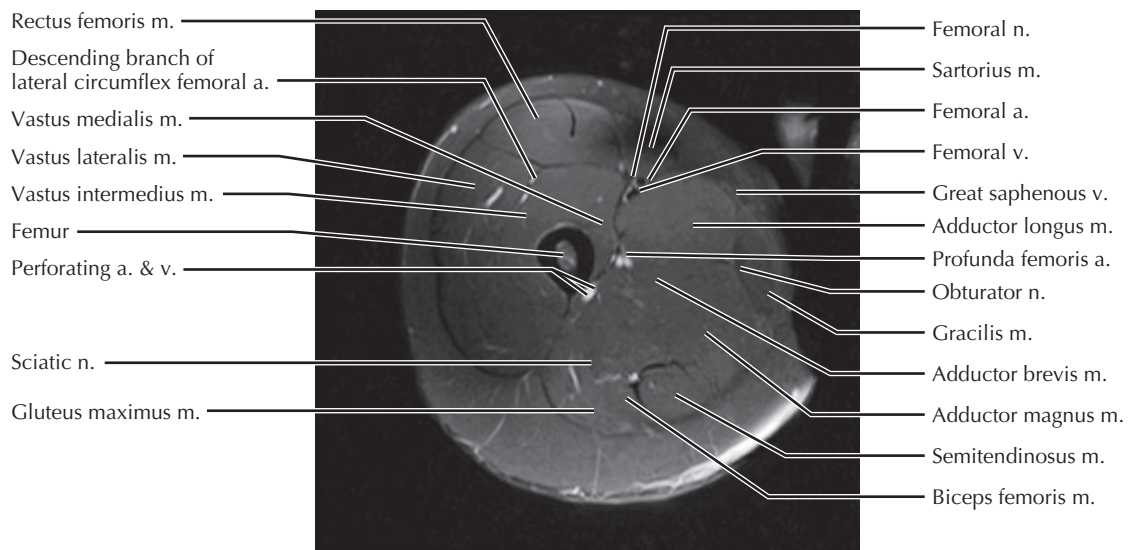
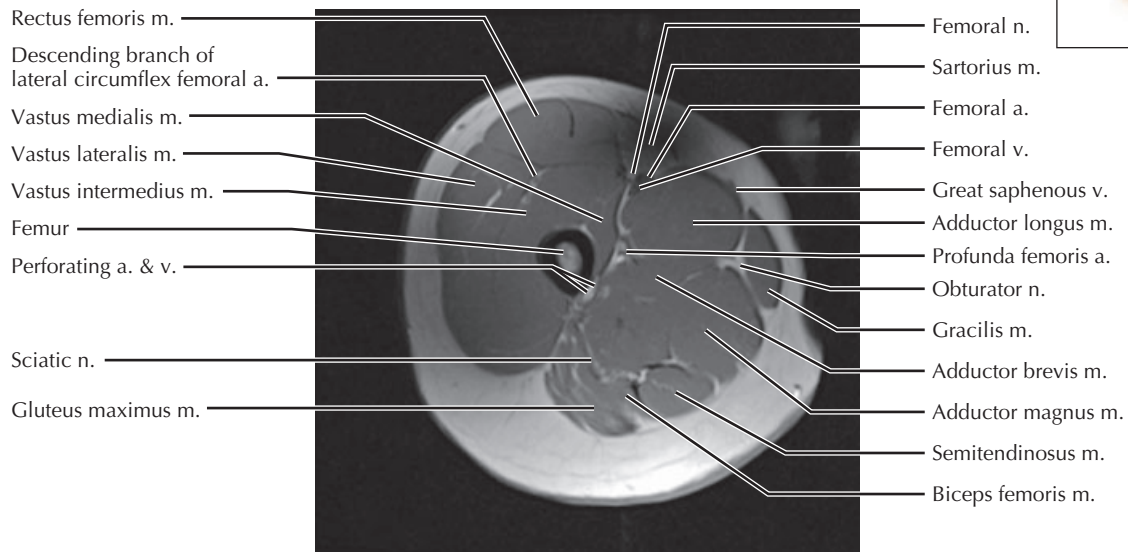


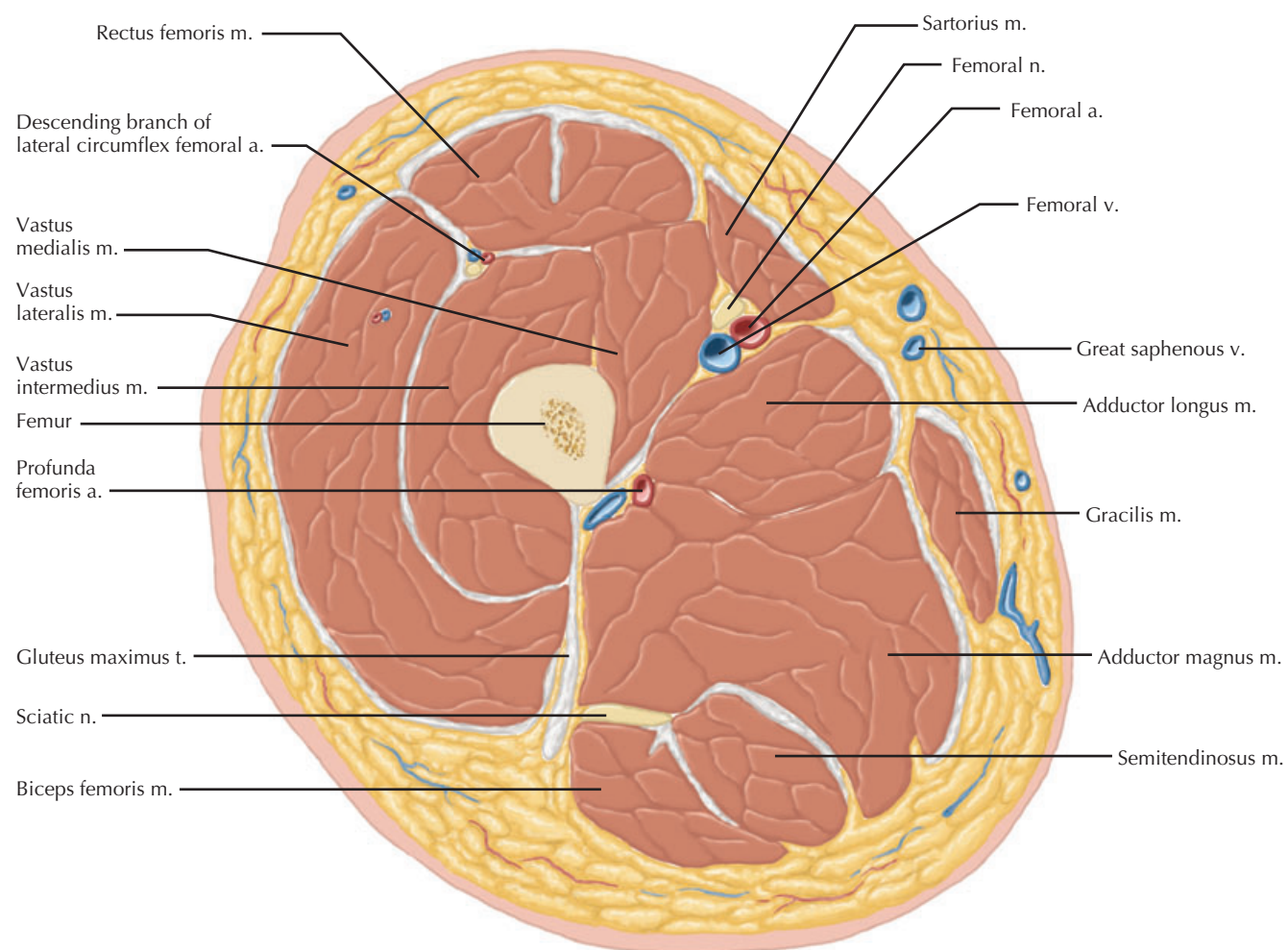
AXIAL 436

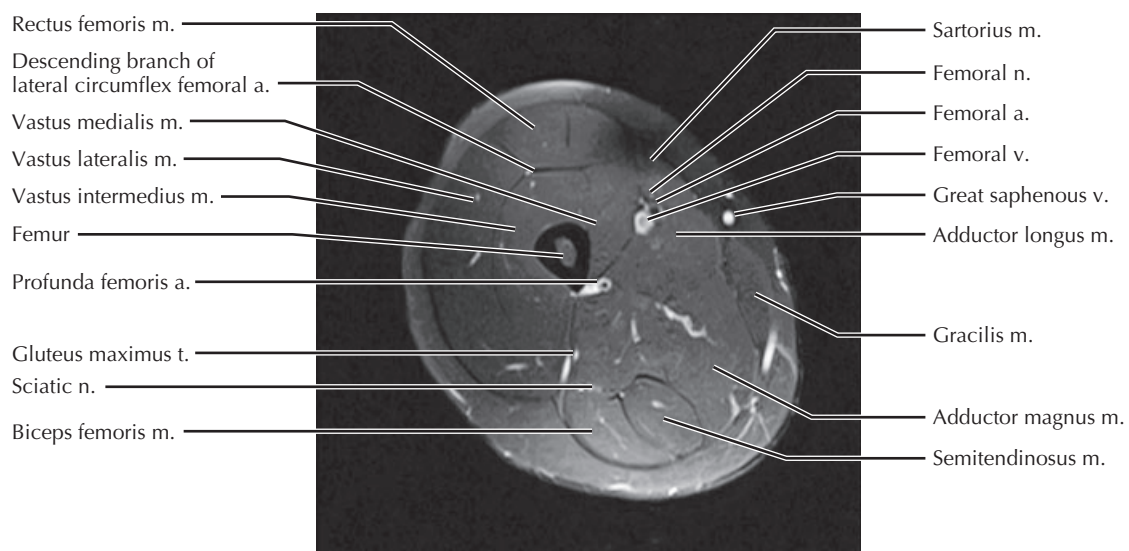
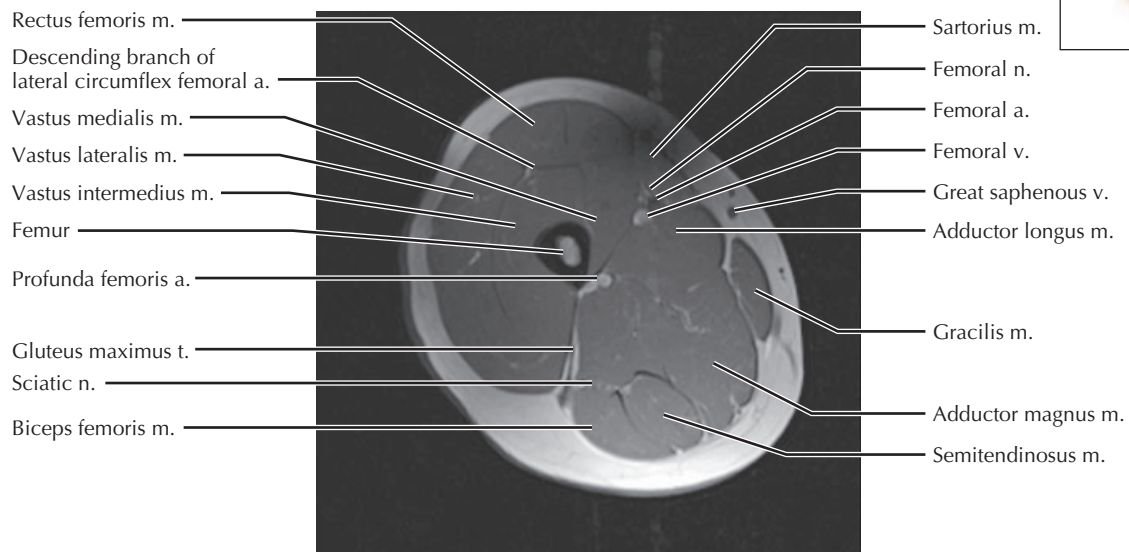
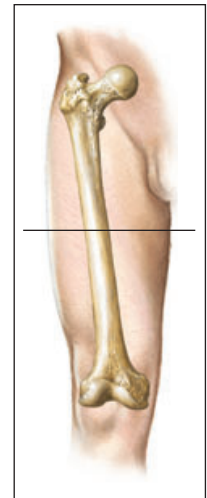


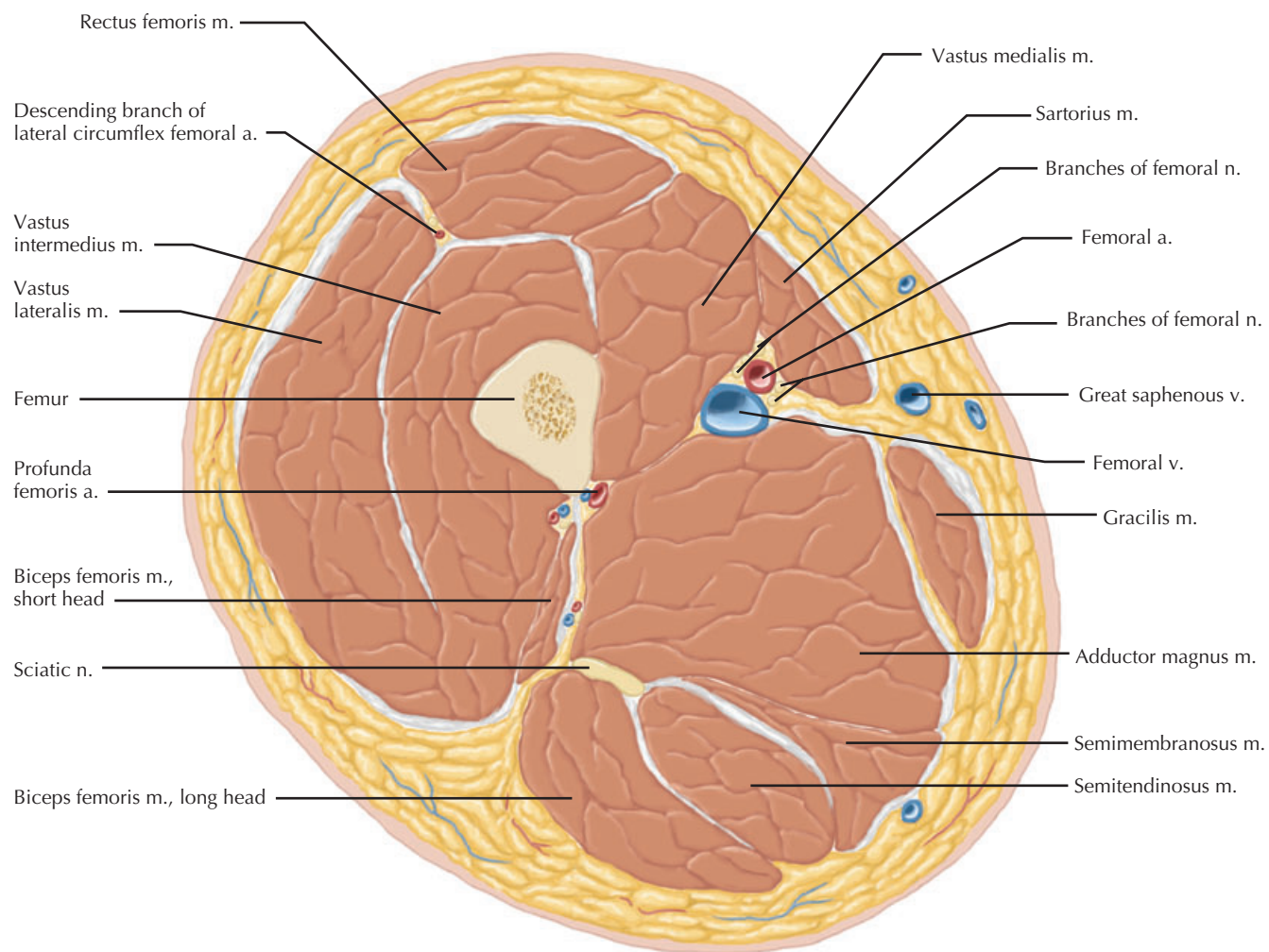


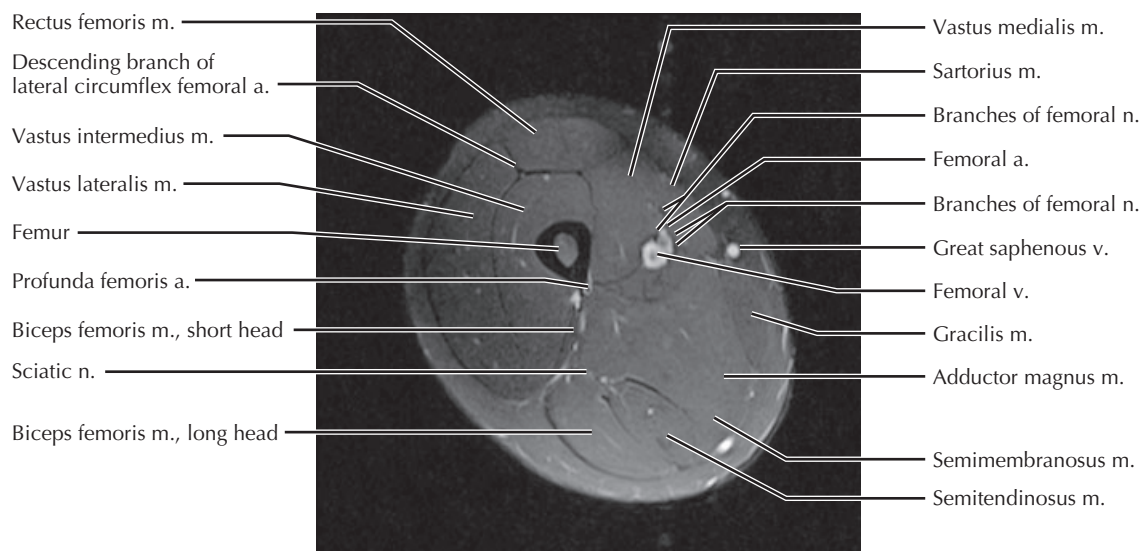
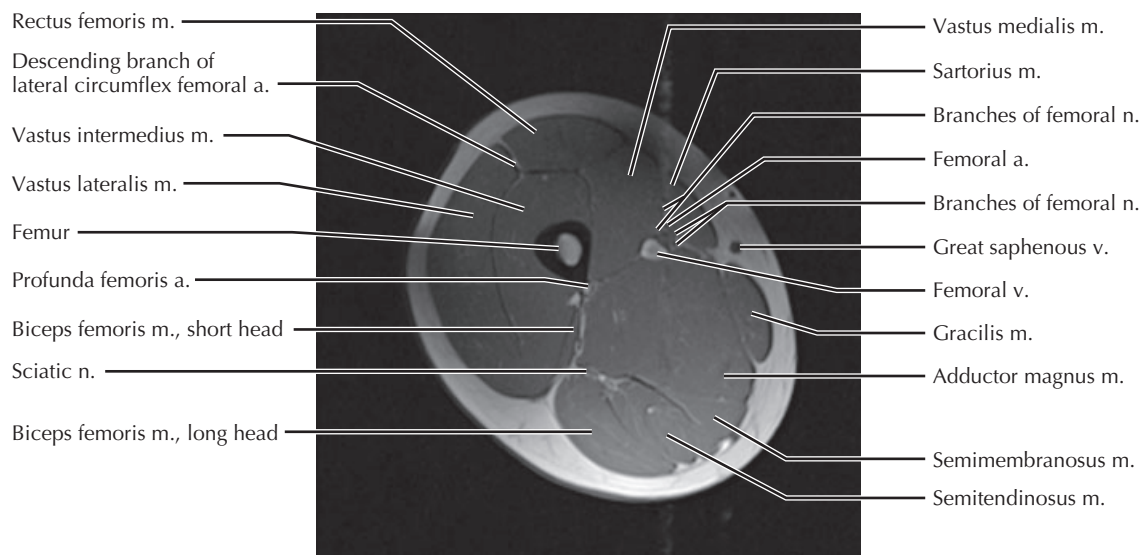
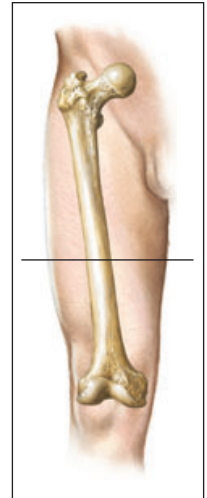


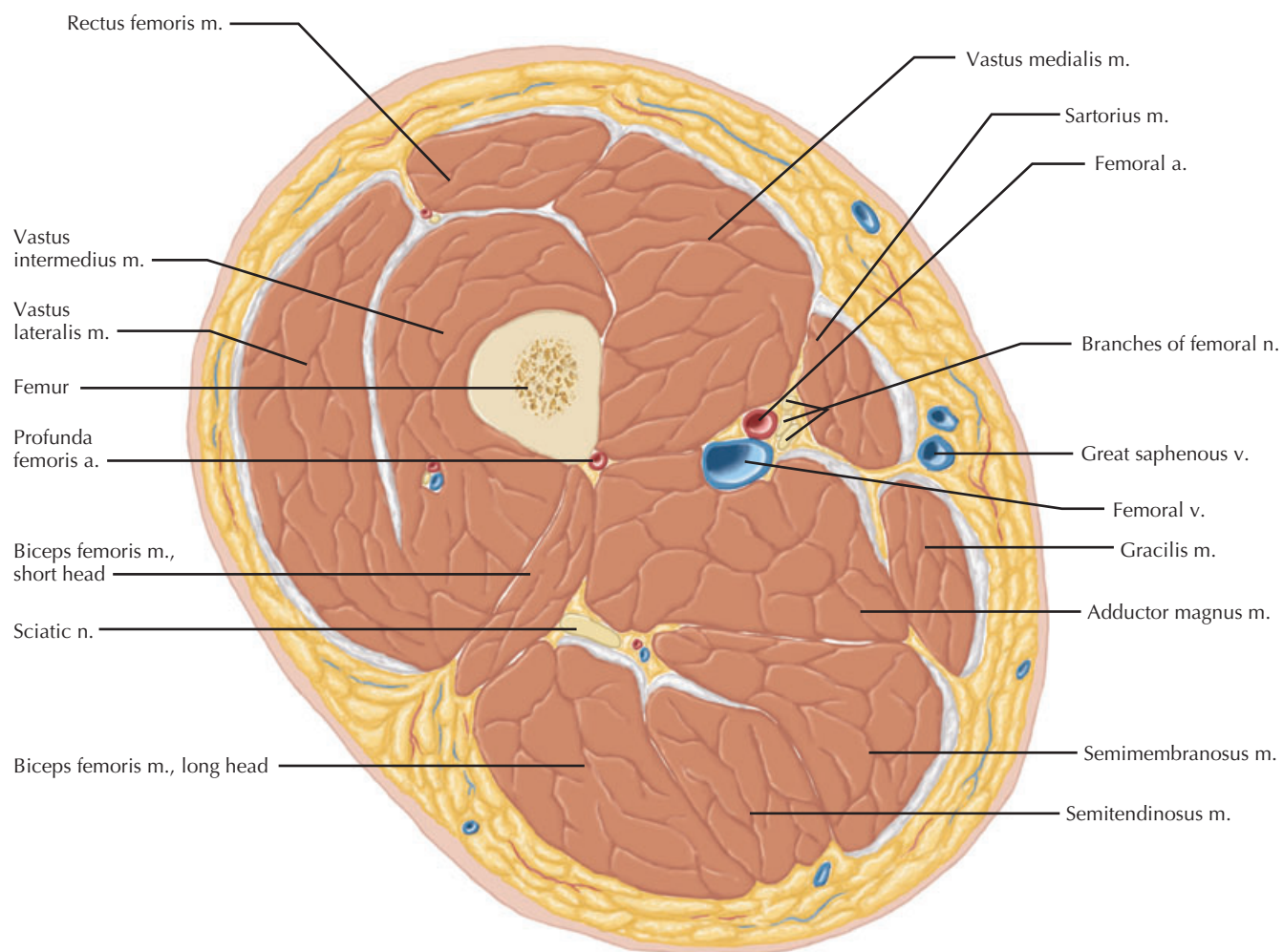


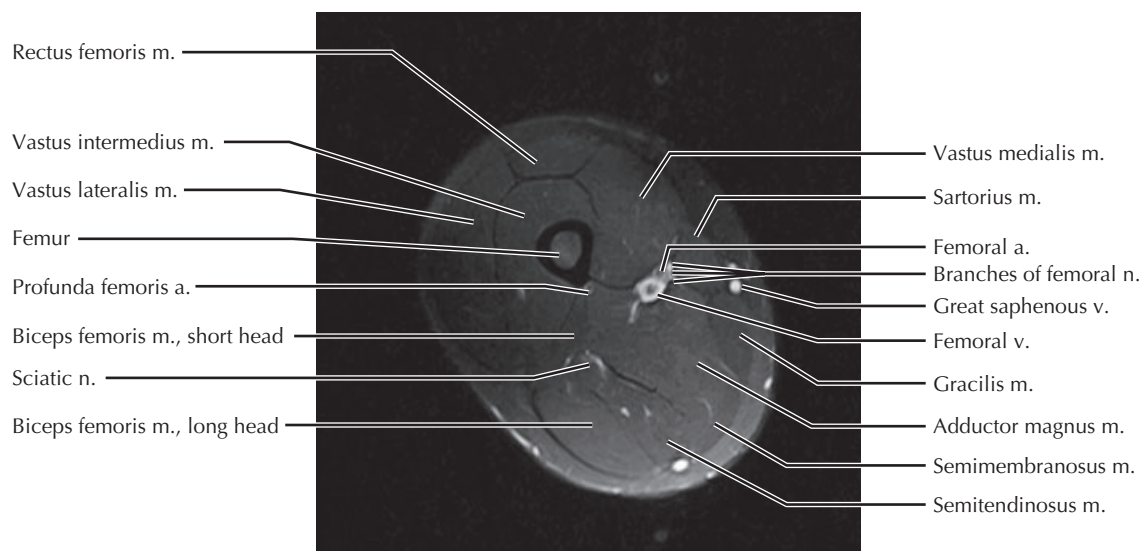
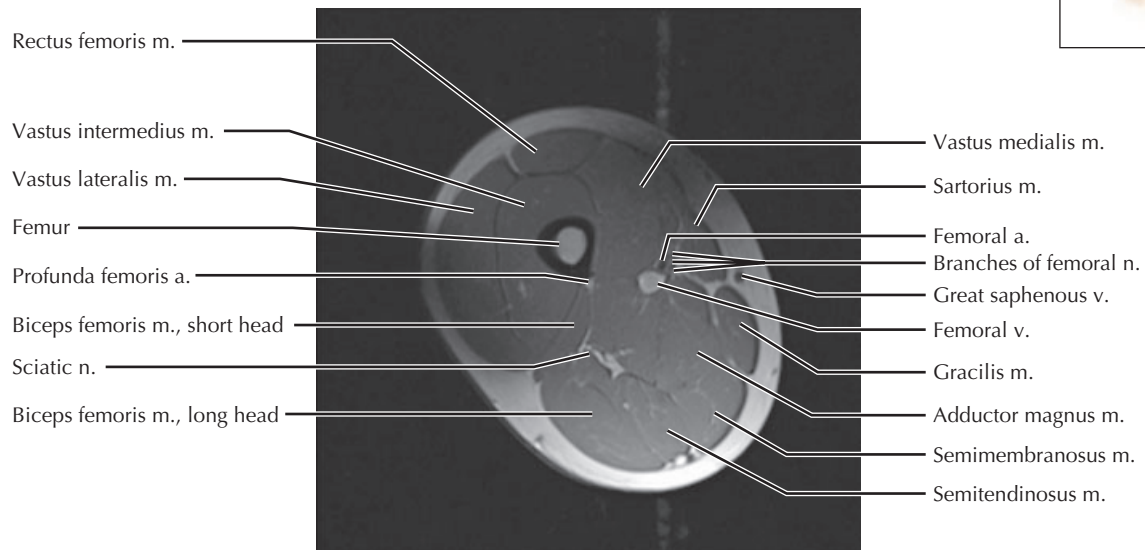
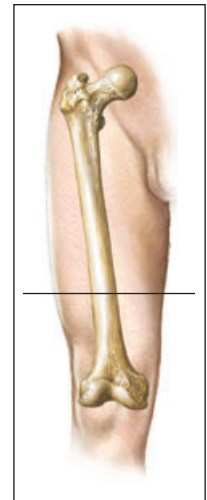


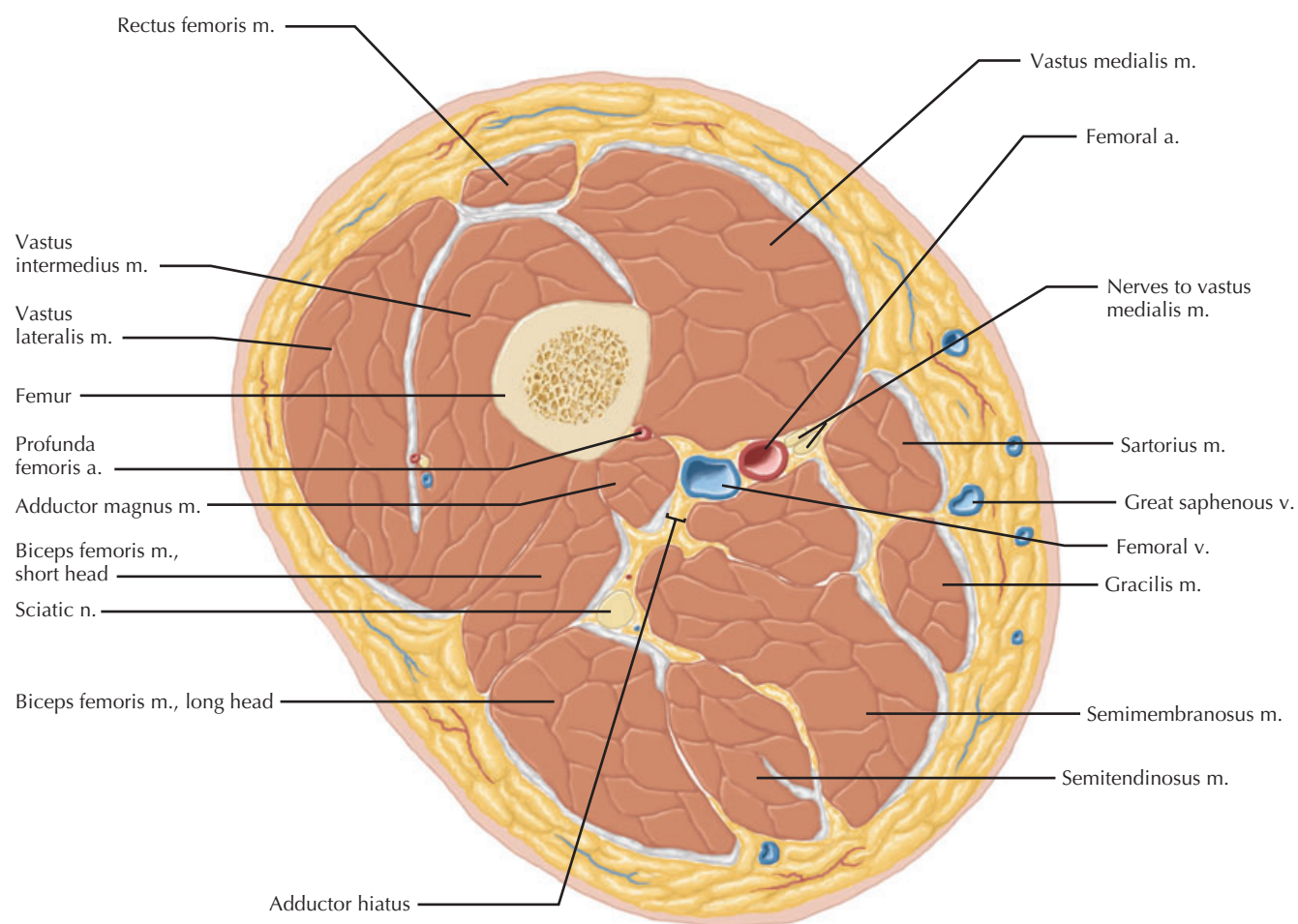


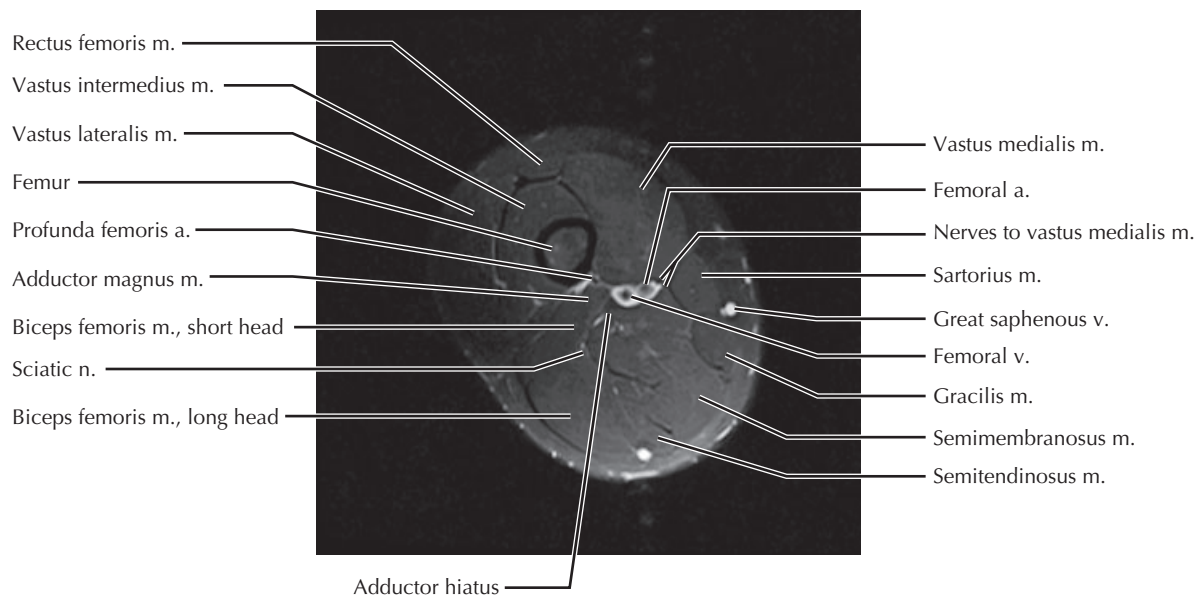
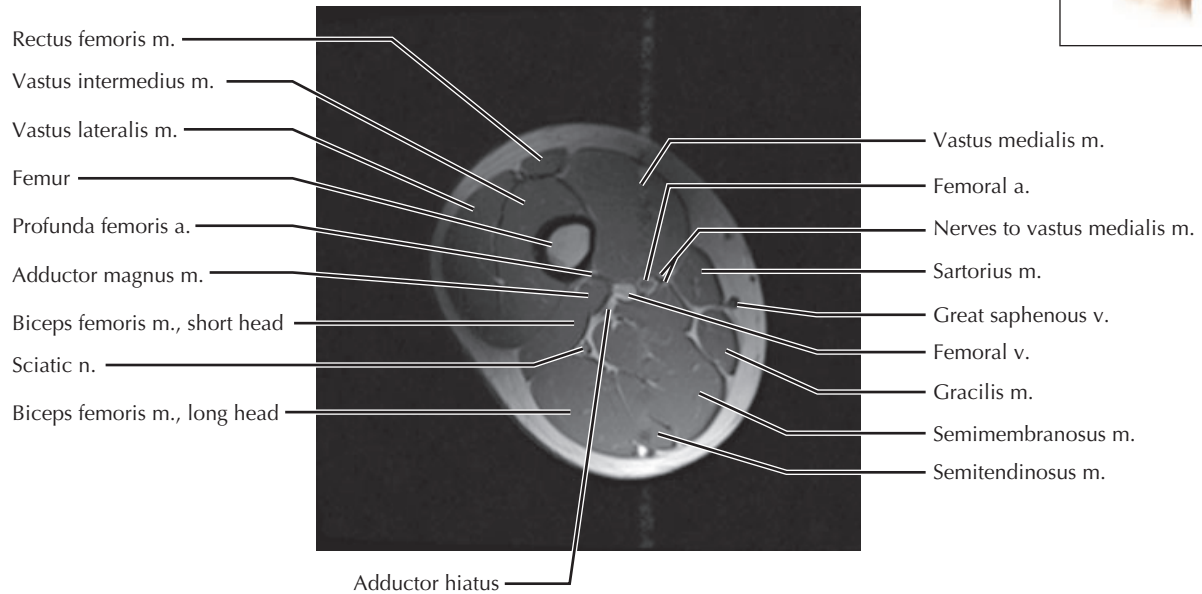


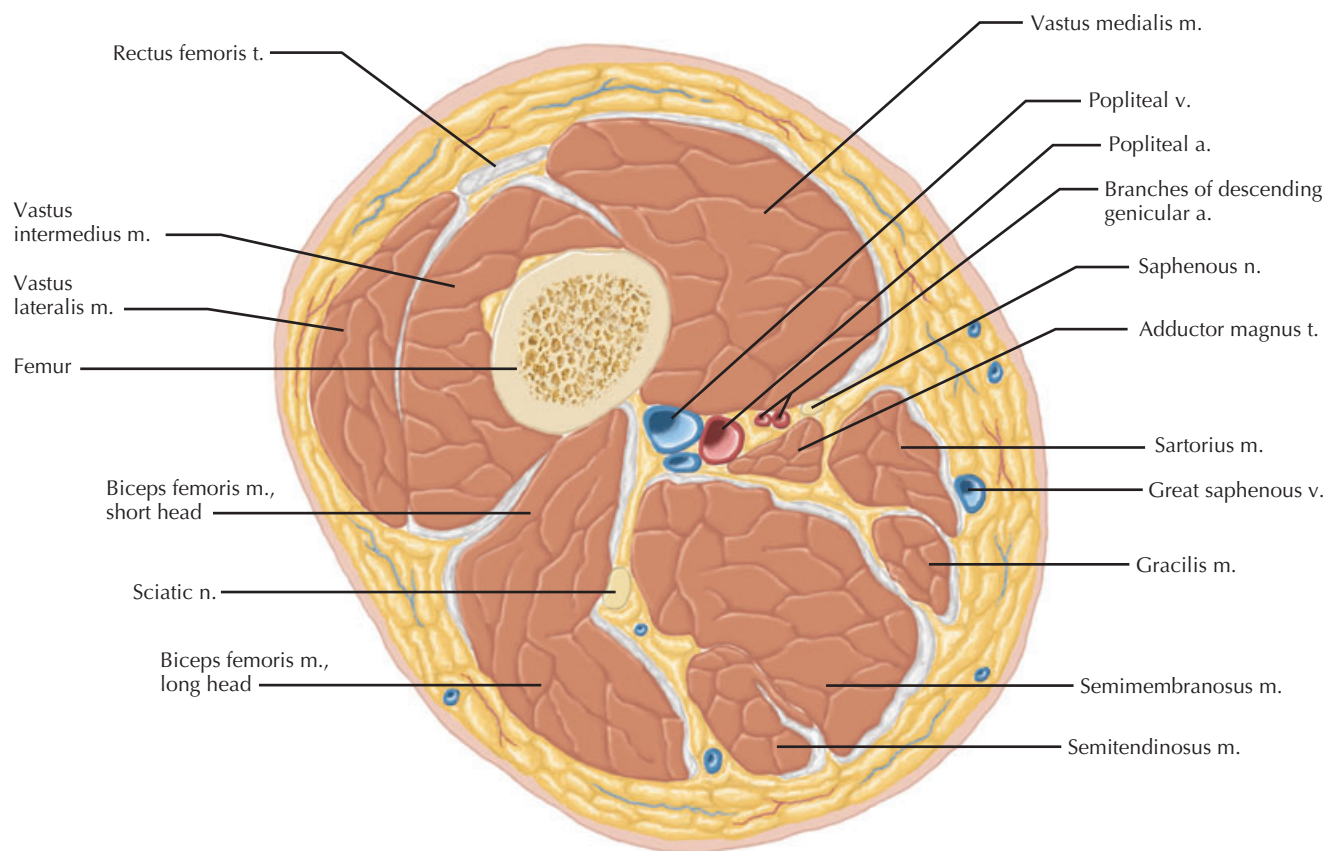


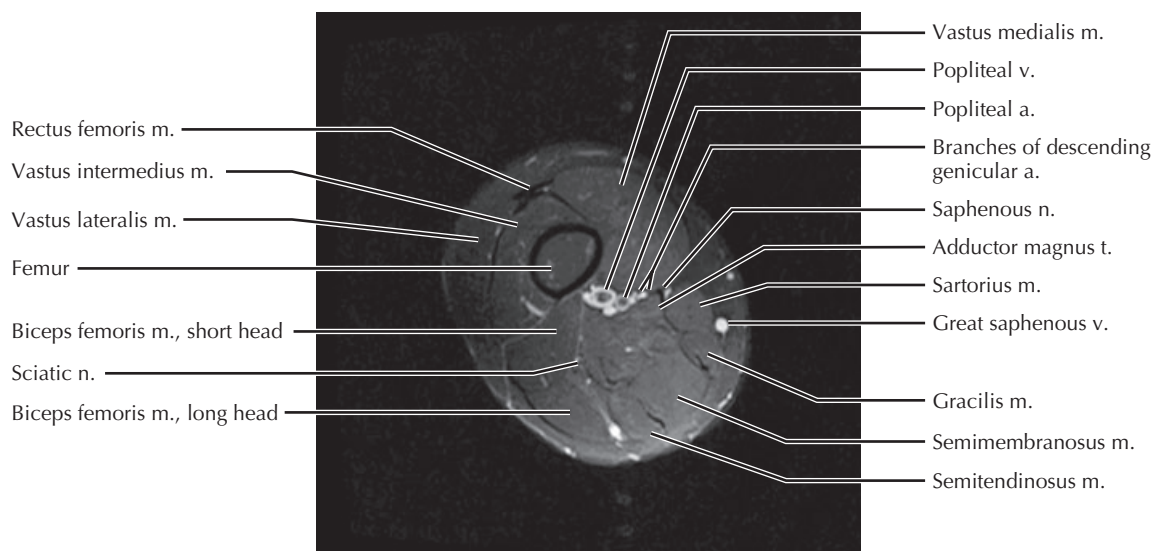
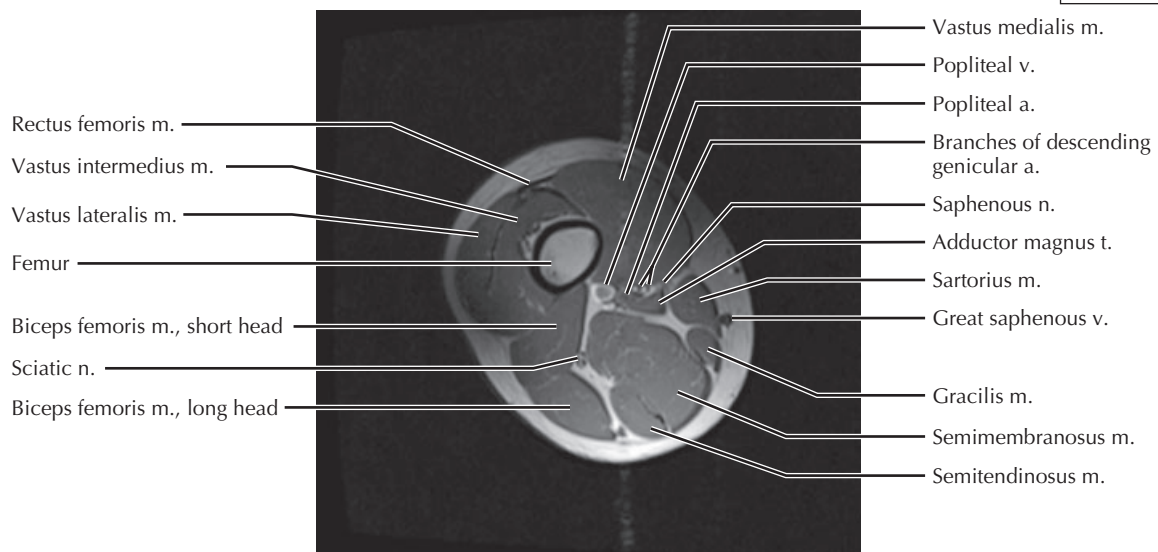










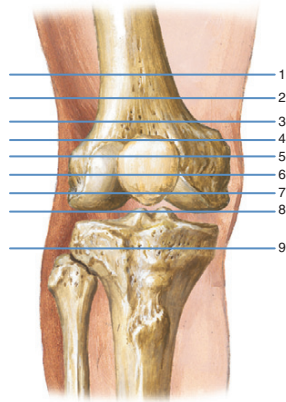


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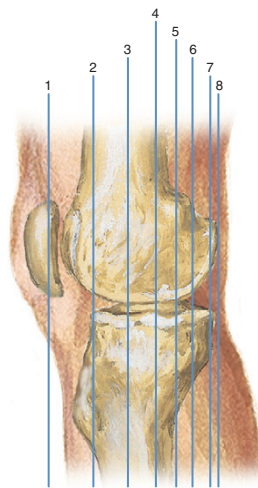
Chapter

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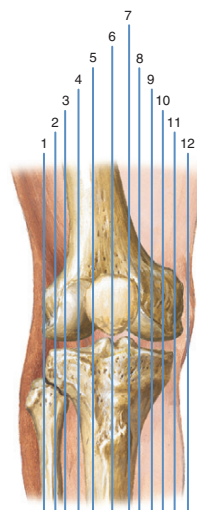
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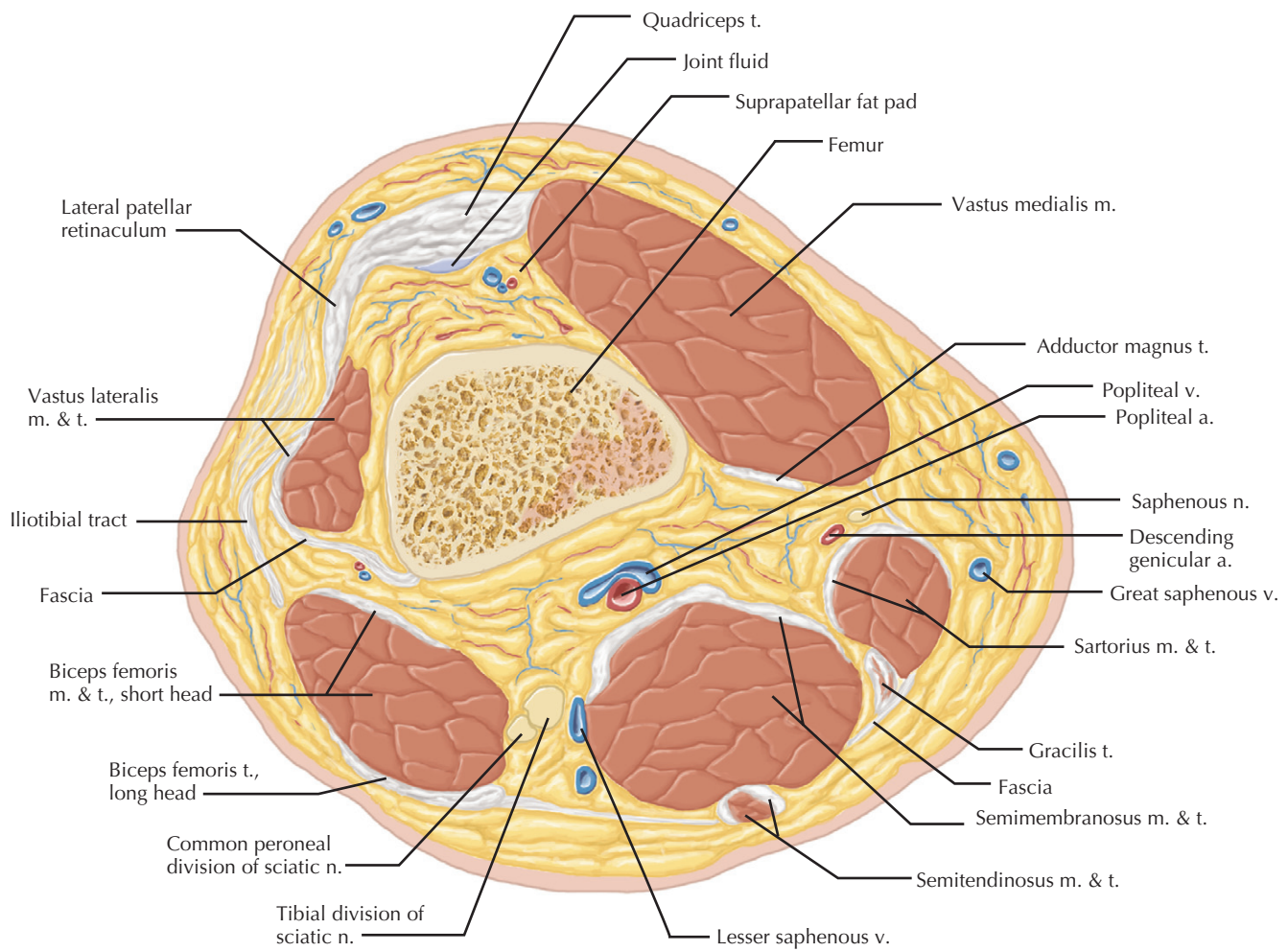
AXIAL 452

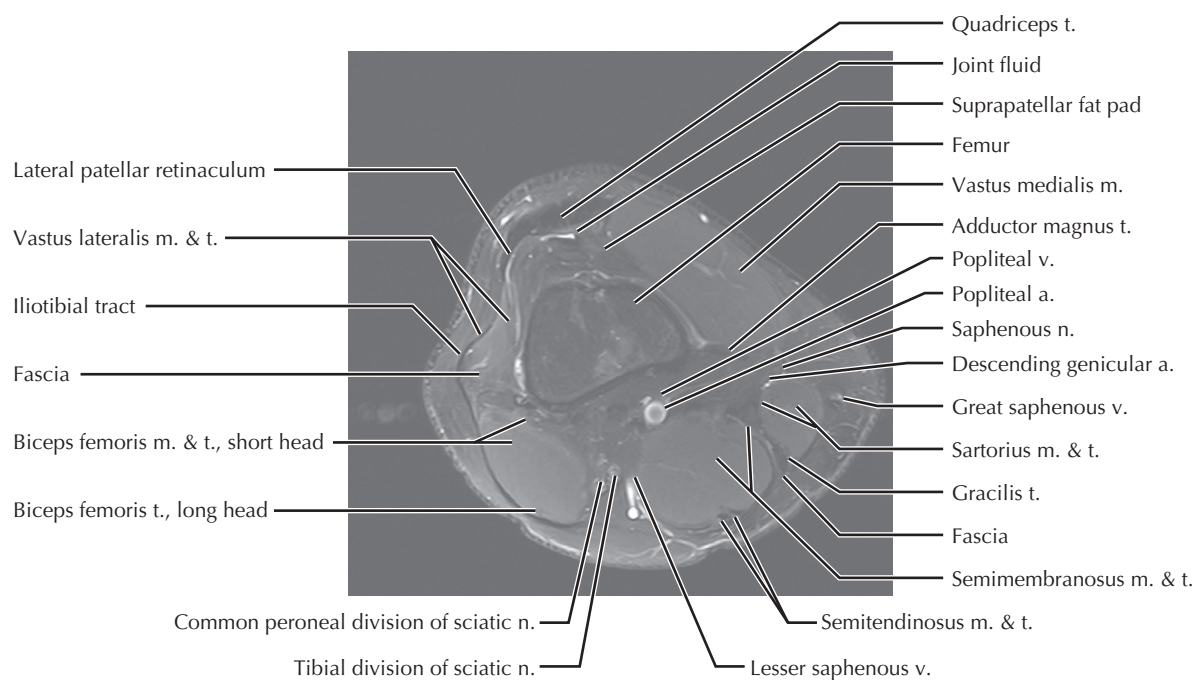
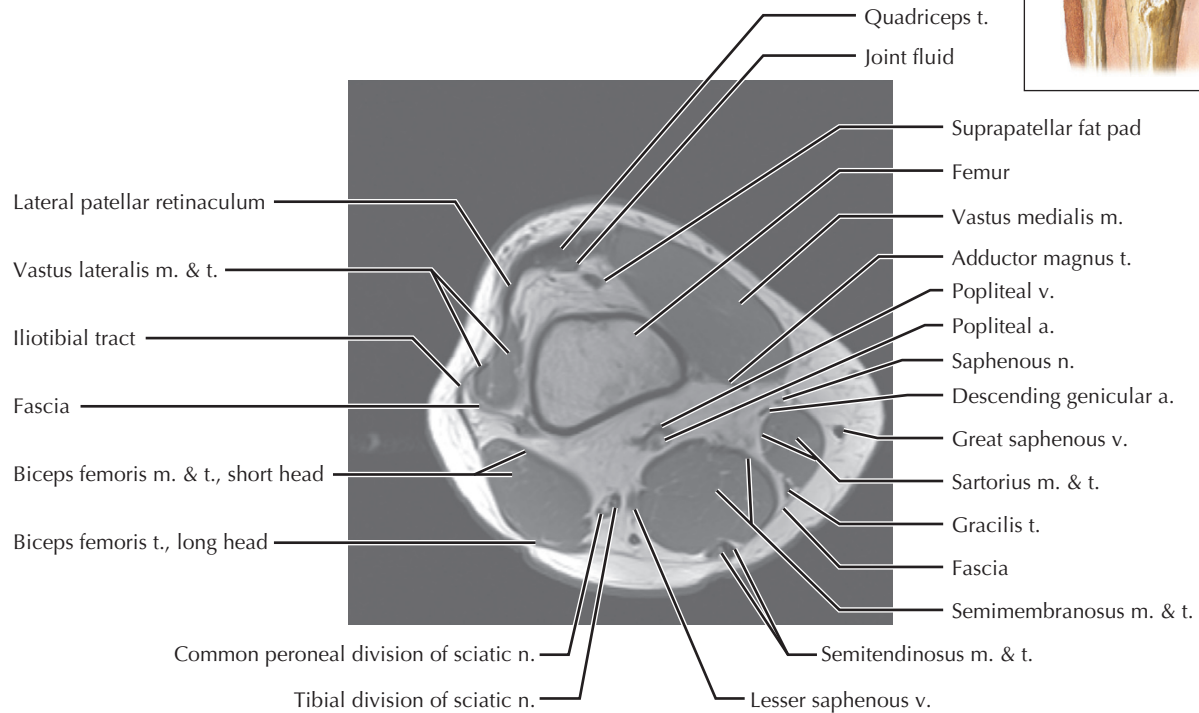
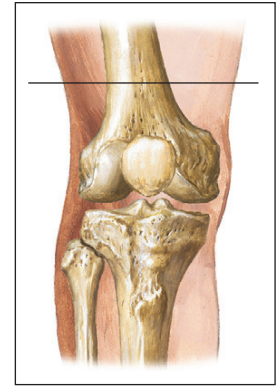


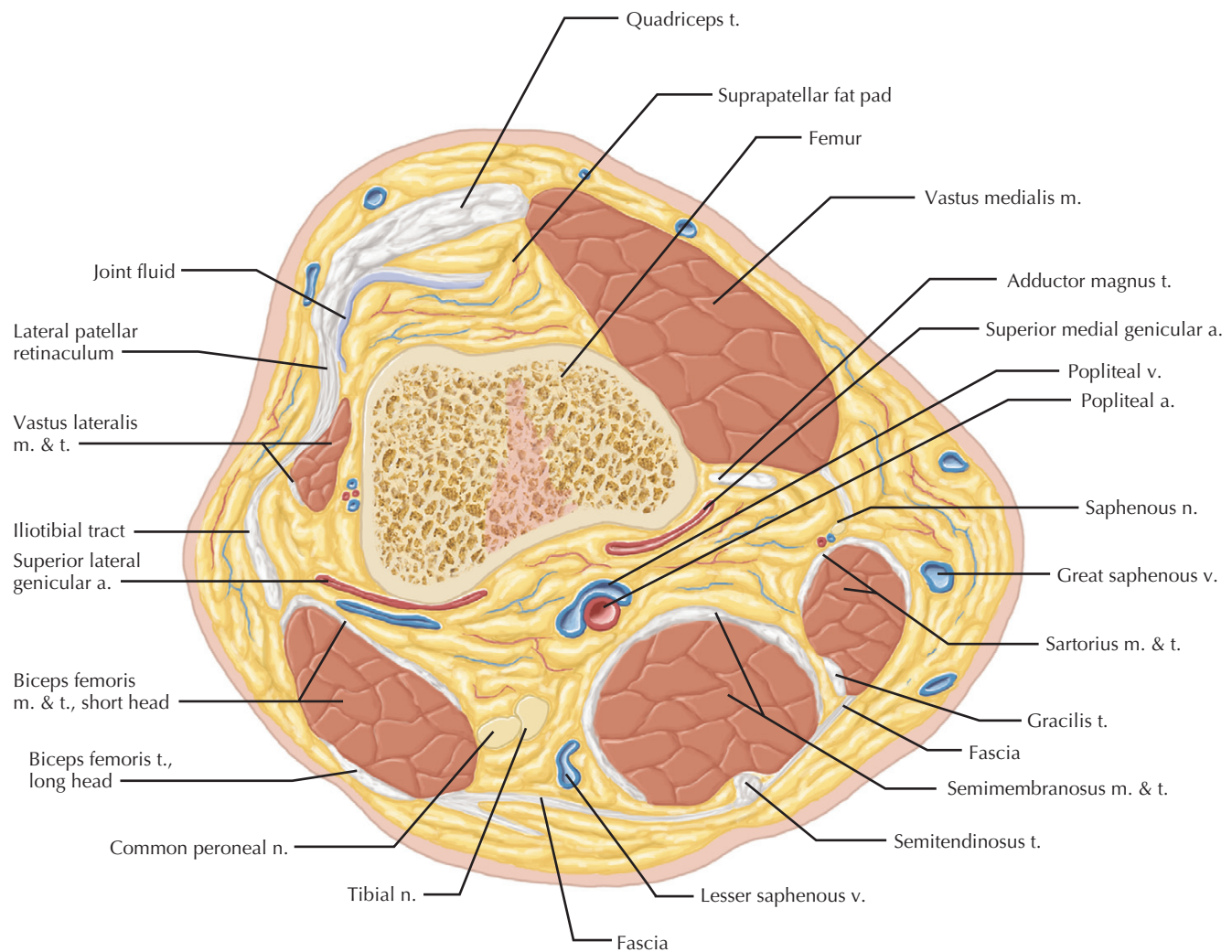
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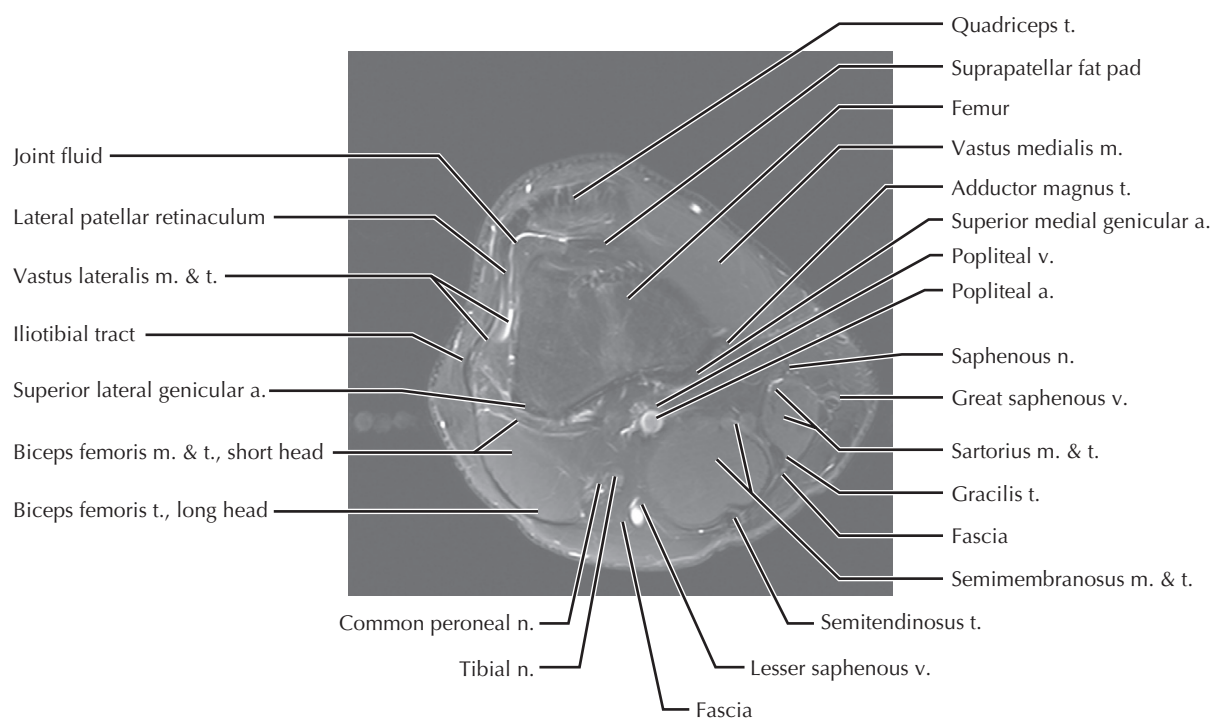
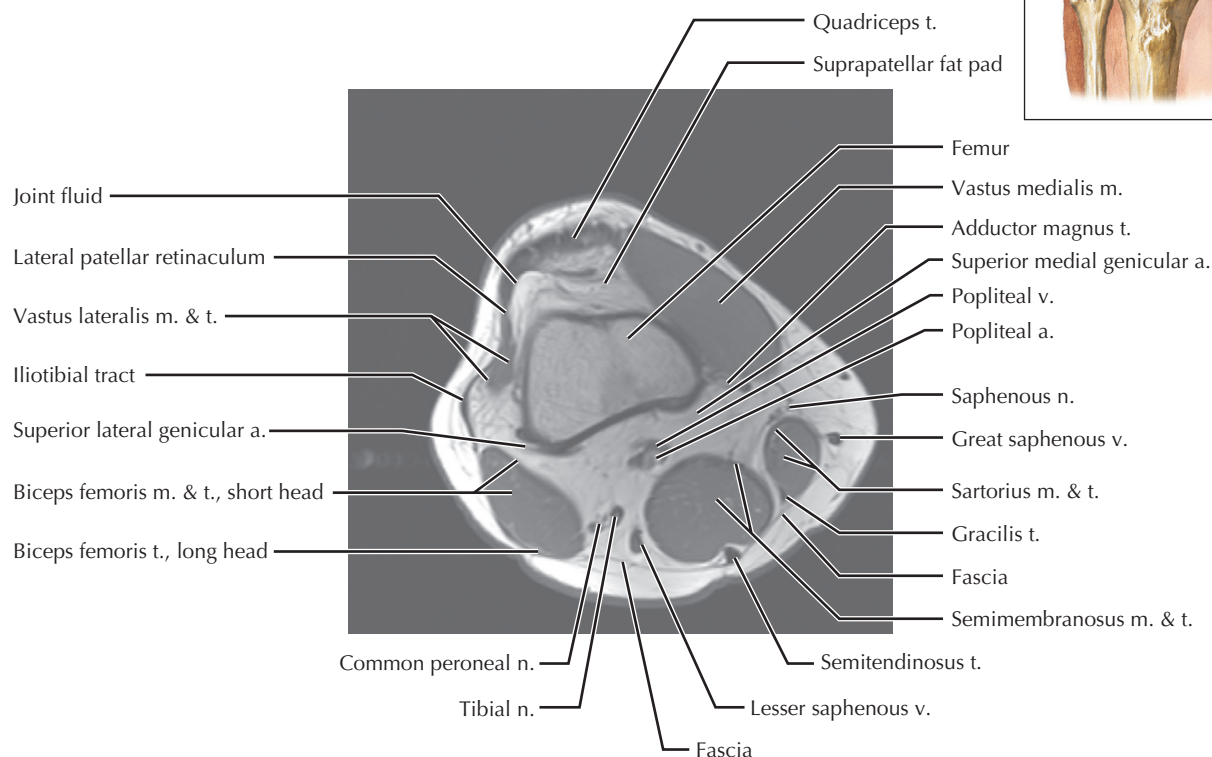
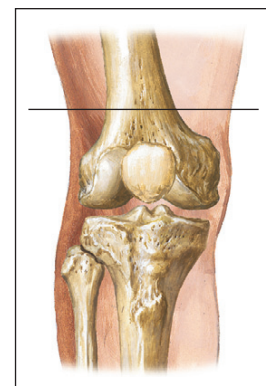


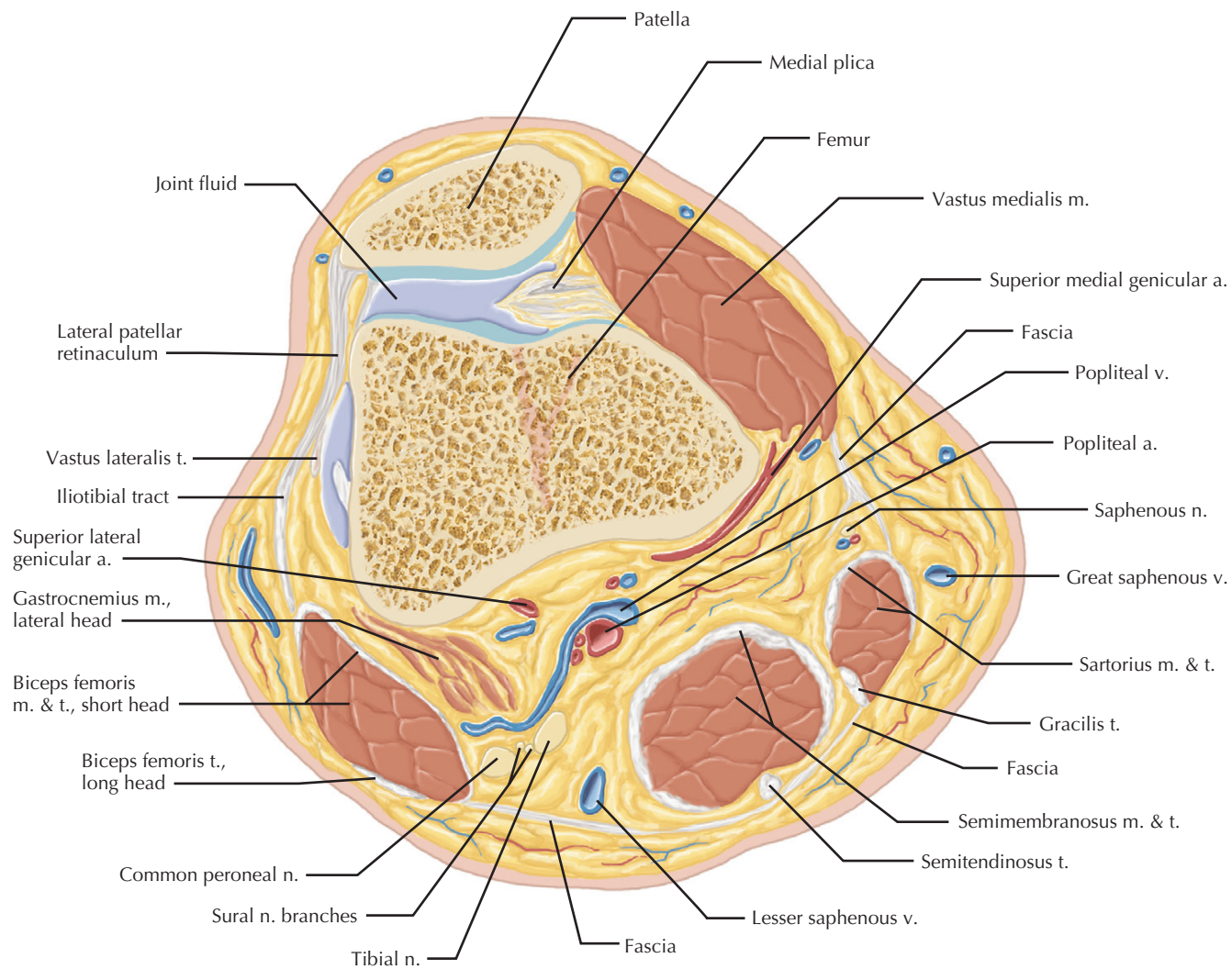
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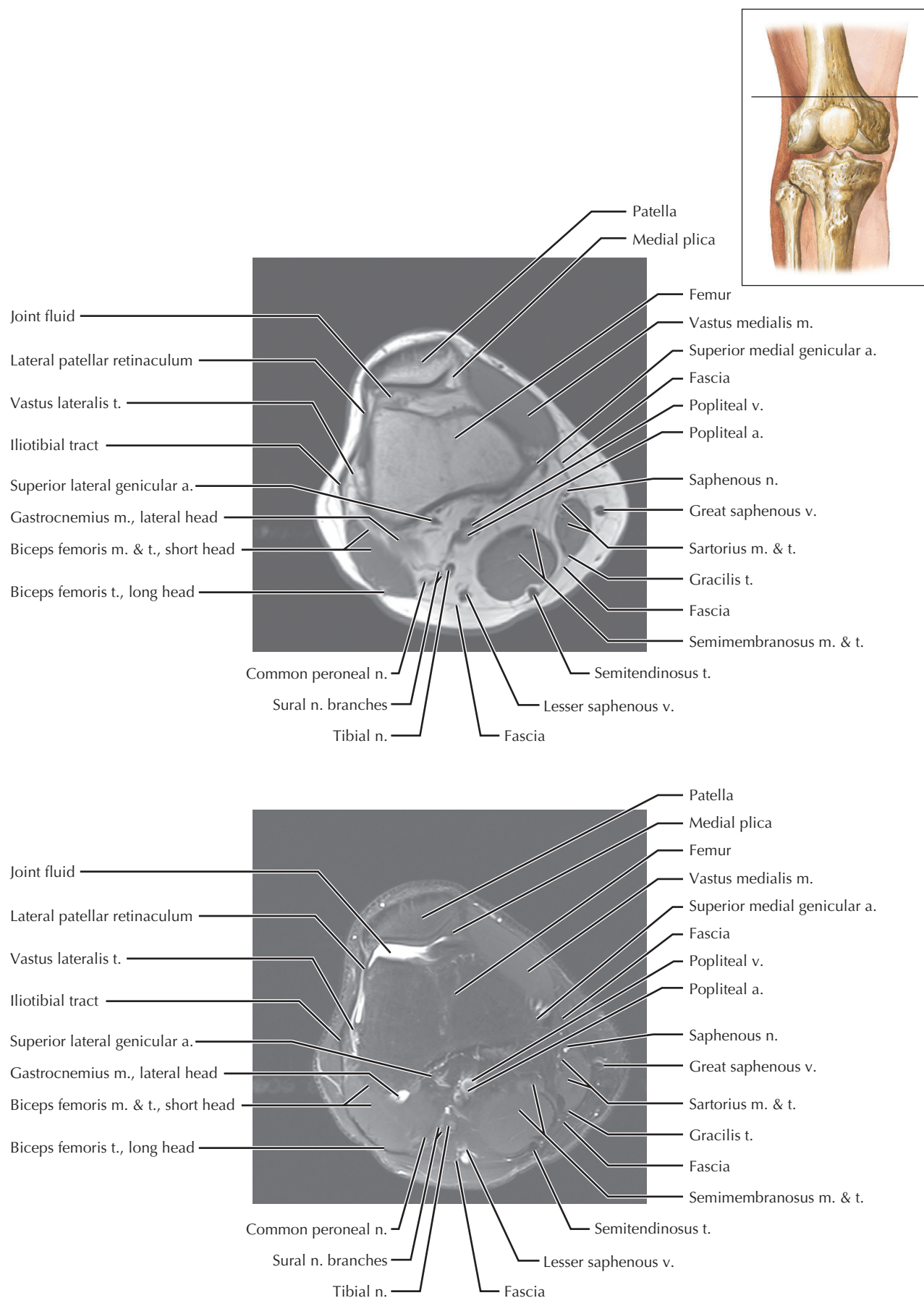


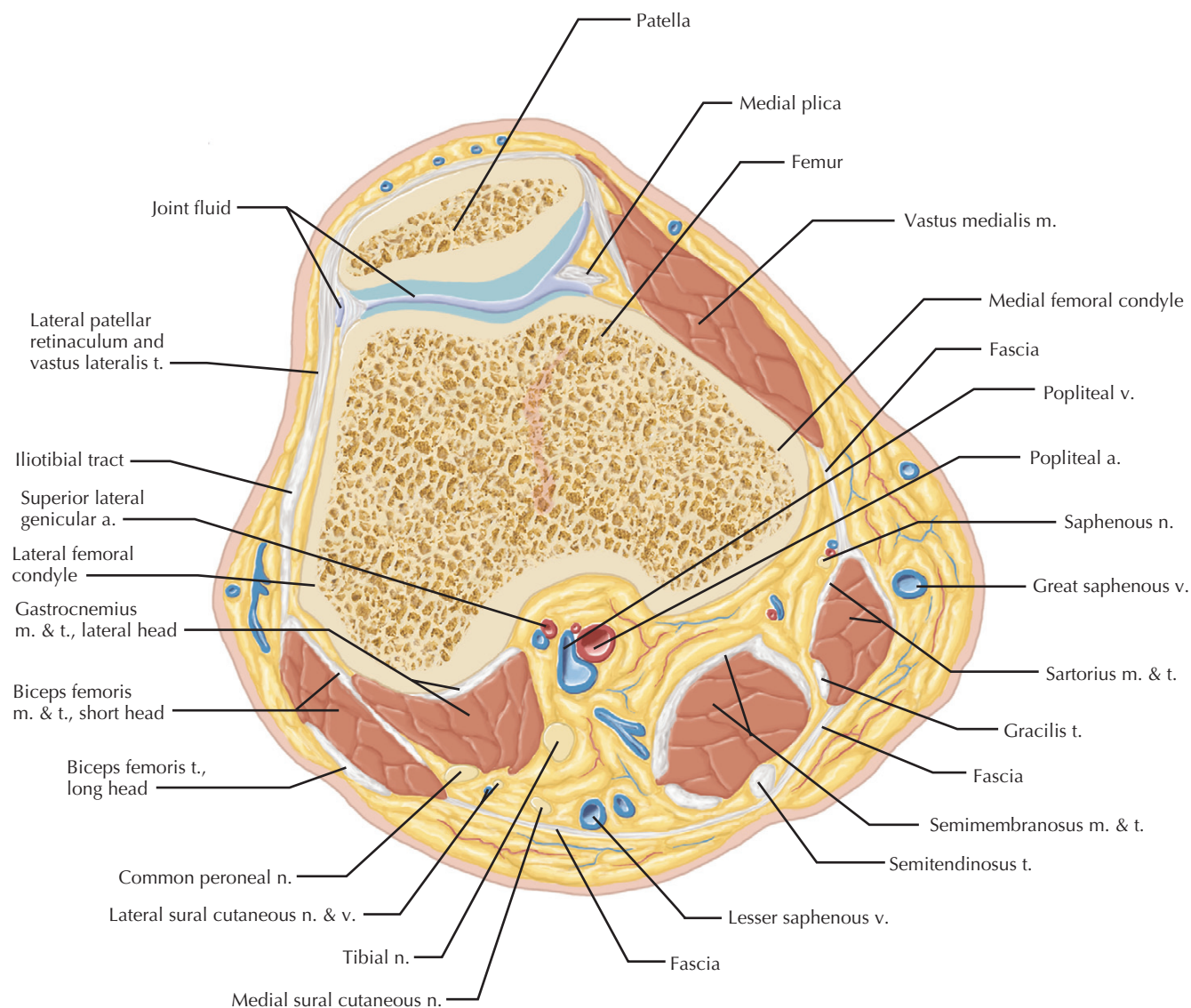










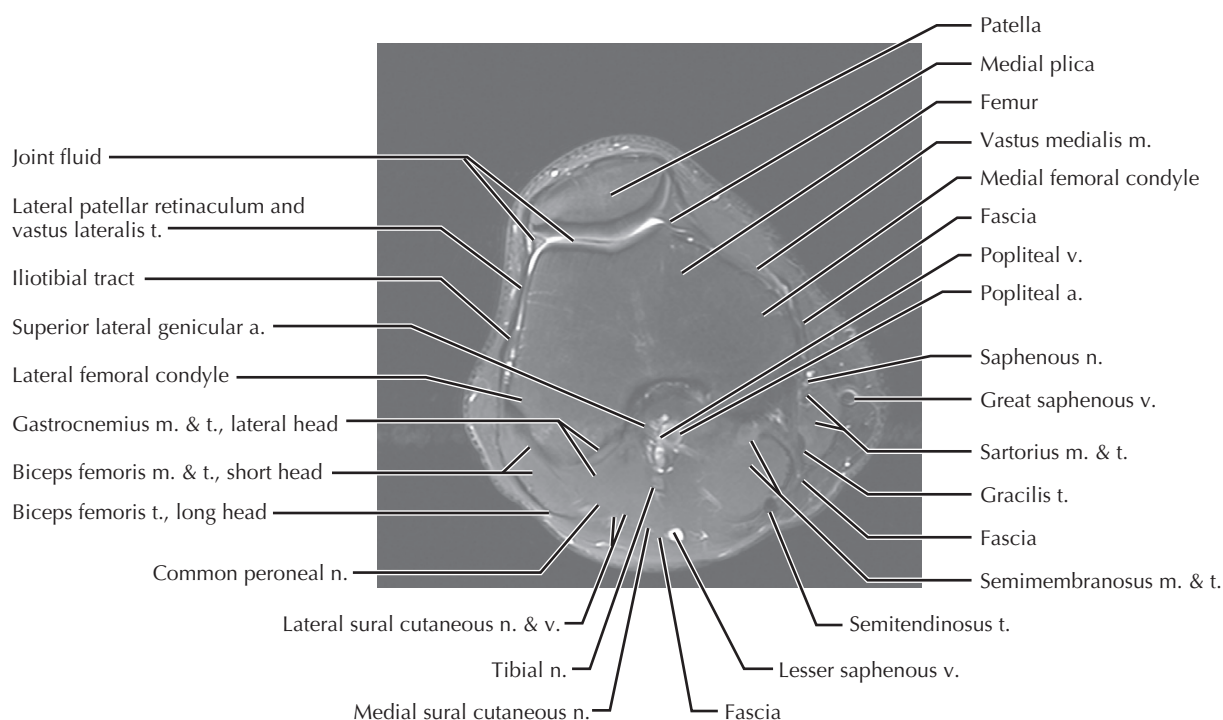
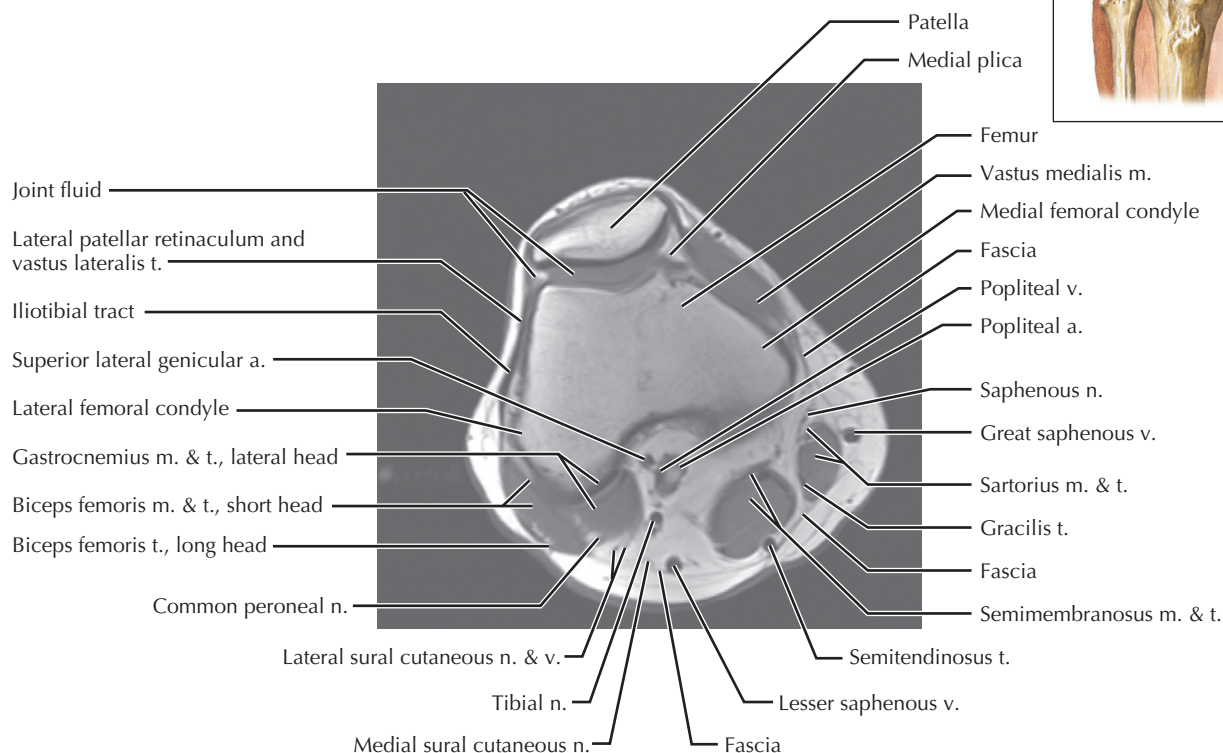
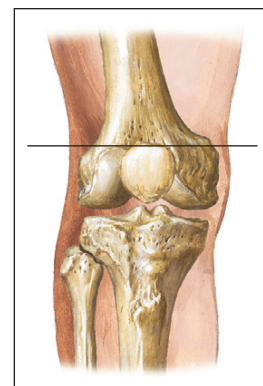


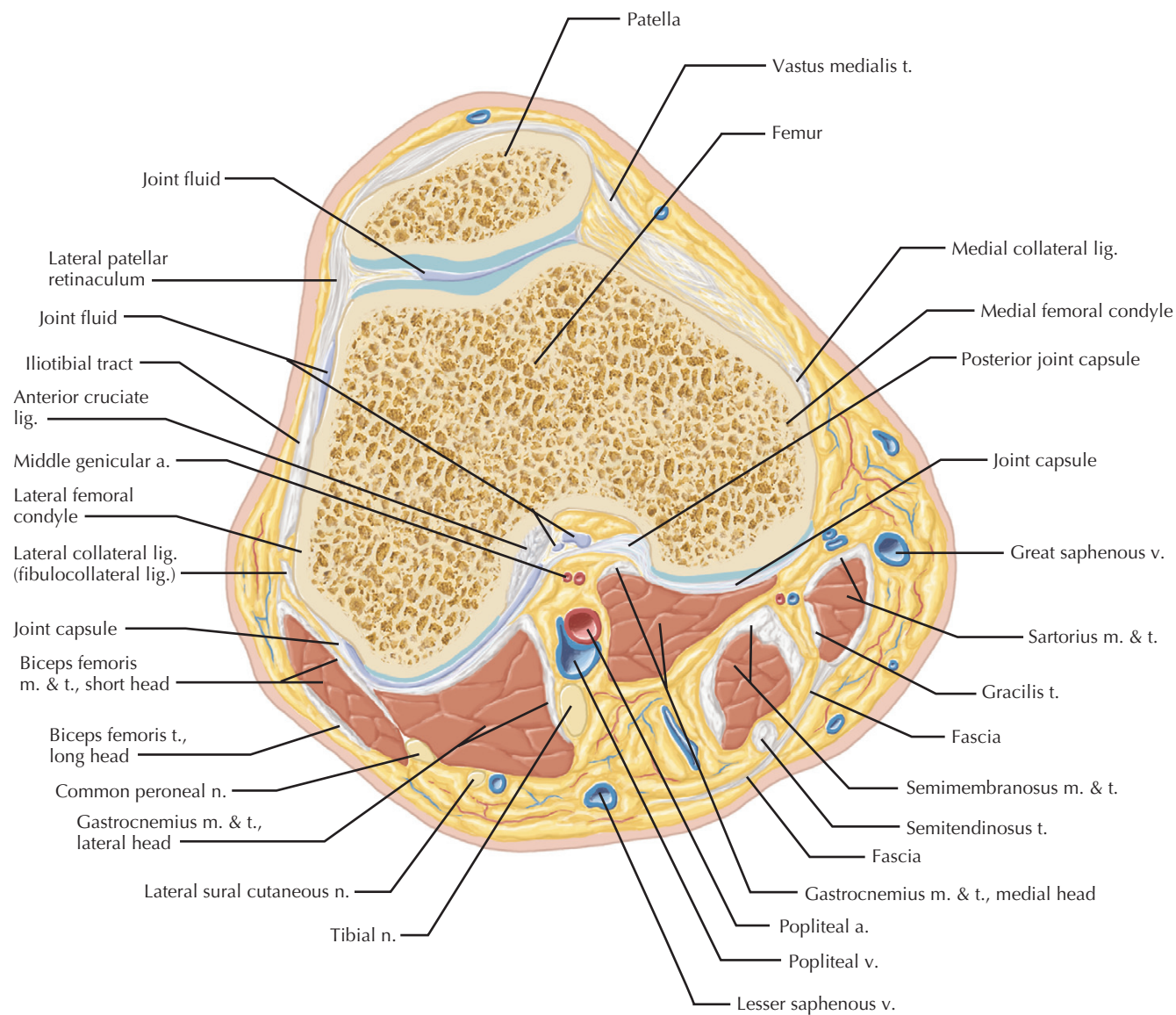
NORMAL ANATOMY

The medial patella plica is a remnant of knee development. Embryologically, the knee is divided into compartments by the superior inferior and medial plicae.

PATHOLOGIC PROCESS

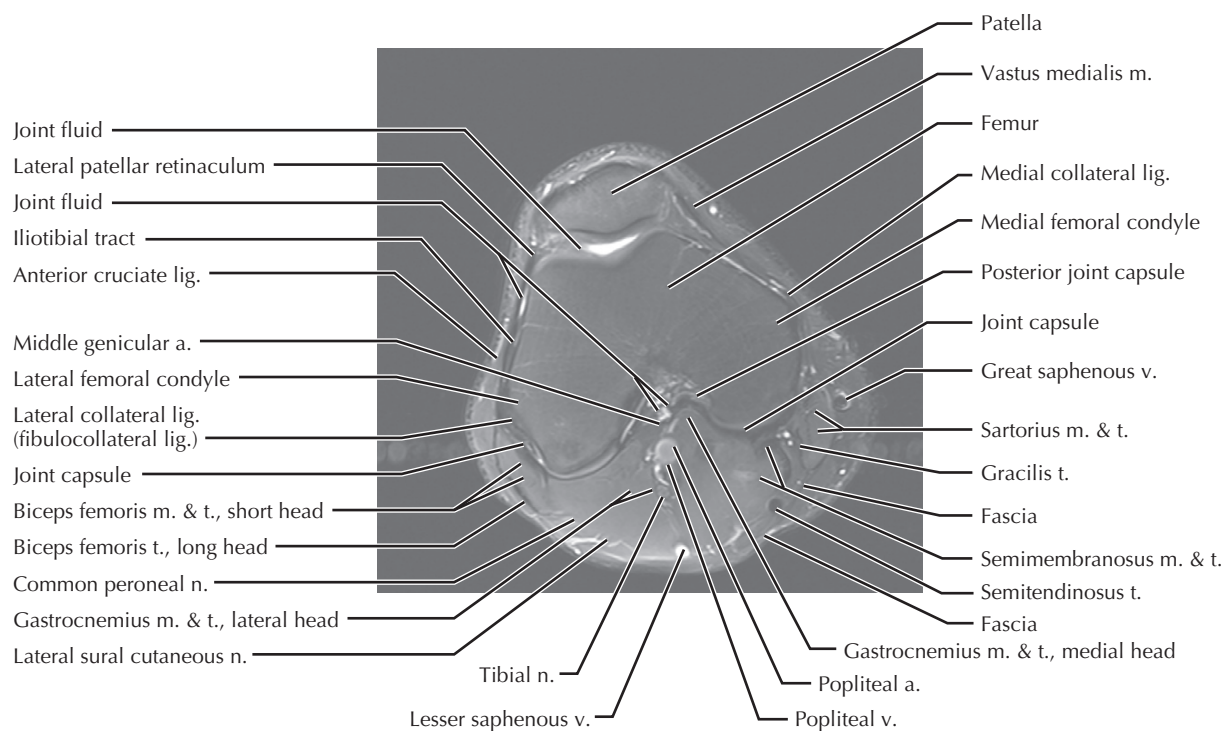
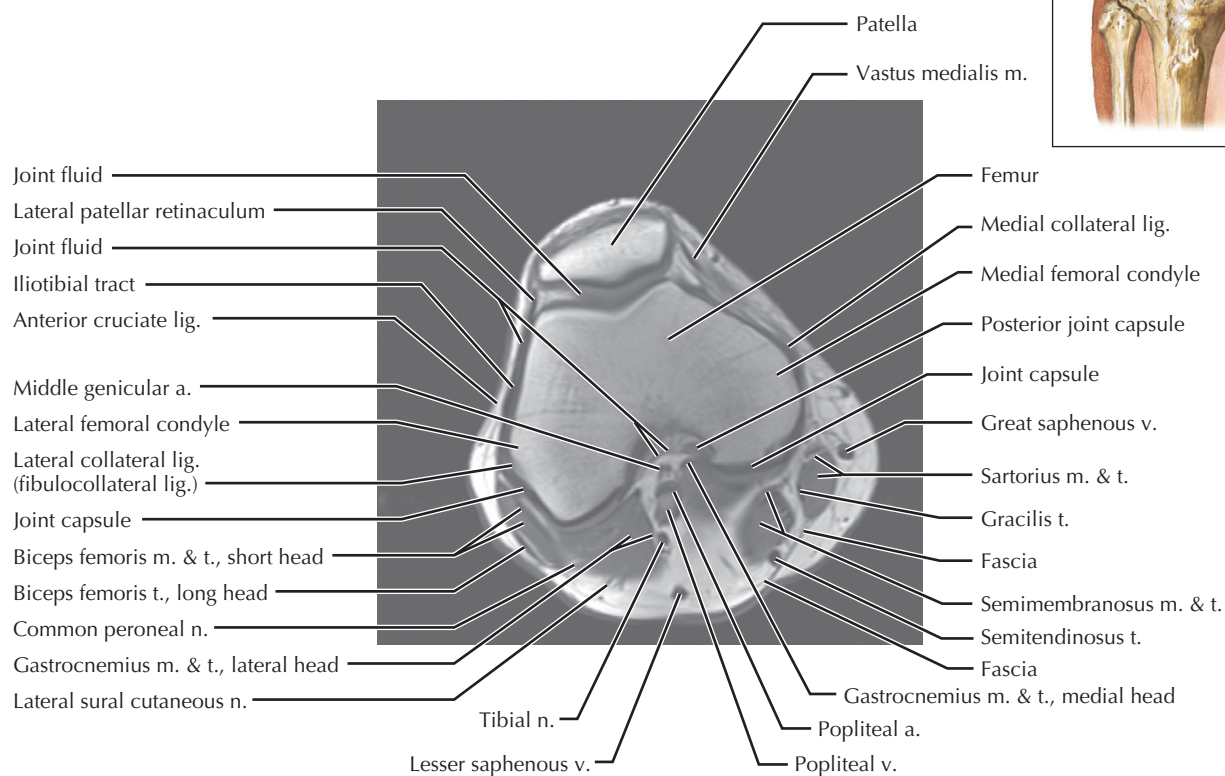
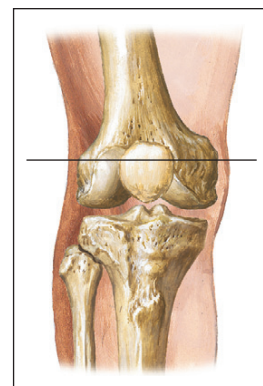
The medial plica can thicken and become trapped between the patella and the femur. The process may be associated with cartilage wear in this location.

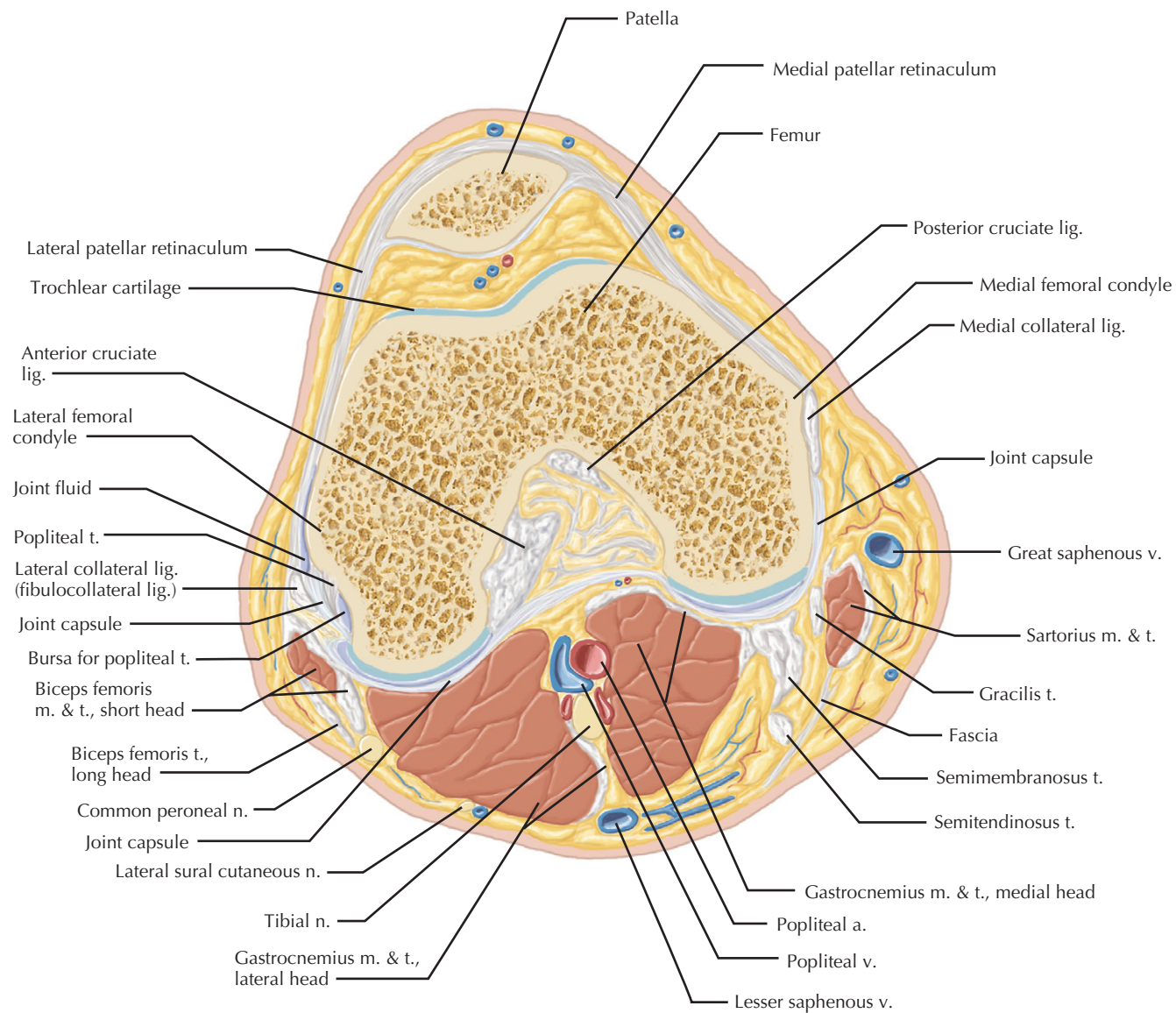


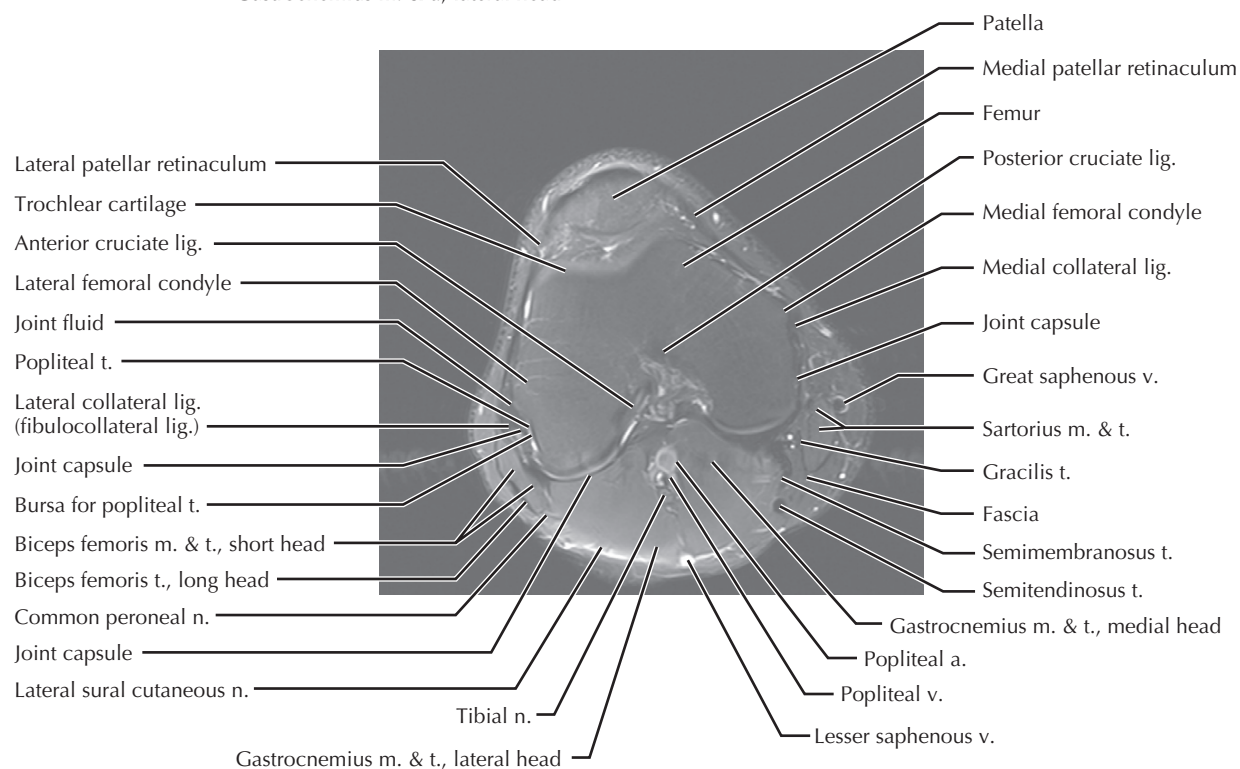
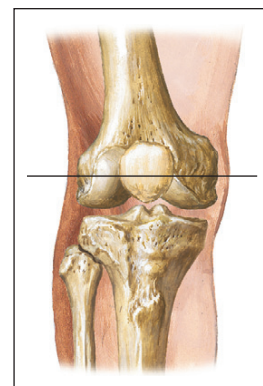
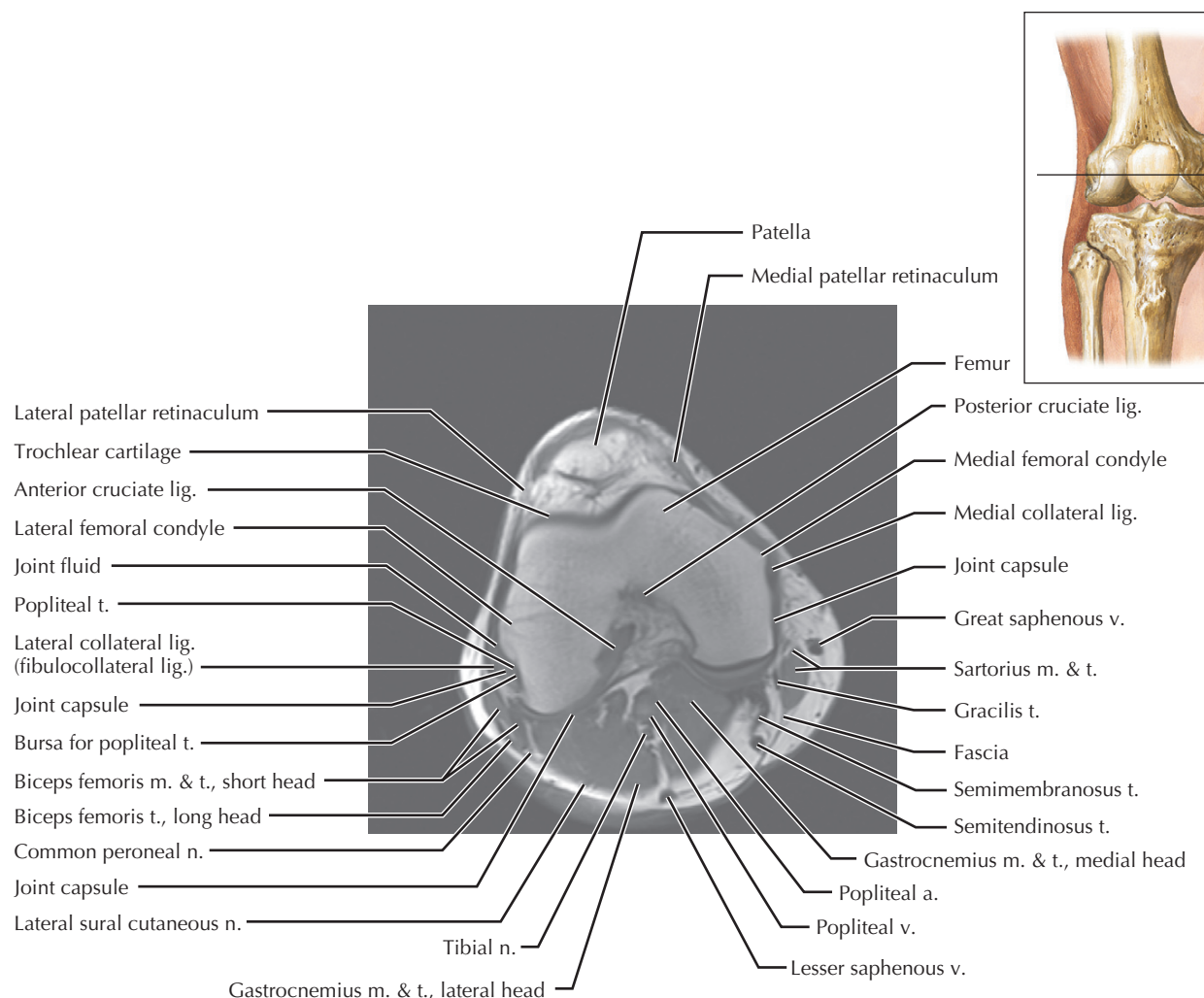


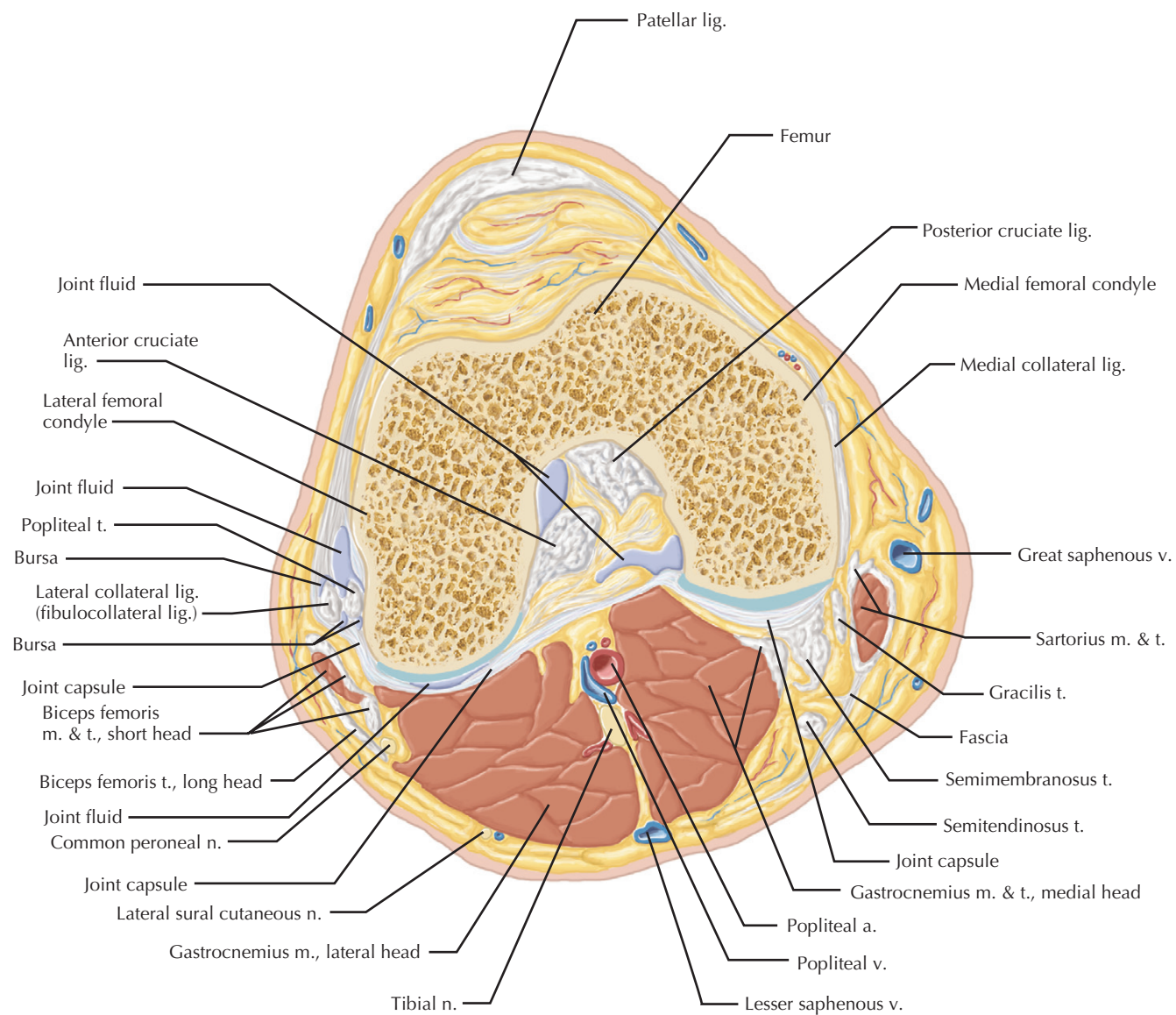
PATHOLOGIC PROCESS

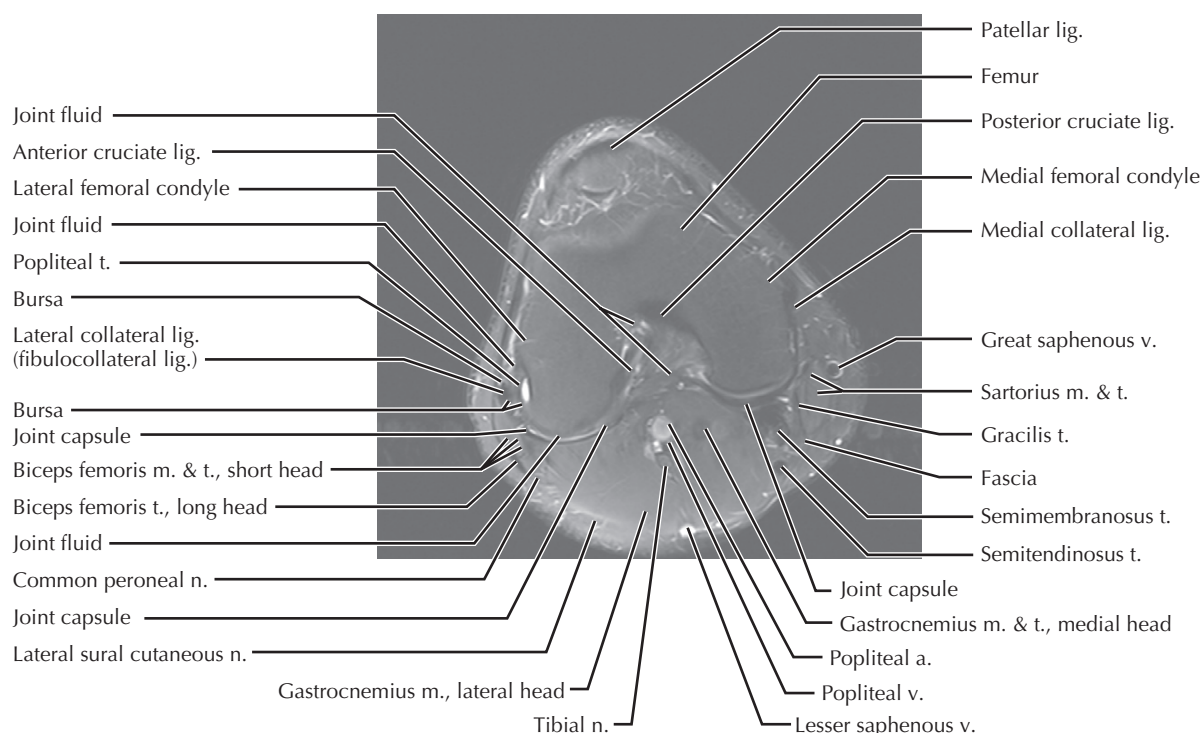
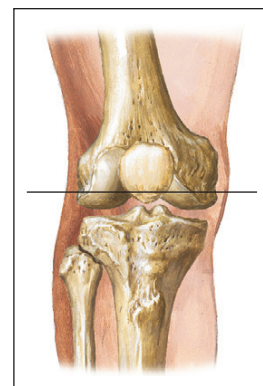
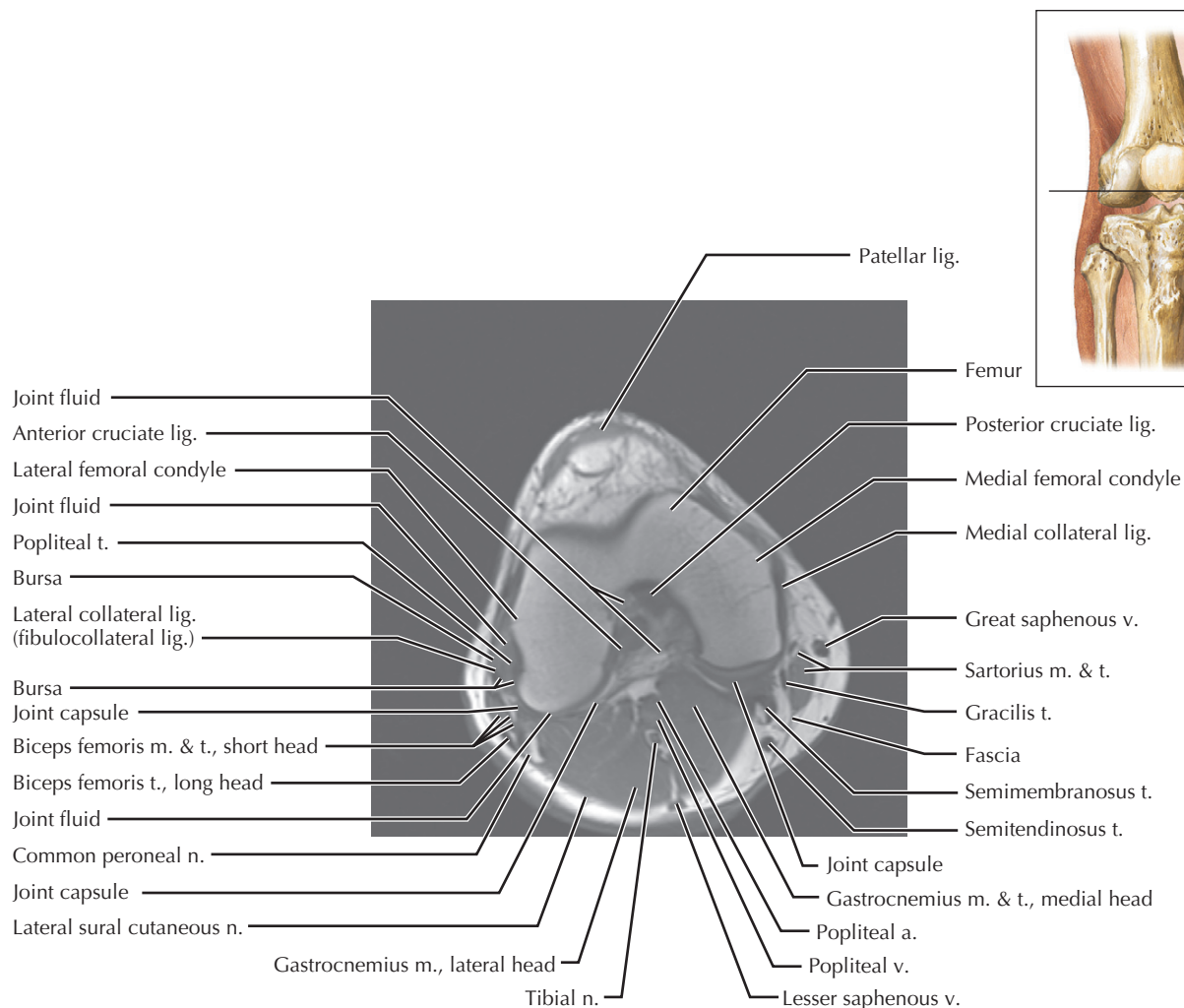
Patella dislocations are always lateral. Therefore, bone contusions are identified on the anterior aspect of the lateral femoral condyle and medial patella (when present).

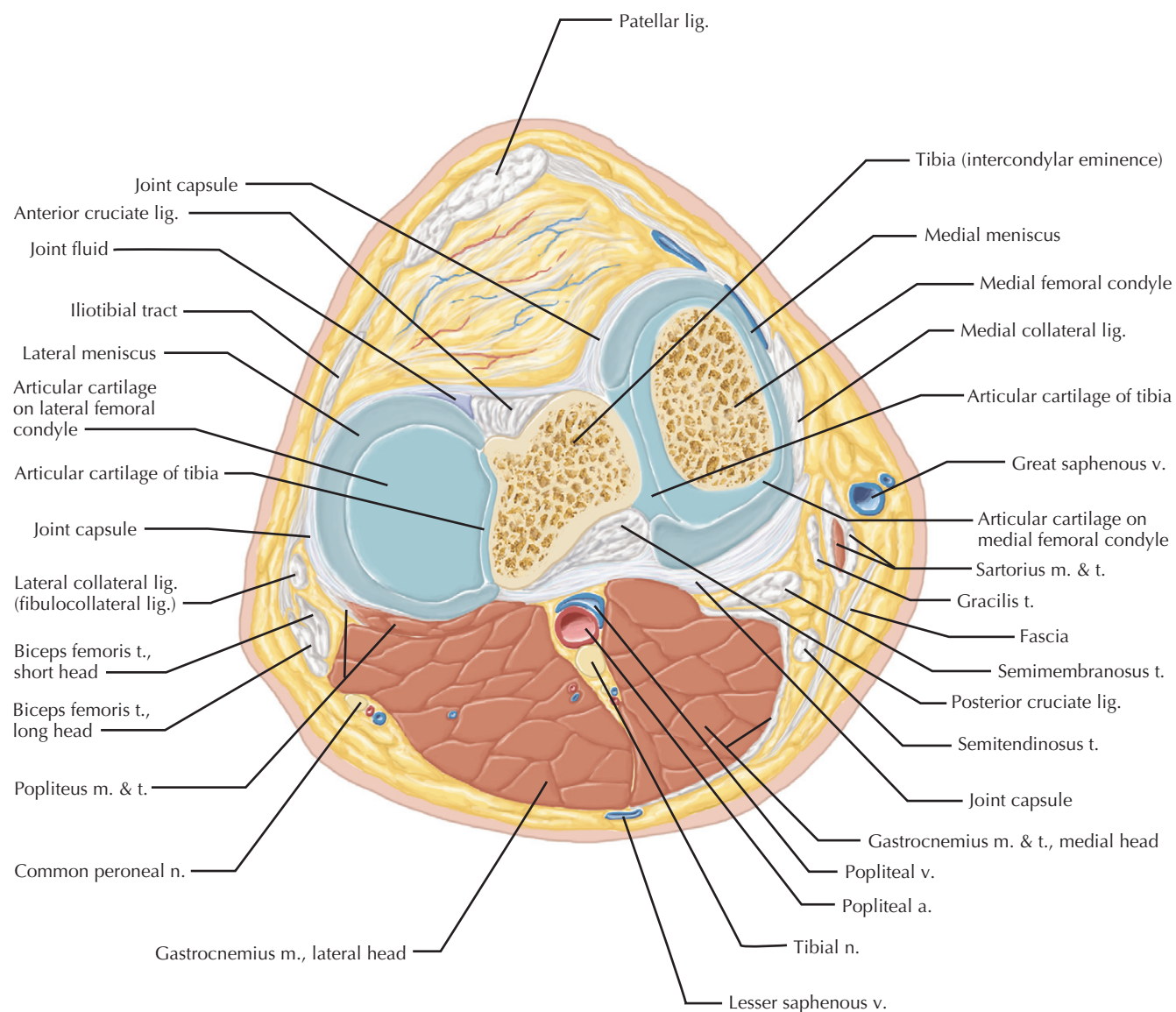


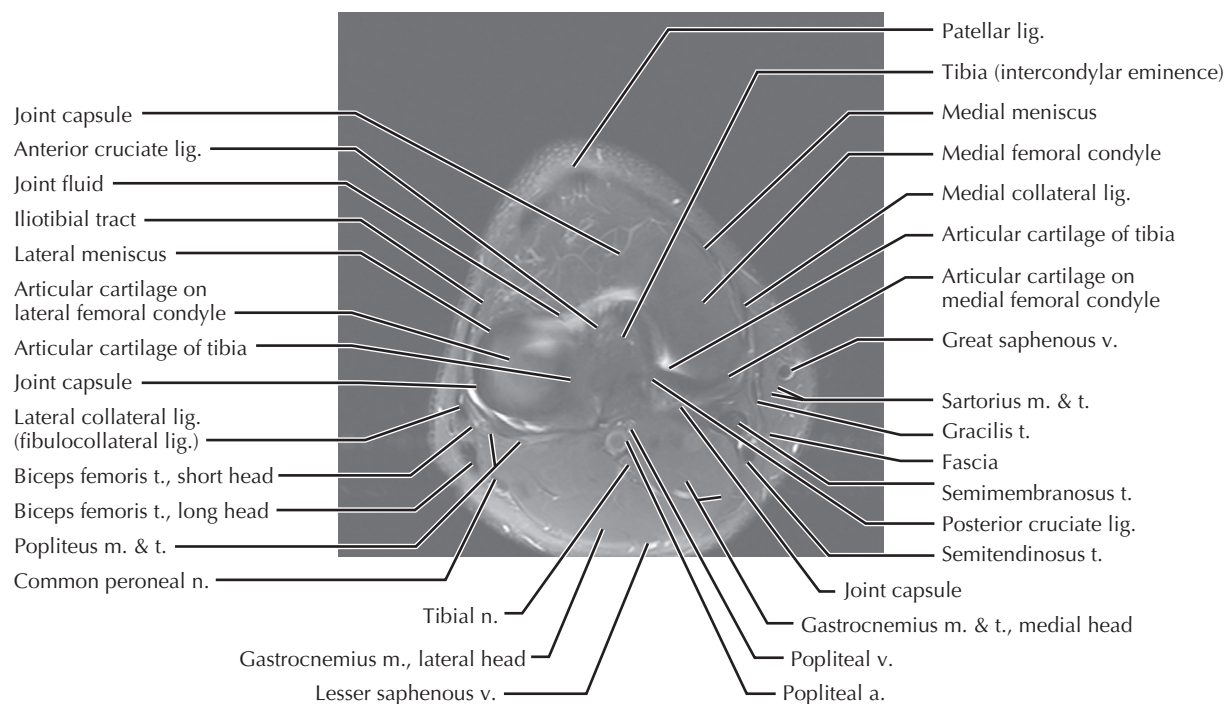
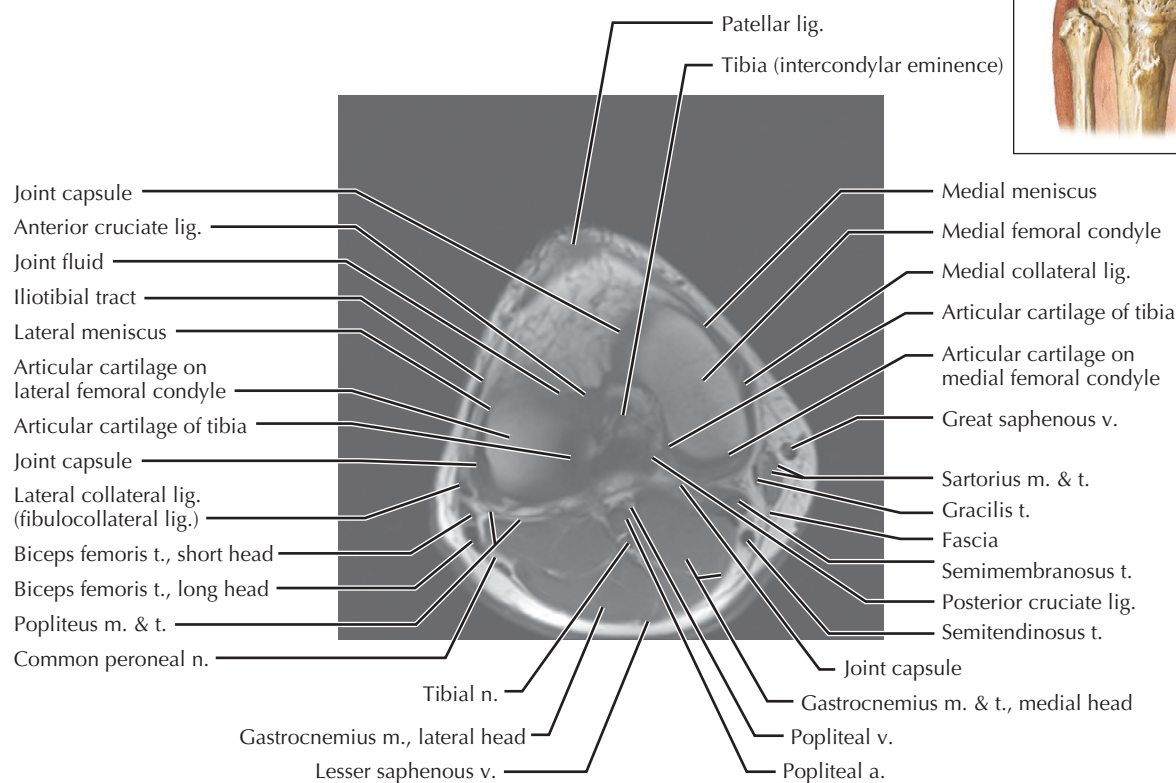
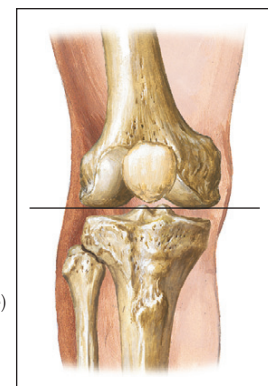


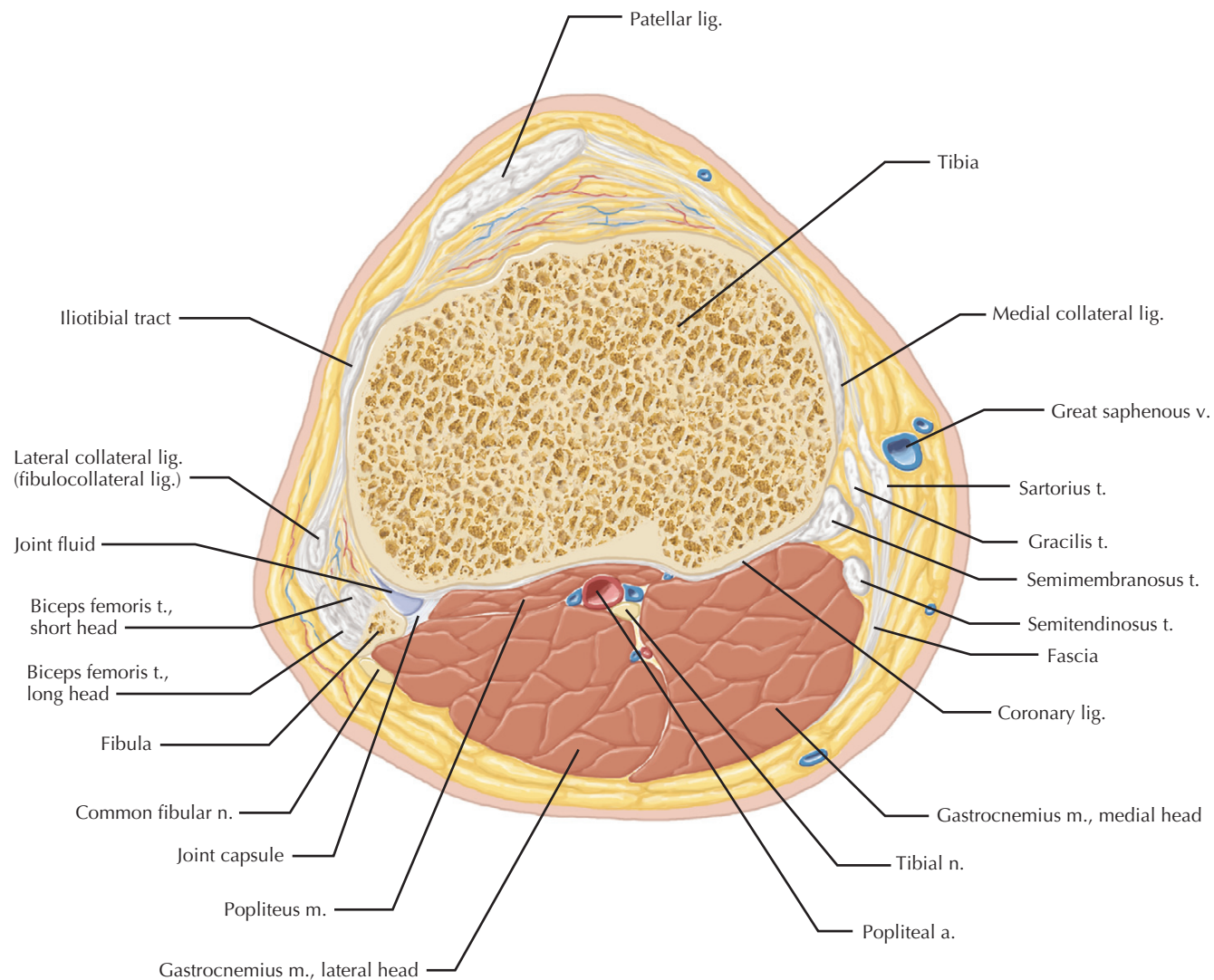






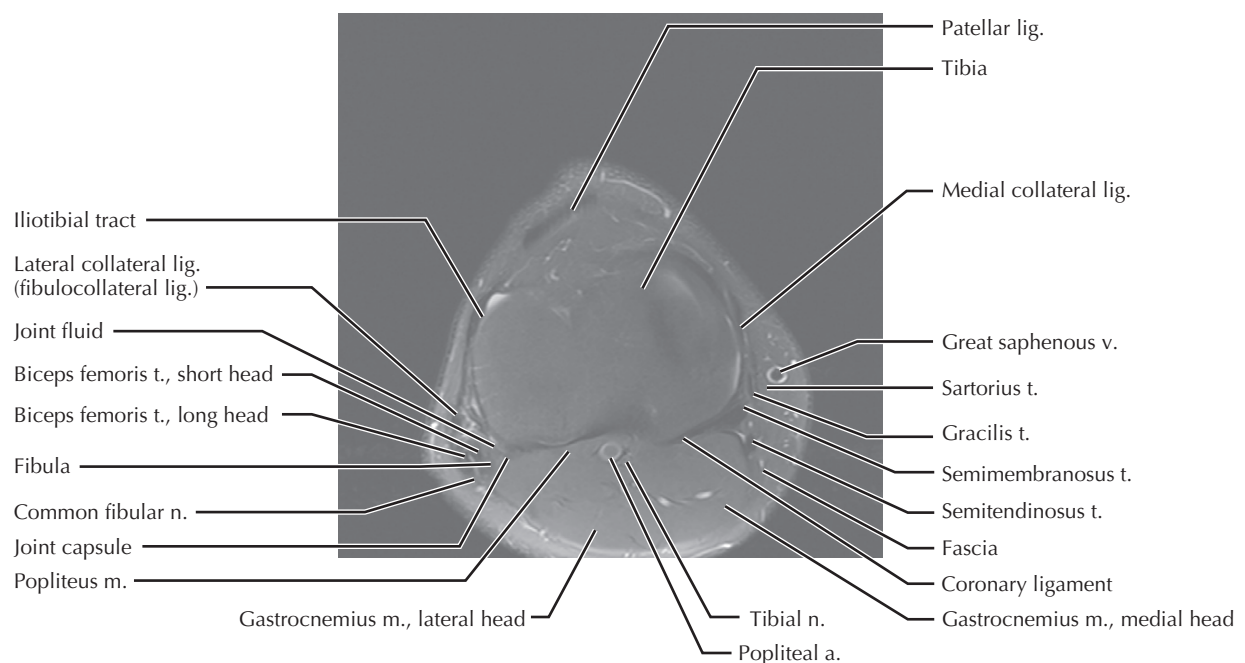
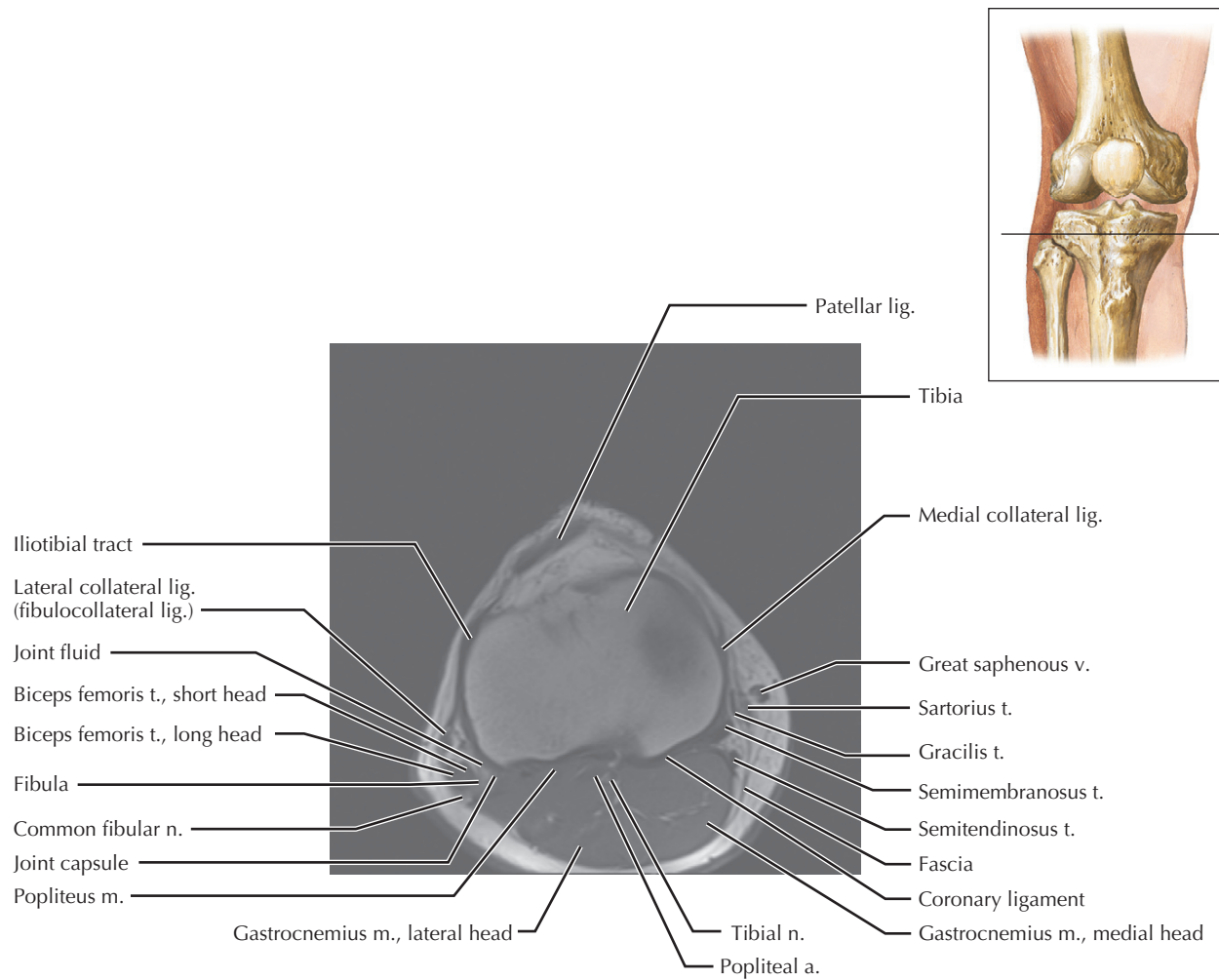


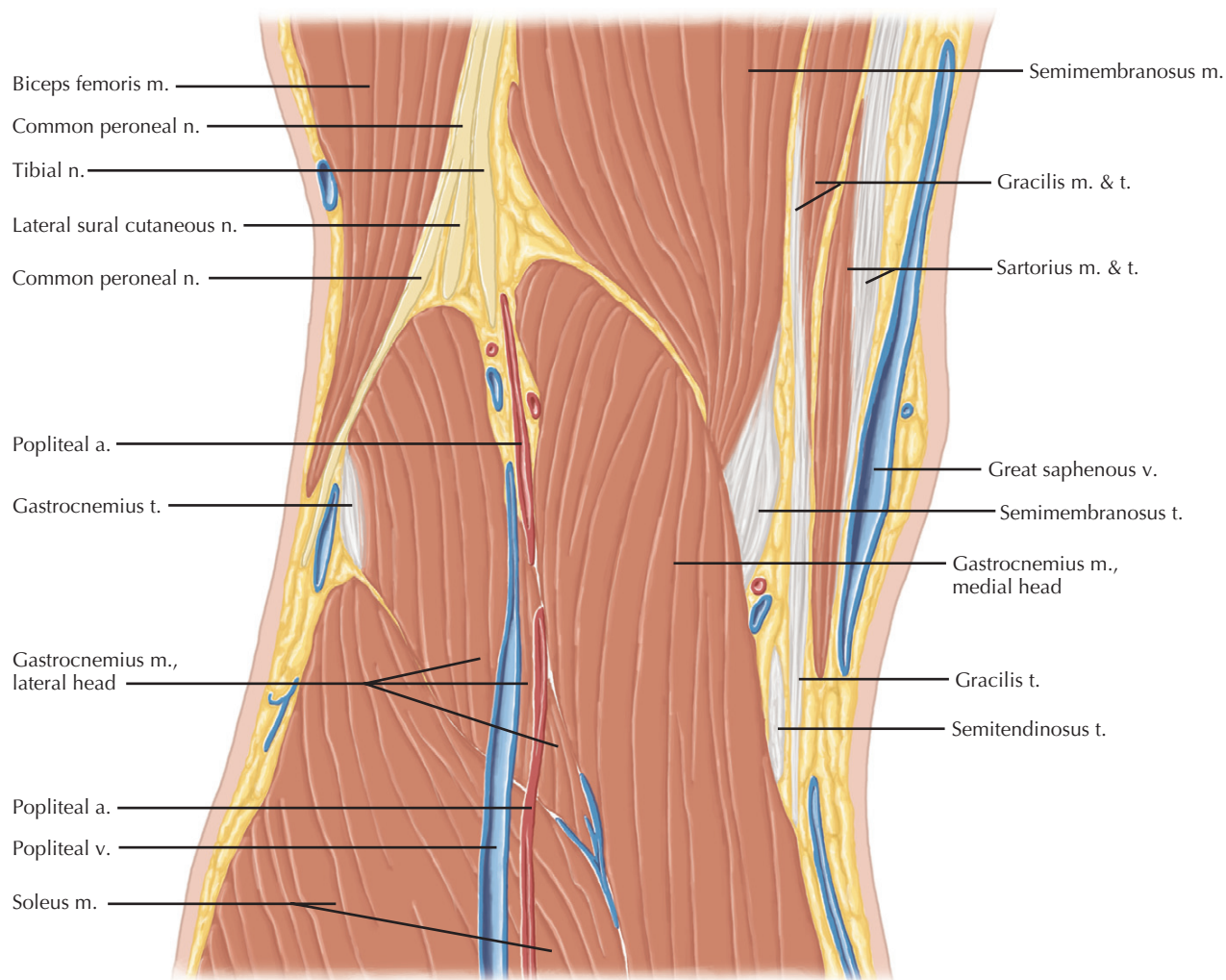


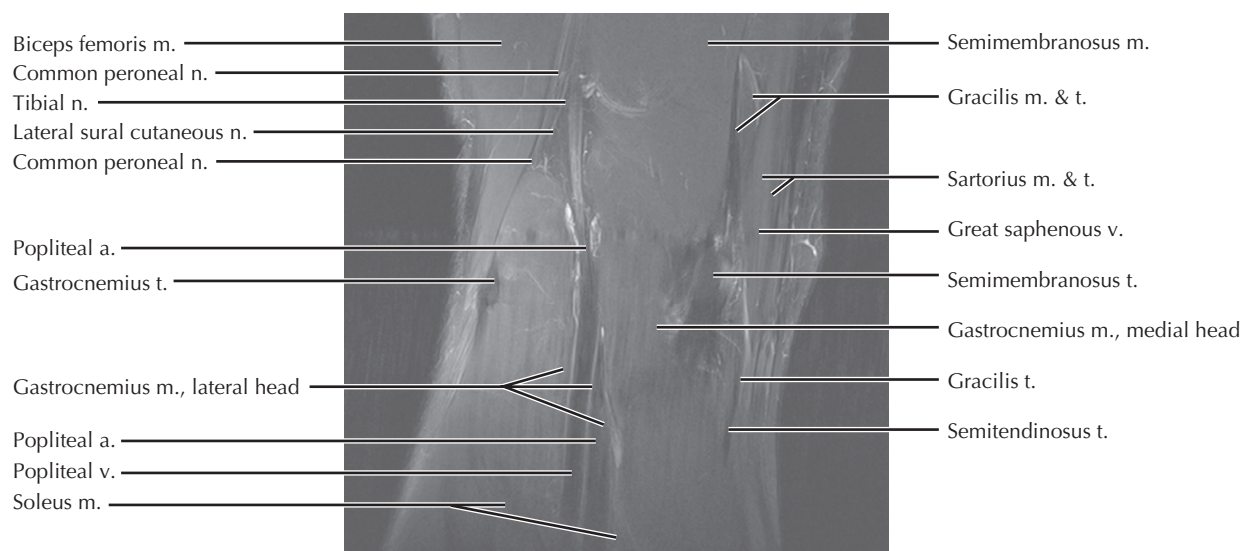
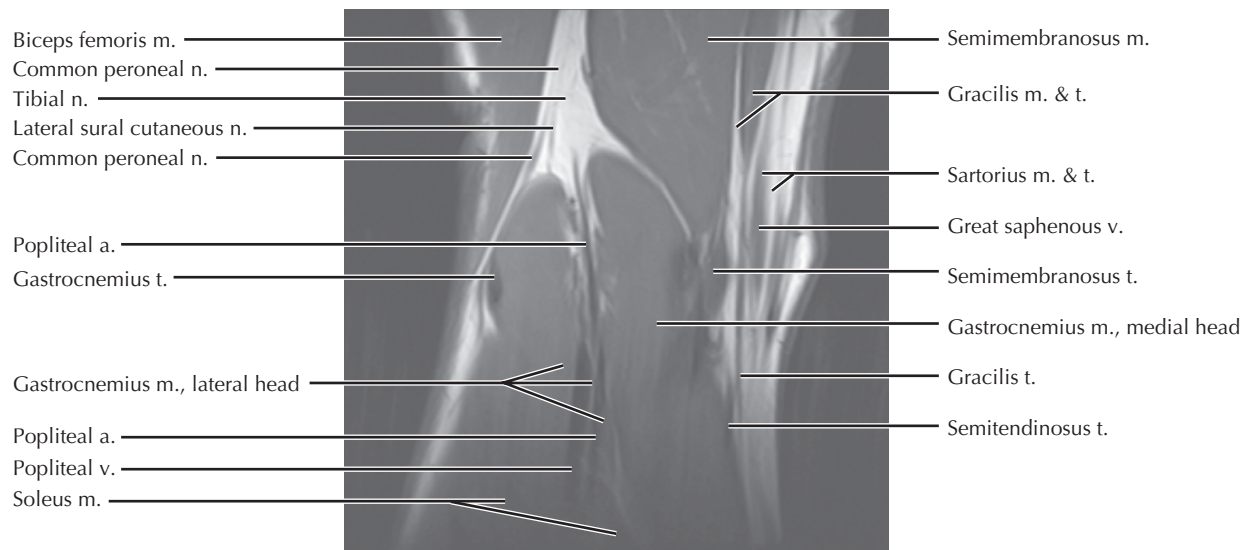
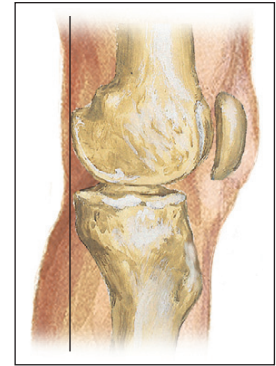


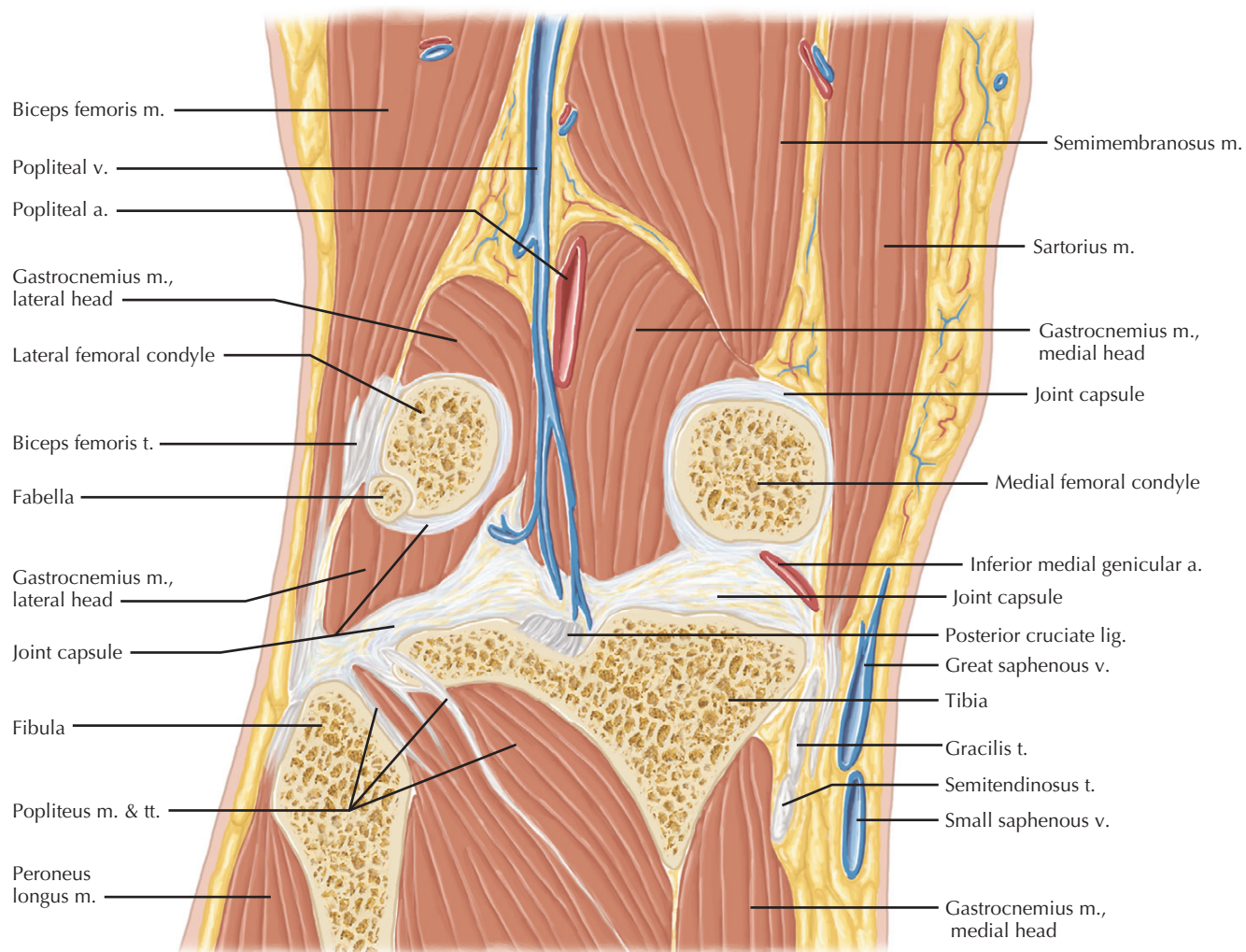
PATHOLOGIC PROCESS

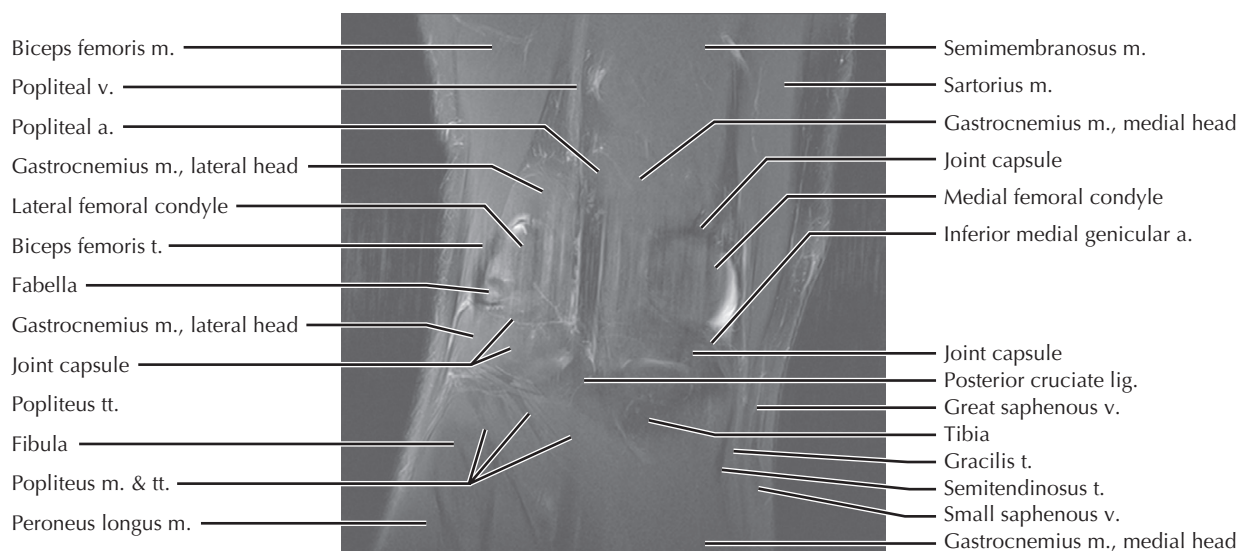
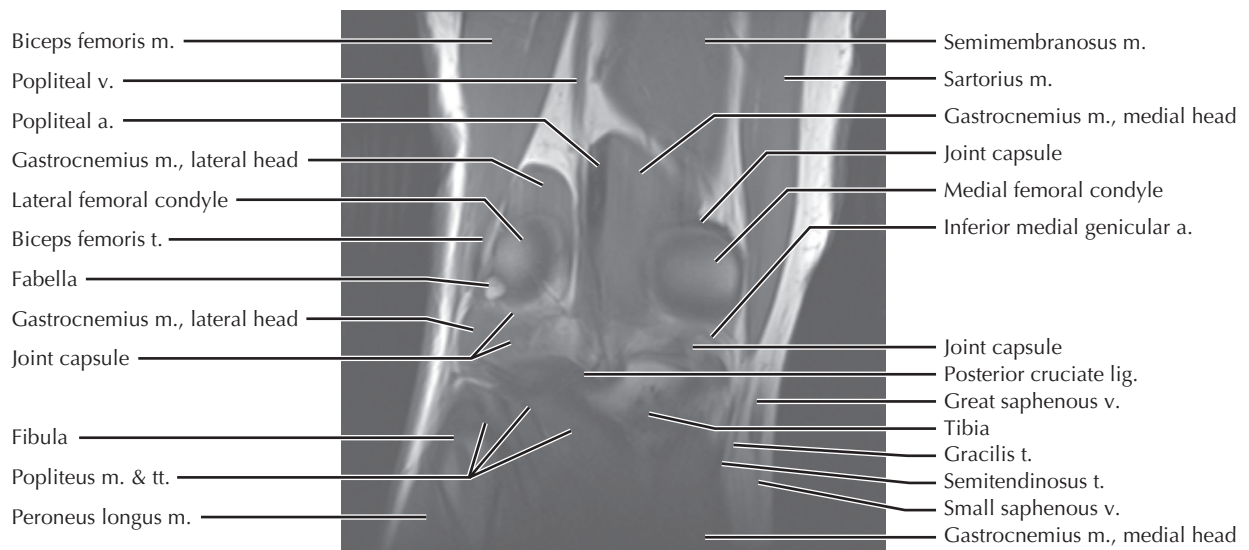
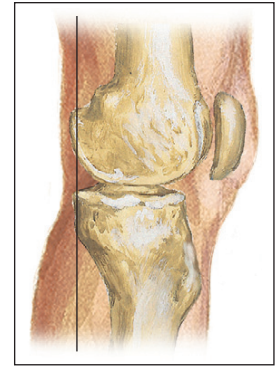
An important bursa is the semimembranosus tibial collateral ligament bursa. When distended, it drapes over the semimembranosus tendon like a comma and is seen on all imaging planes.

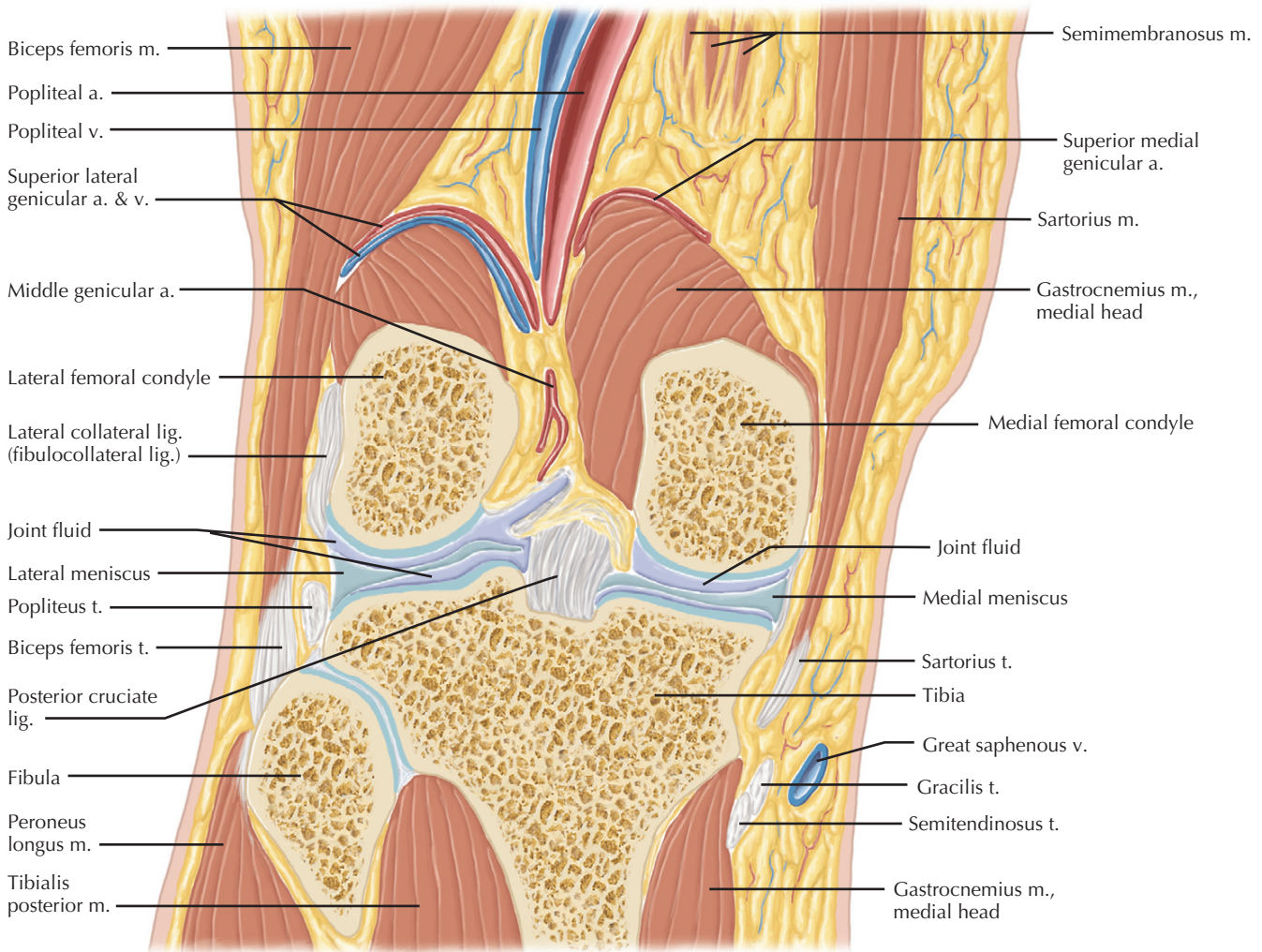












NORMAL ANATOMY

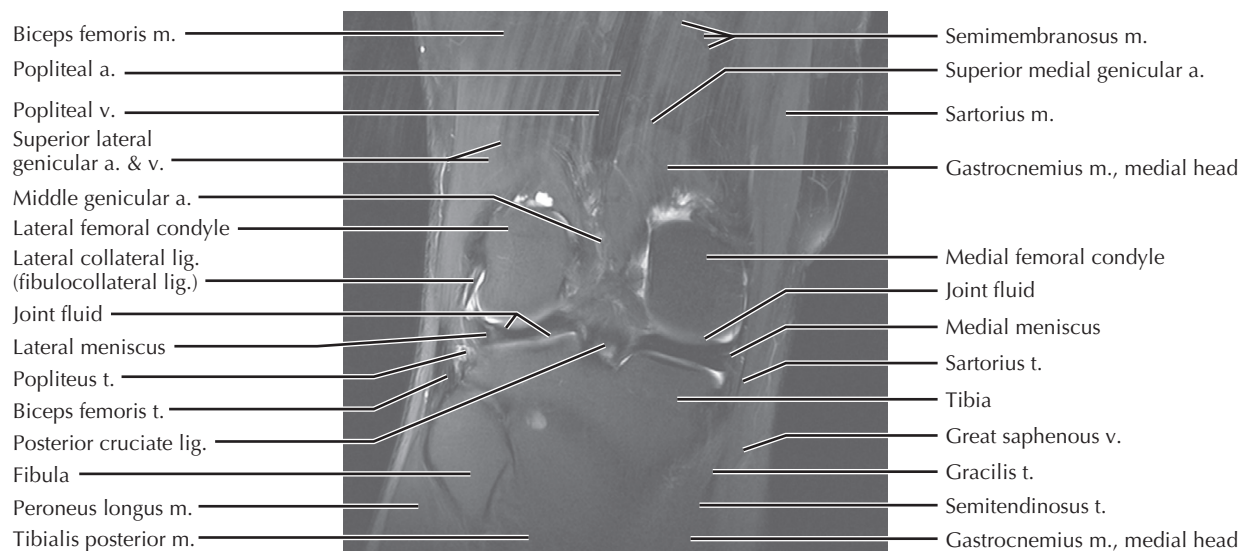
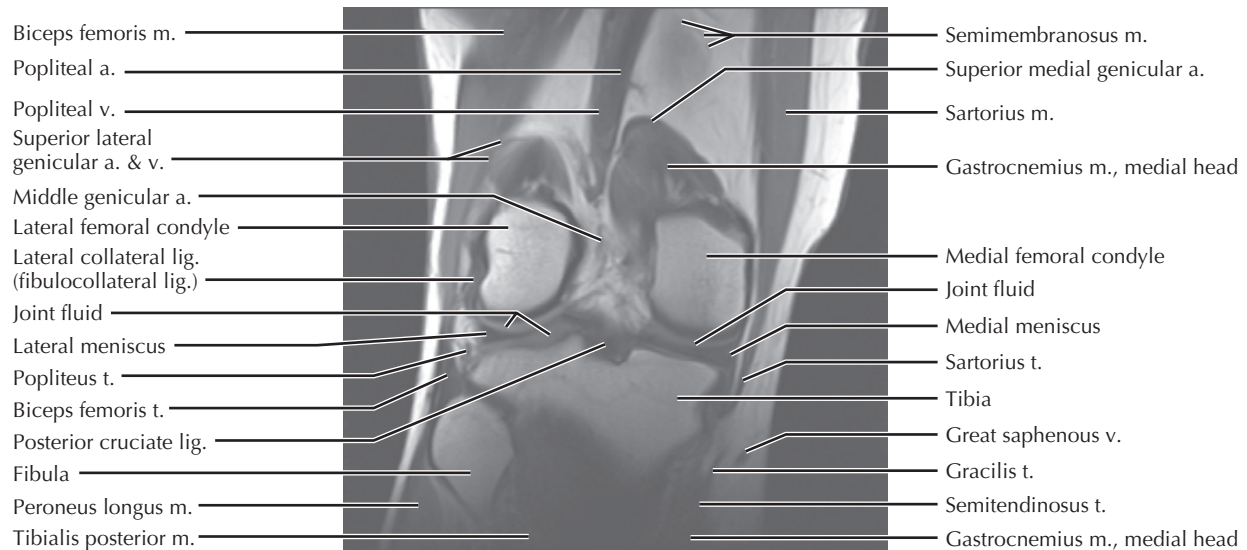
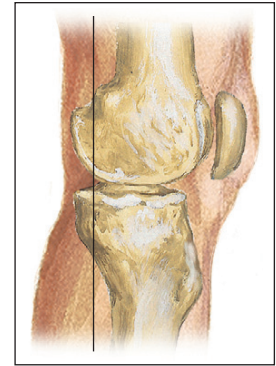
Components of the posterolateral corner include the lateral collateral ligament complex (biceps femoris, iliotibial band, and lateral or fibular collateral ligament), the popliteus tendon, a variably-present popliteofibular ligament, the arcuate ligament (joint capsule posteriorly), and other short ligamentous attachments.

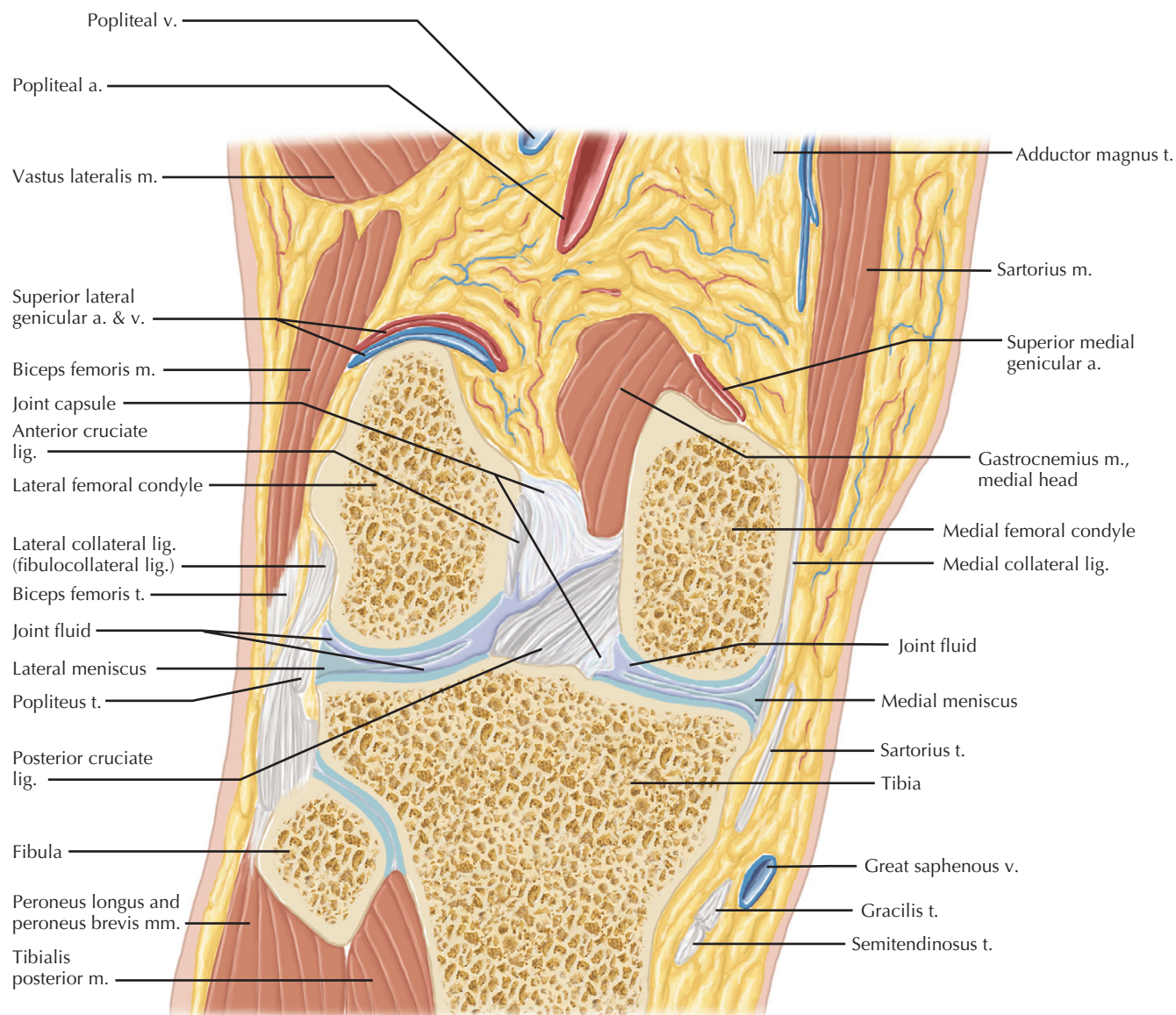
PATHOLOGIC PROCESS

Injury to three structures of the posterolateral corner requires prompt attention and is almost always associated with an anterior cruciate ligament (ACL) or posterior cruciate ligament (PCL) injury.

NORMAL VARIANT

The normal meniscus is devoid of signal on all imaging sequences, except in children and young adults. In this population, intermediate signal may be noted, especially in the posterior horn of the meniscus as it attaches to the capsule.





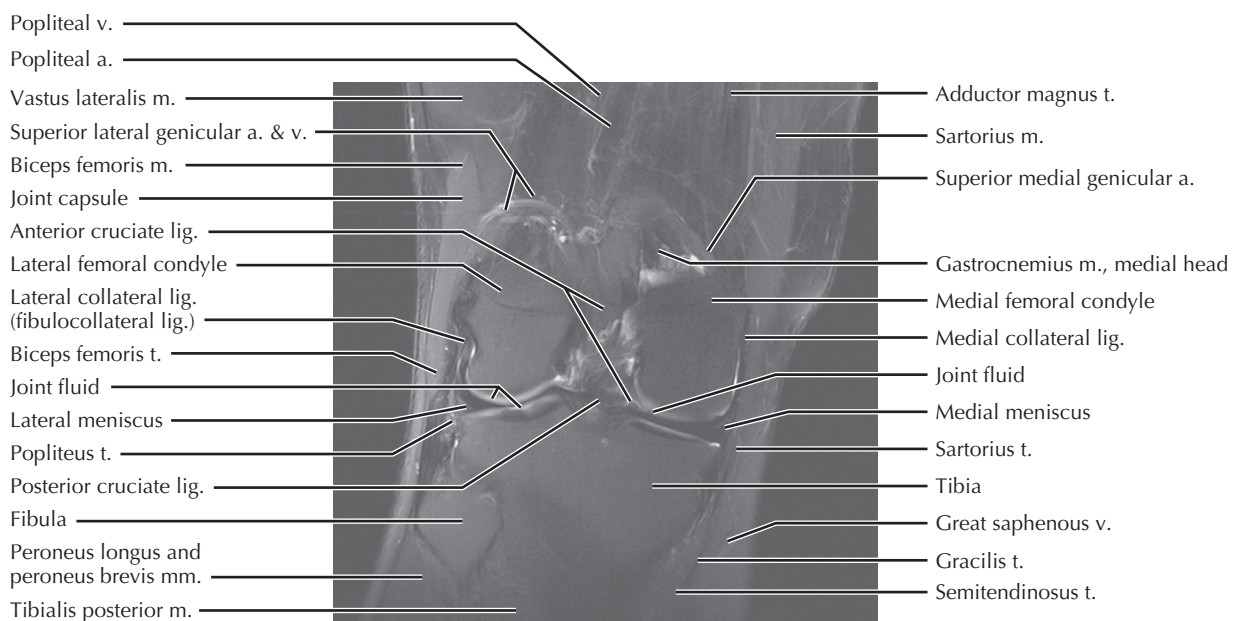
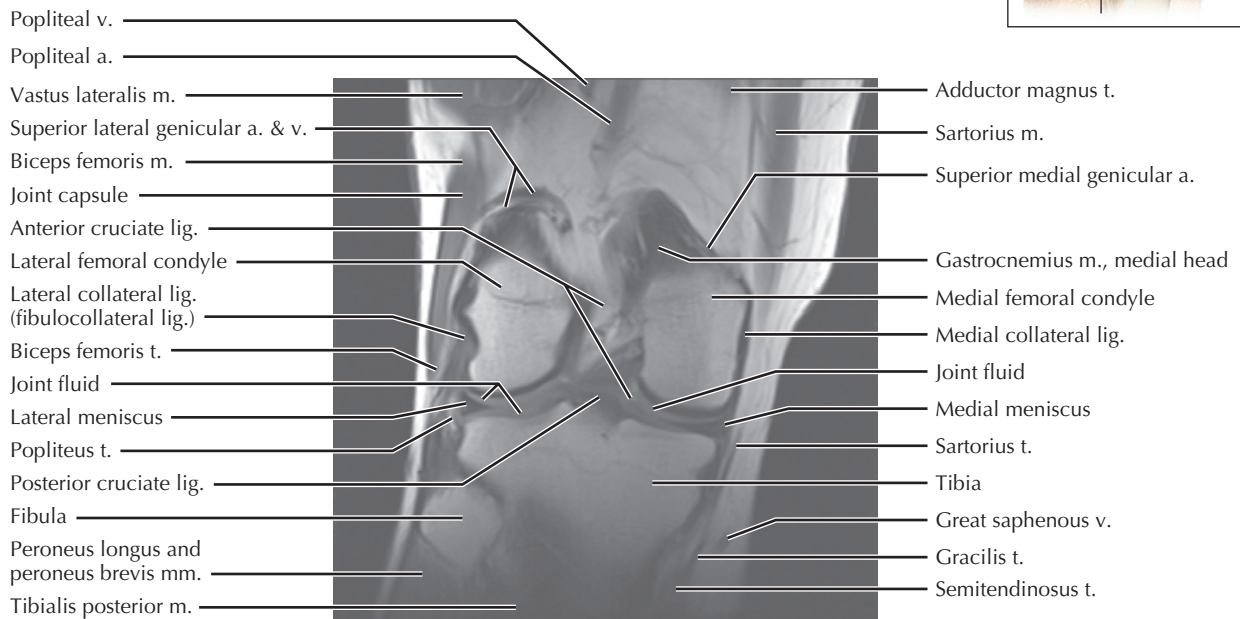
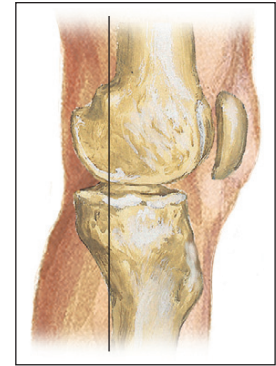
NORMAL ANATOMY

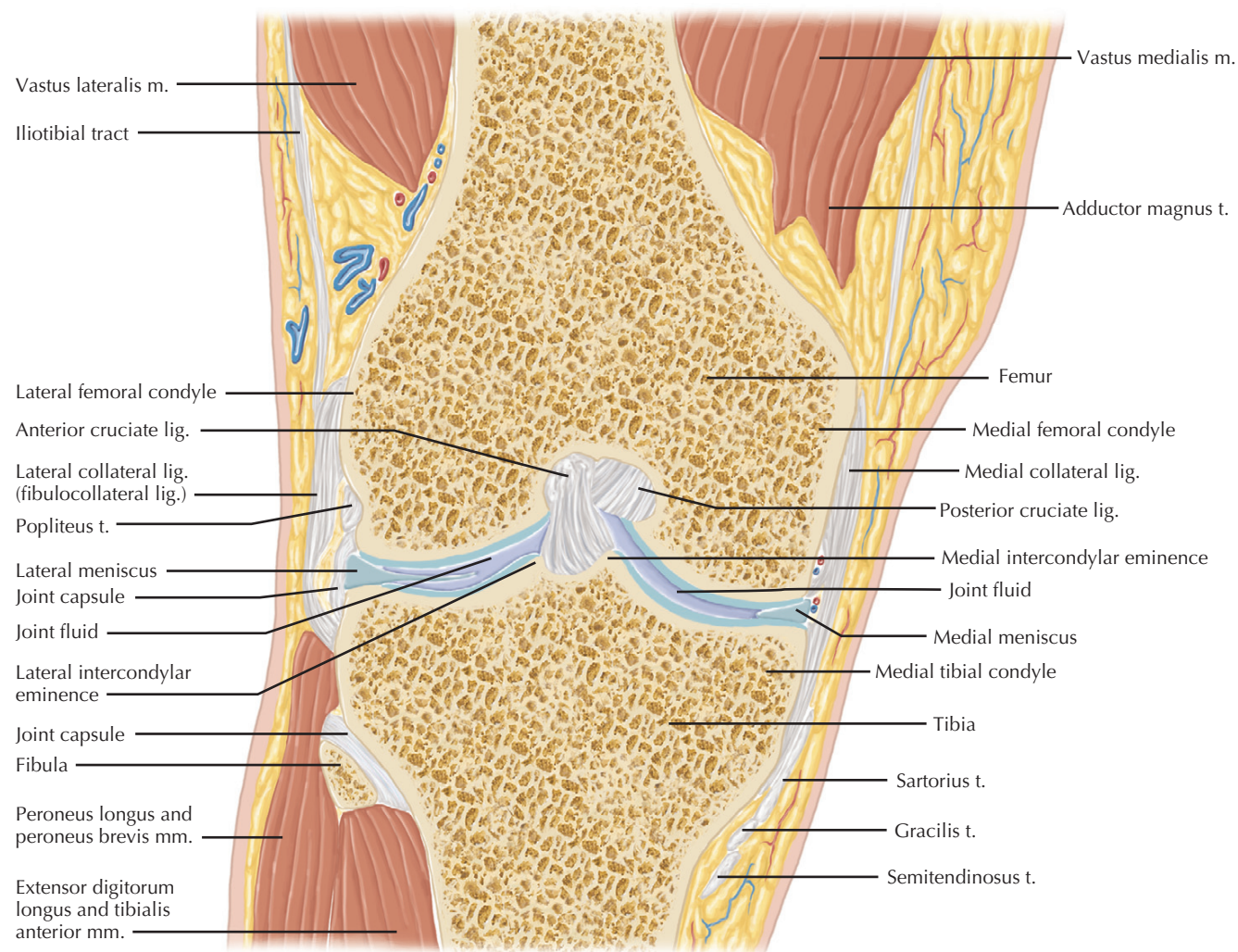
The normal meniscus has attachments to the tibia called "coronary ligaments," but they are not identified on imaging.

PATHOLOGIC PROCESS

The vascularity of the meniscus is near the periphery and is nonexistent near the free edge (intercondylar notch). Therefore, peripheral tears can more often be repaired, whereas more central or free-edge tears cannot.

Radial or free-edge tears of the meniscus can leave the meniscus with a truncated (or nontriangular) configuration.



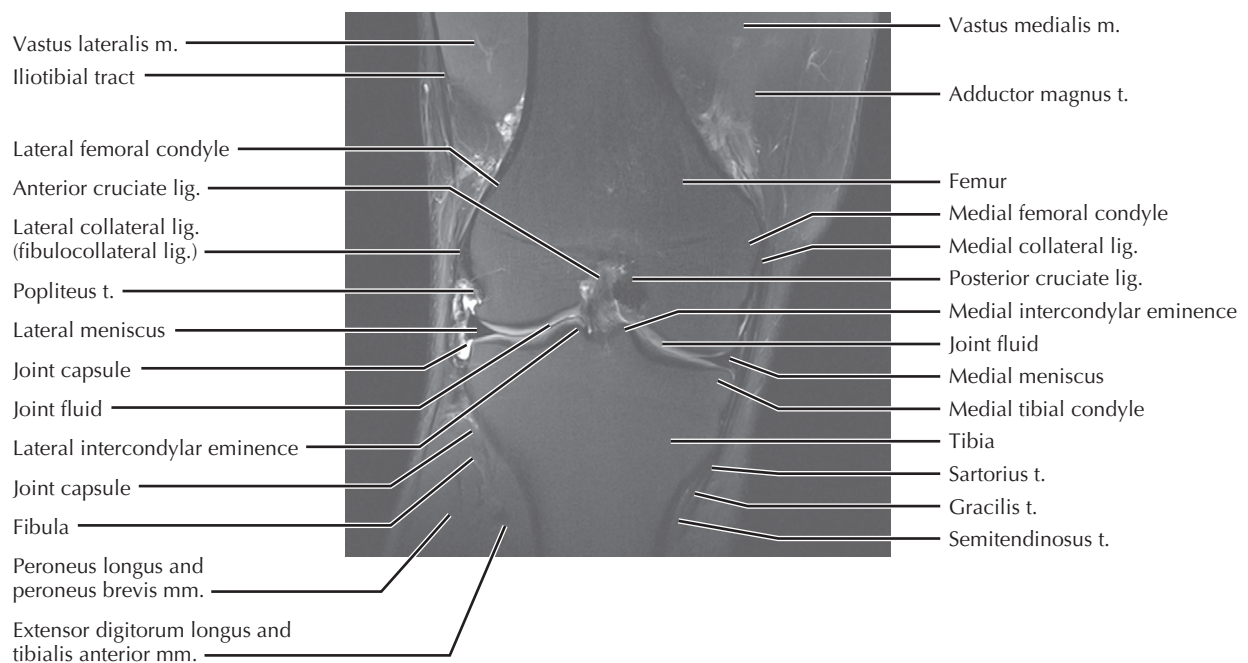
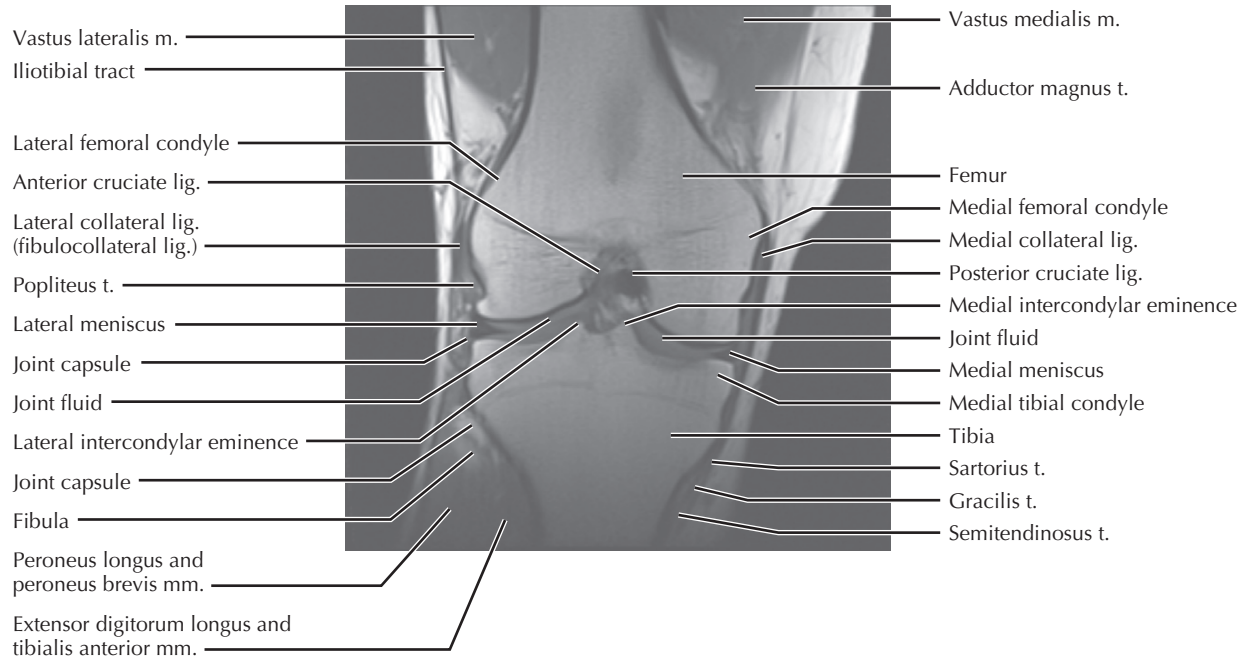
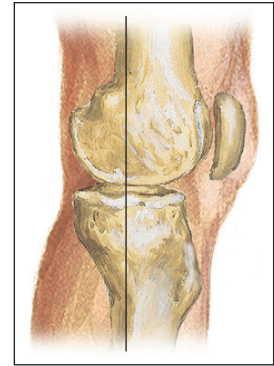


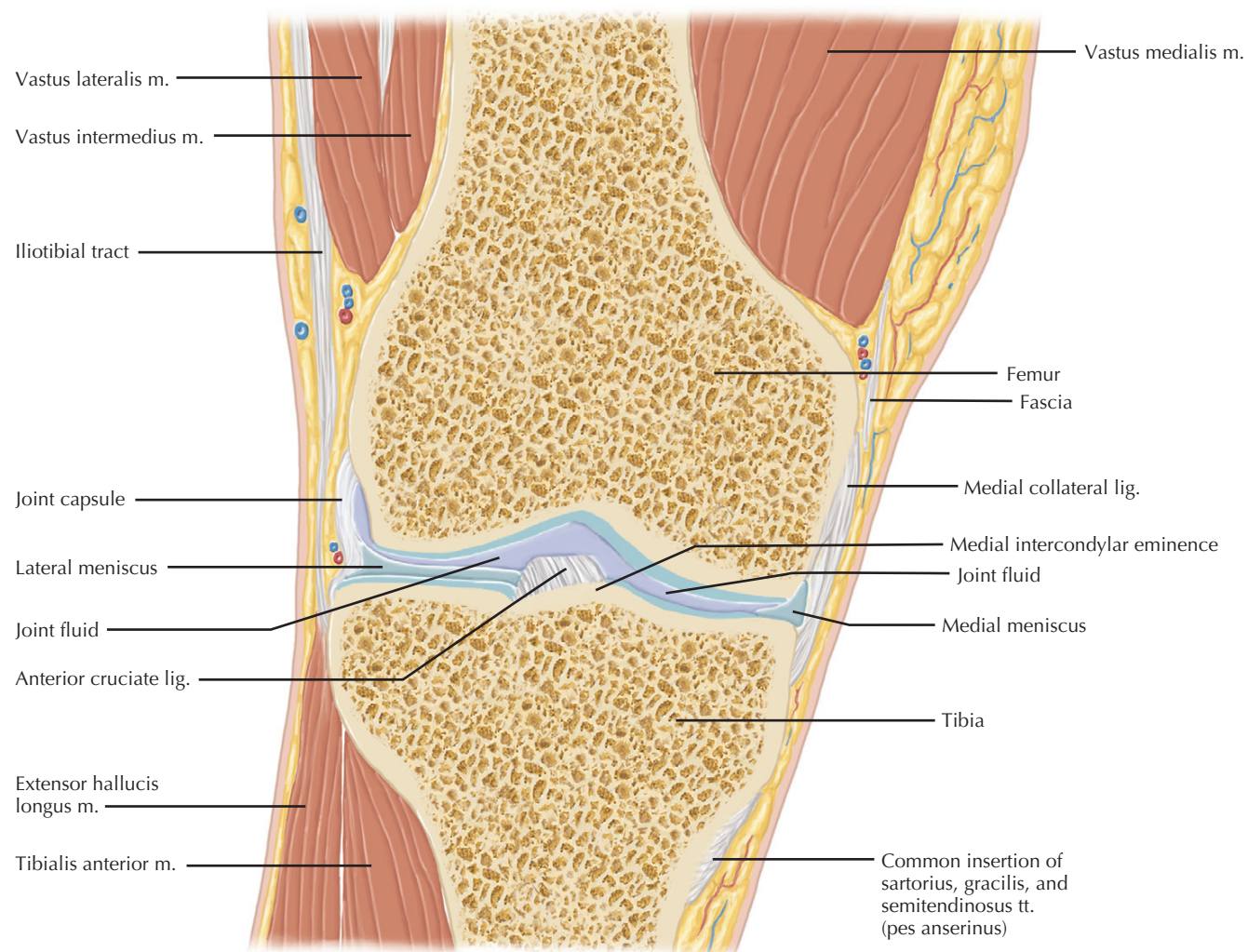
DIAGNOSTIC CONSIDERATION

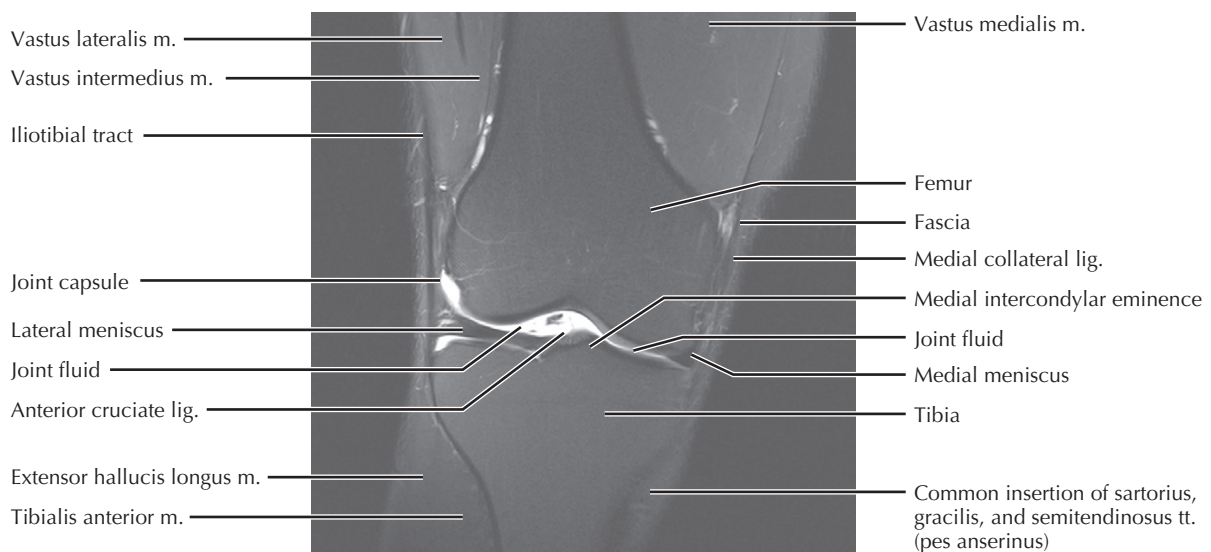
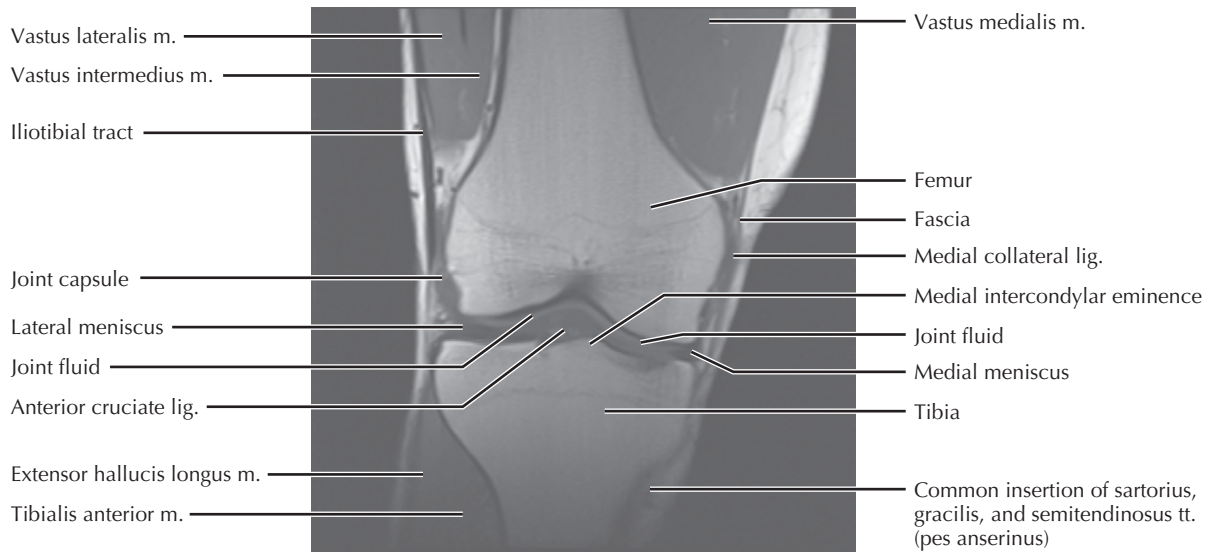
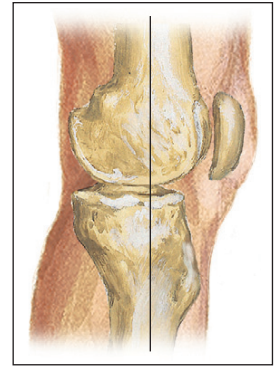
A sprain of the medial collateral ligament (MCL) is identified when fluid signal is noted superficial to the MCL (grade 1) and within the MCL (grade 2). Complete tears are disruptions of the MCL and are generally not referred to as "grade 3 injury," but instead, MCL tears.

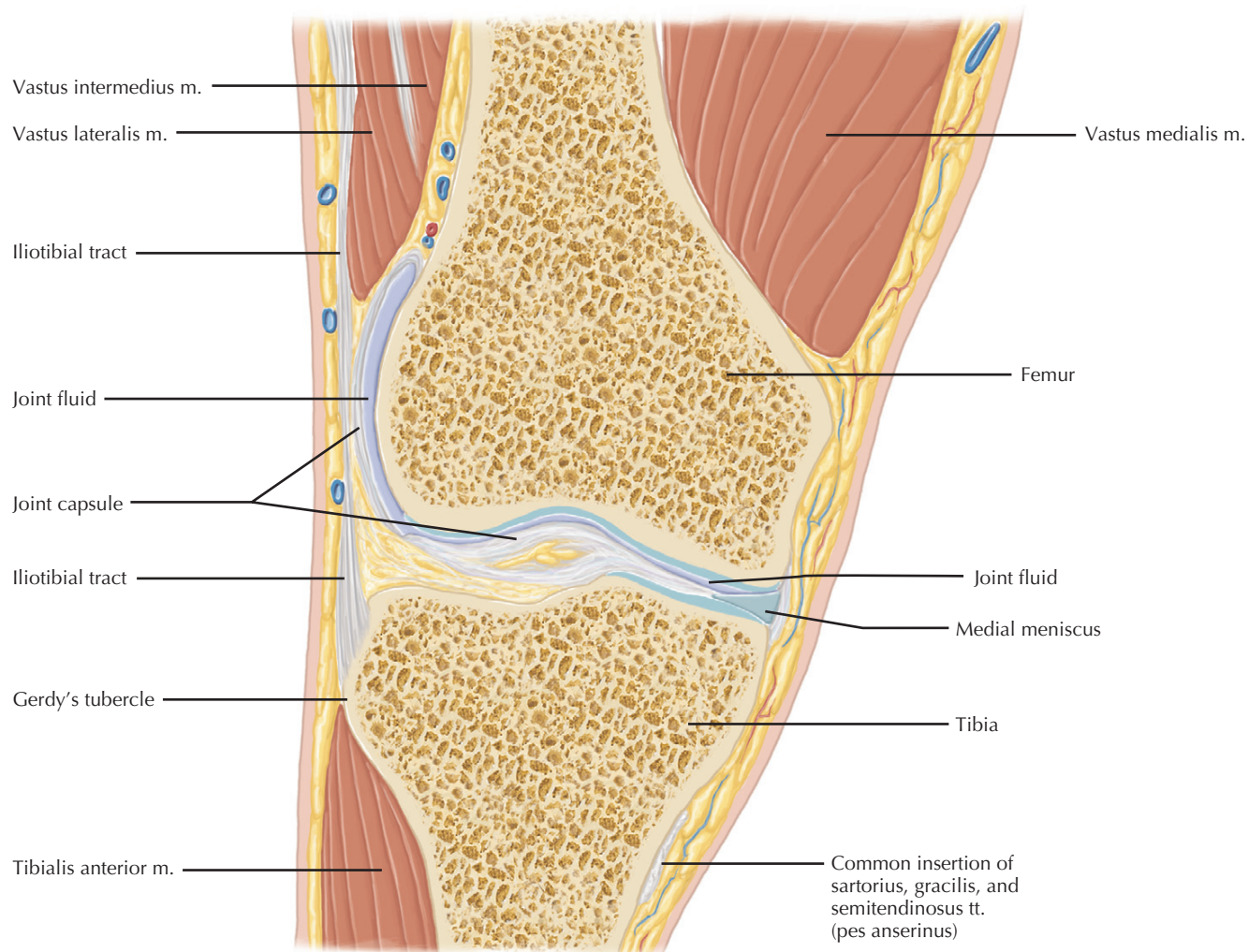
Meniscocapsular separations are diagnosed when there is fluid signal between the substance of the meniscus and the deep fibers of the MCL at the periphery of the meniscus. These are most often seen posteriorly.

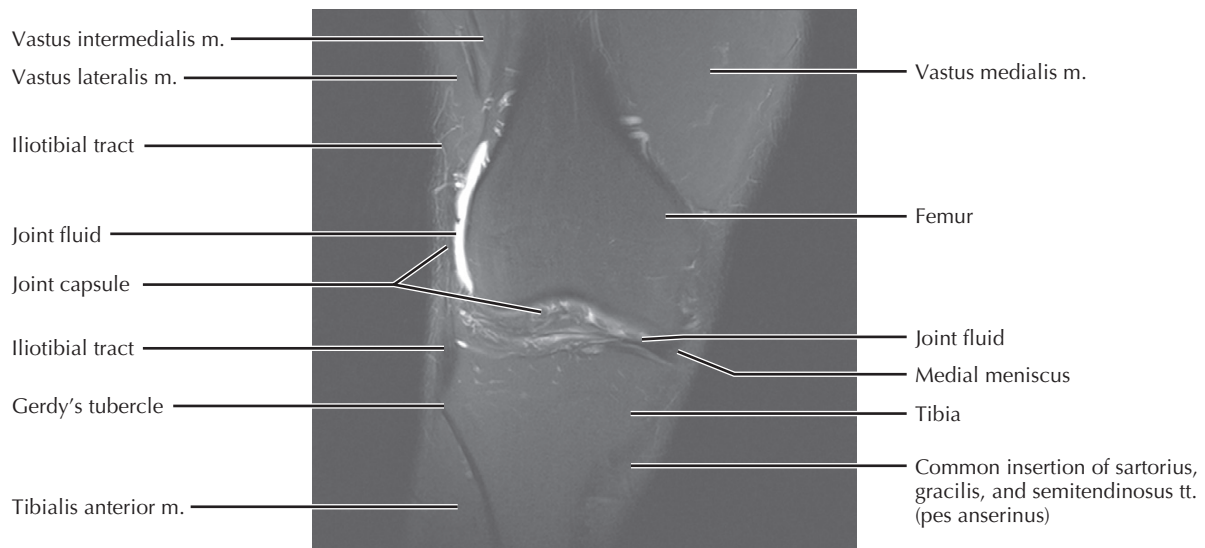
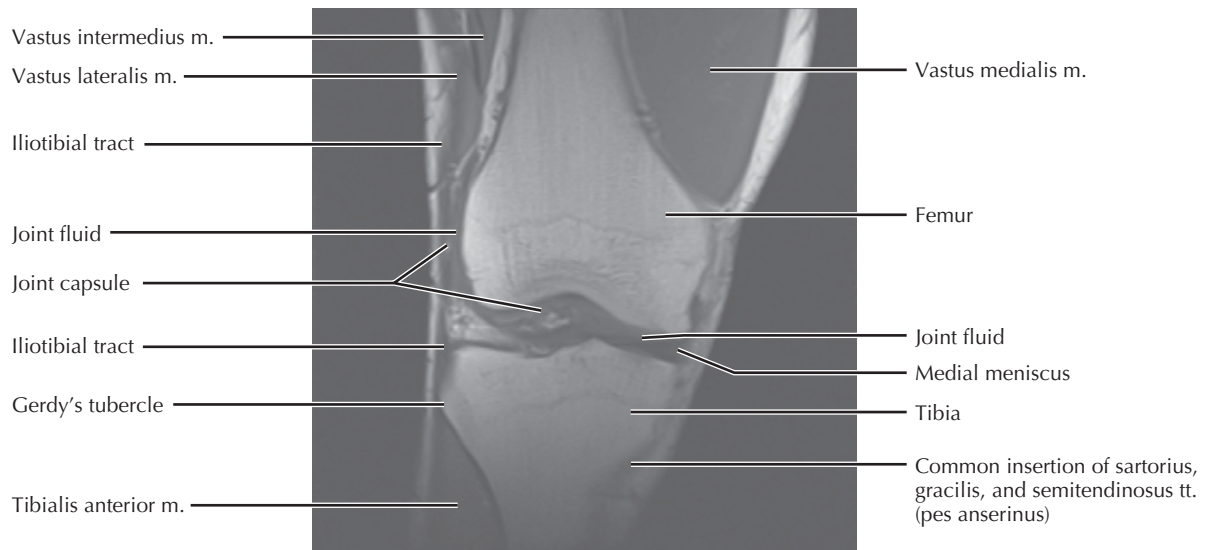
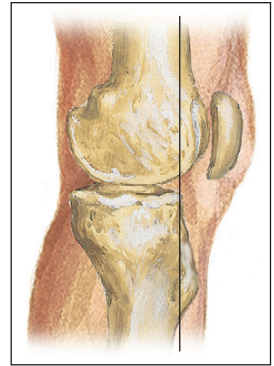
The MCL (or tibiocollateral ligament) bursa can be distinguished from meniscocapsular separation by identifying a well-defined fluid collection above and below the joint space, versus the diffuse distribution seen with a meniscocapsular separation.

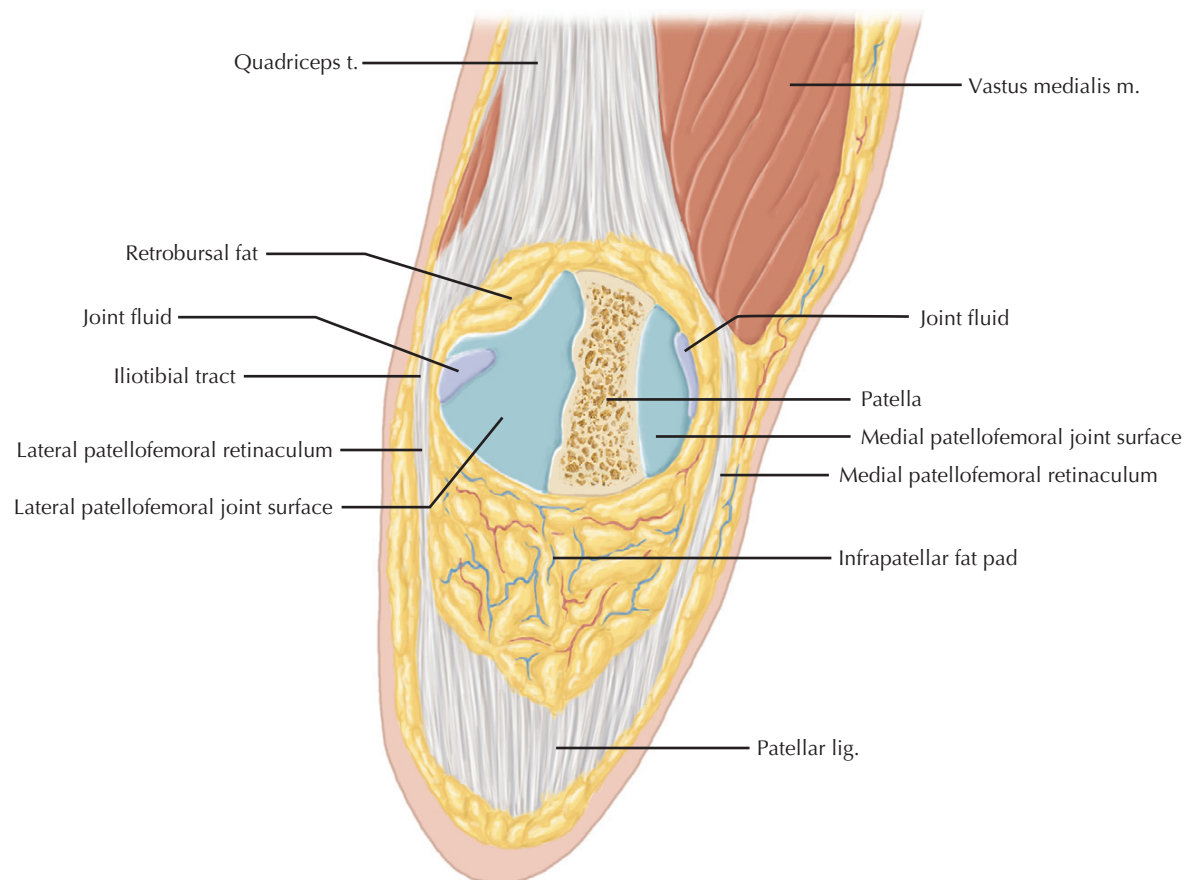


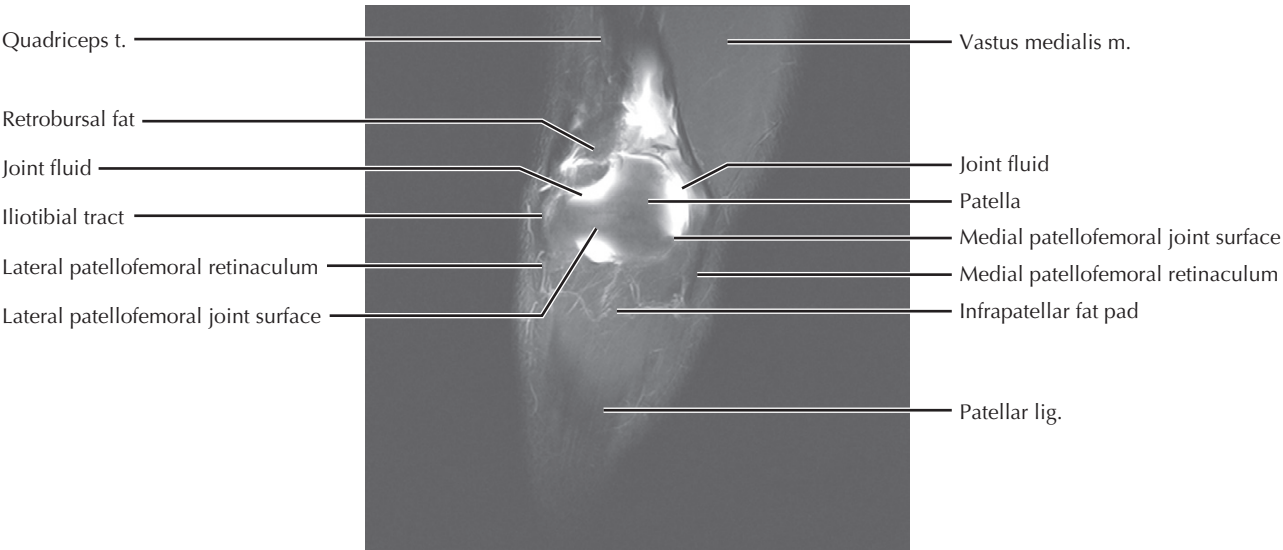
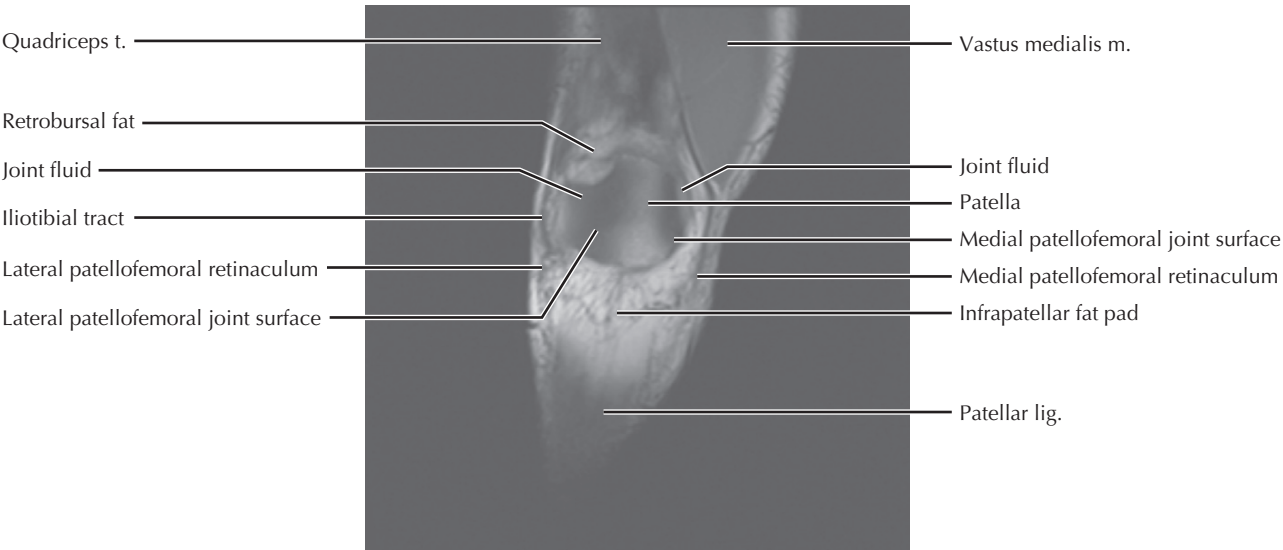
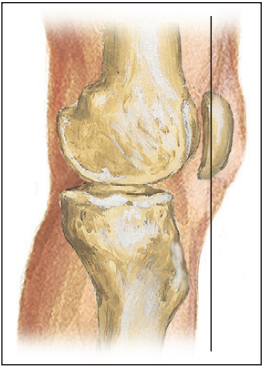


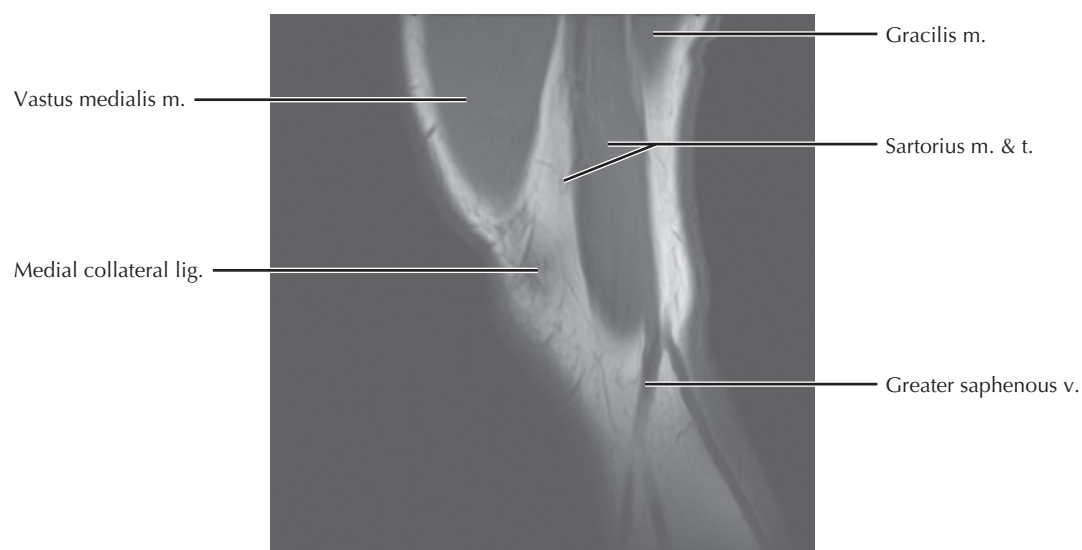
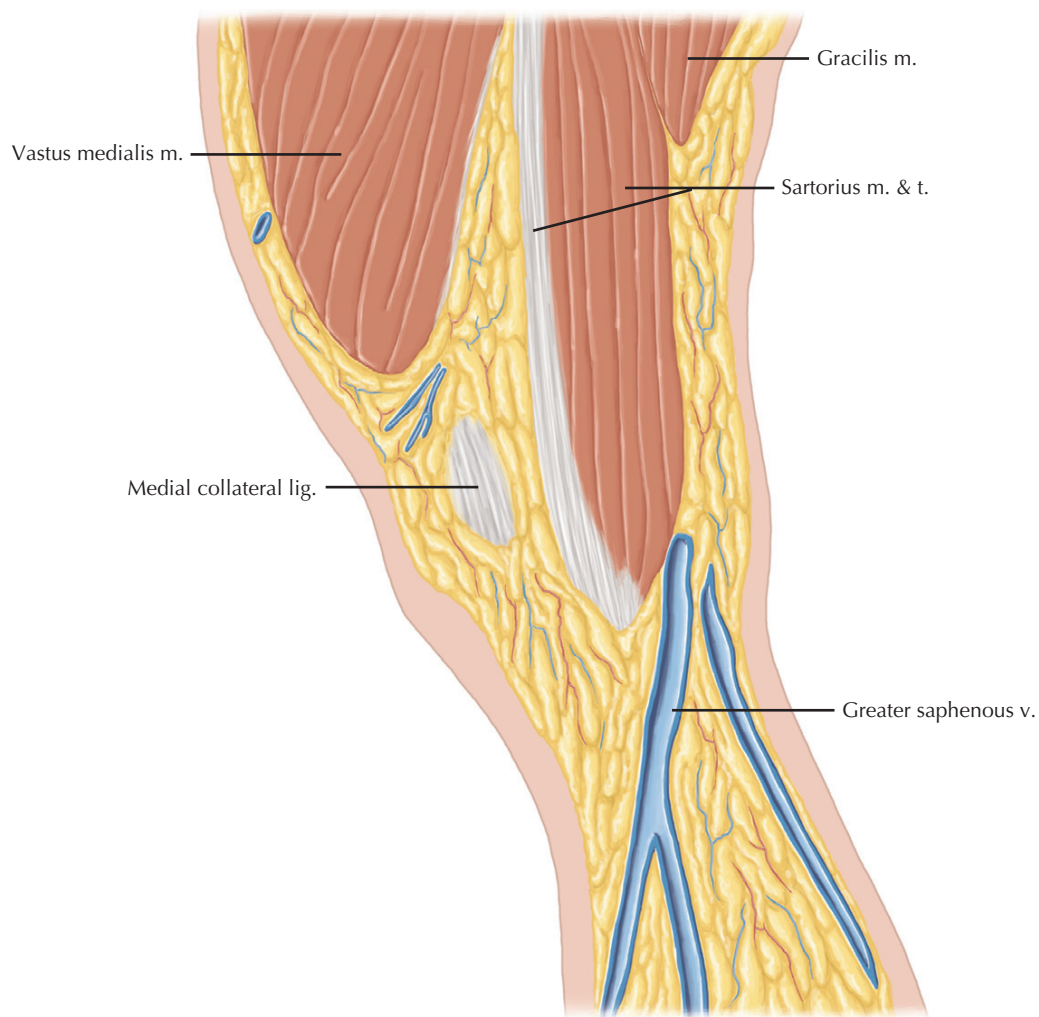


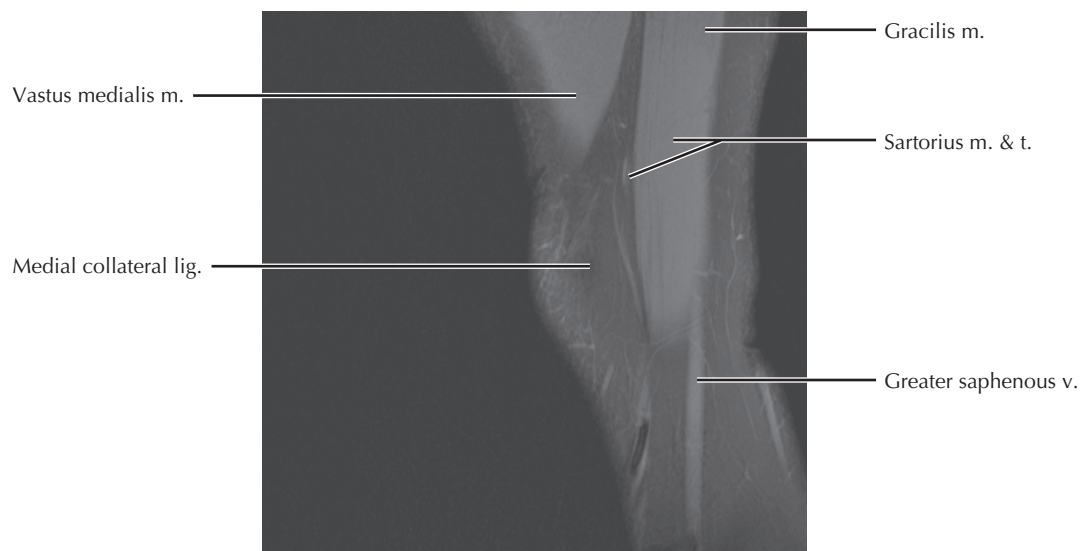
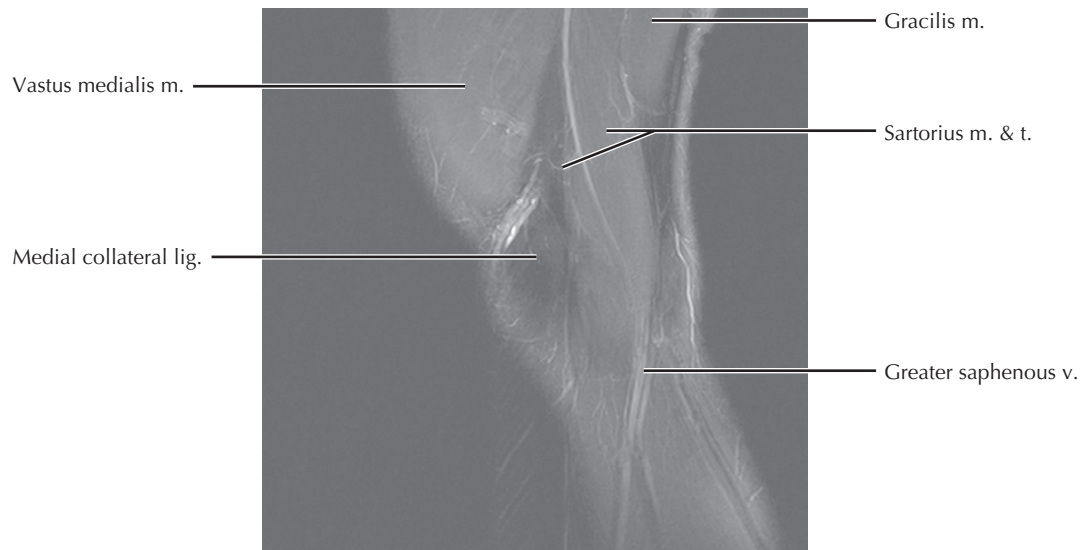
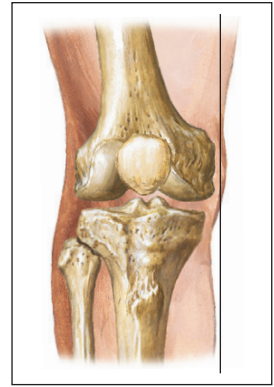


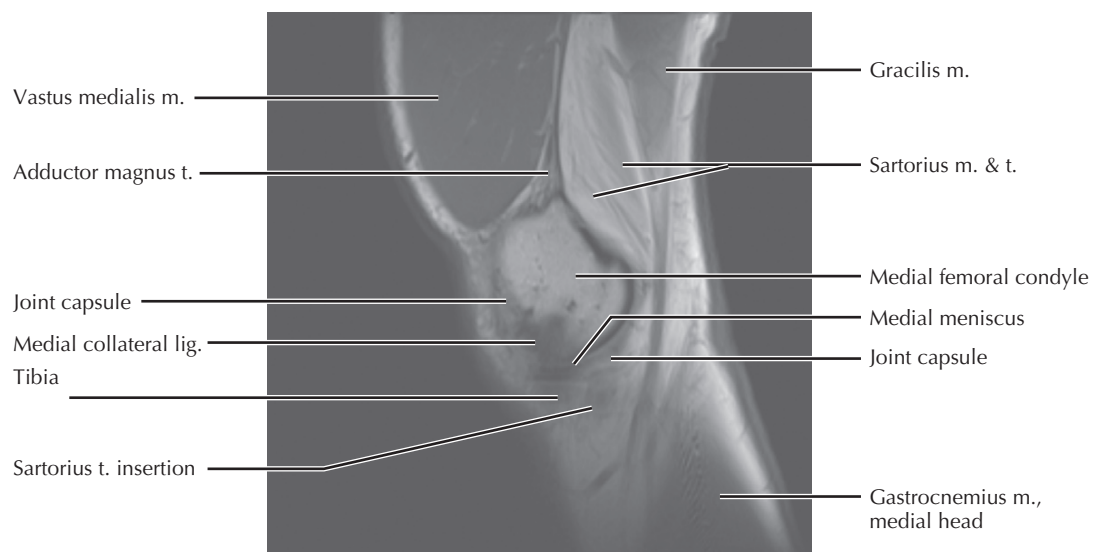
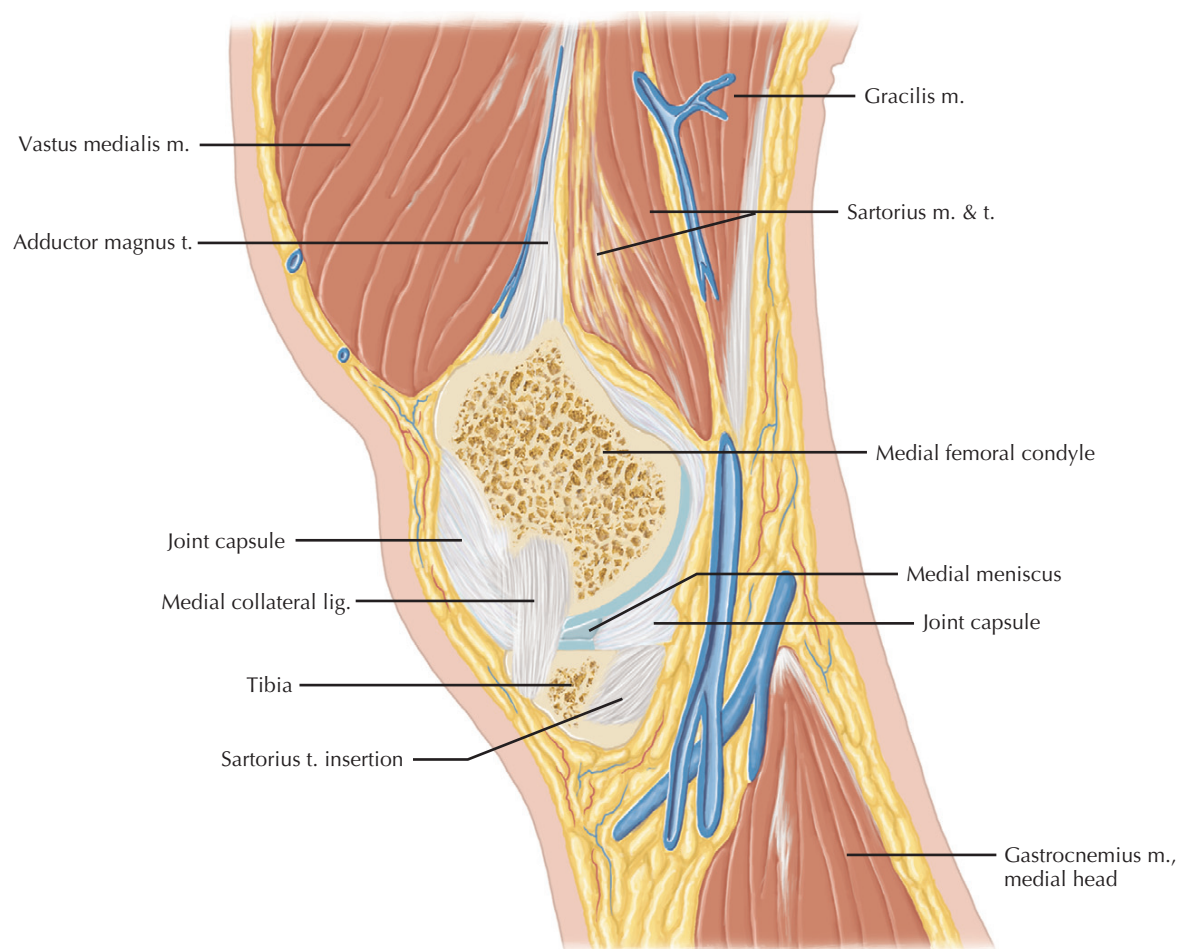


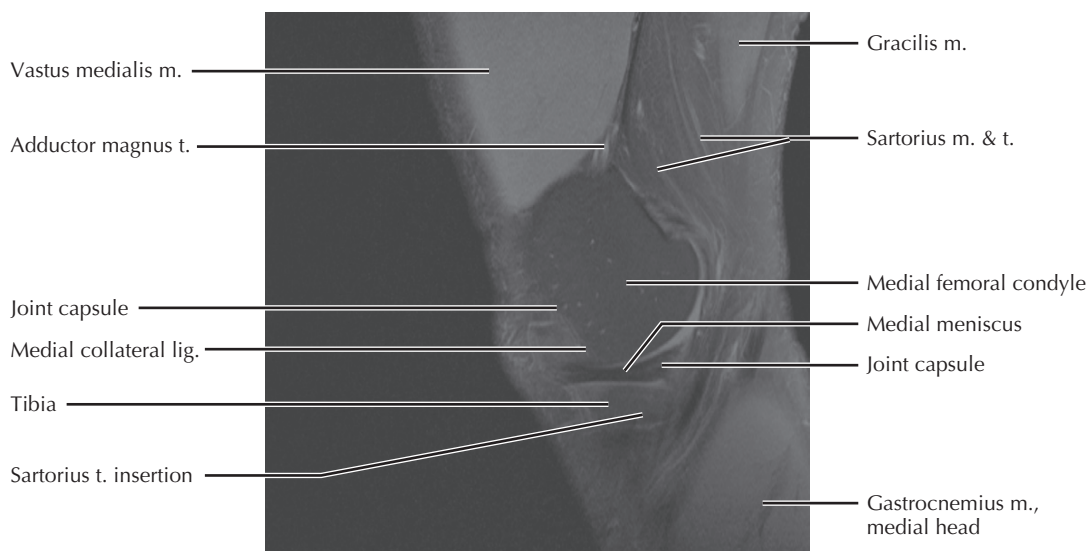
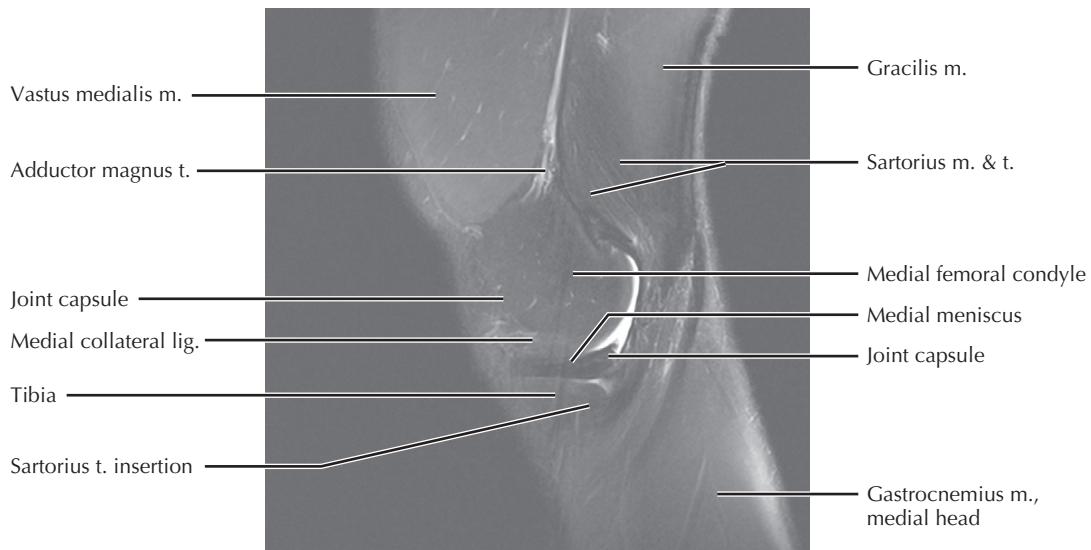
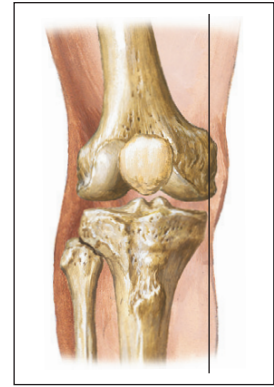


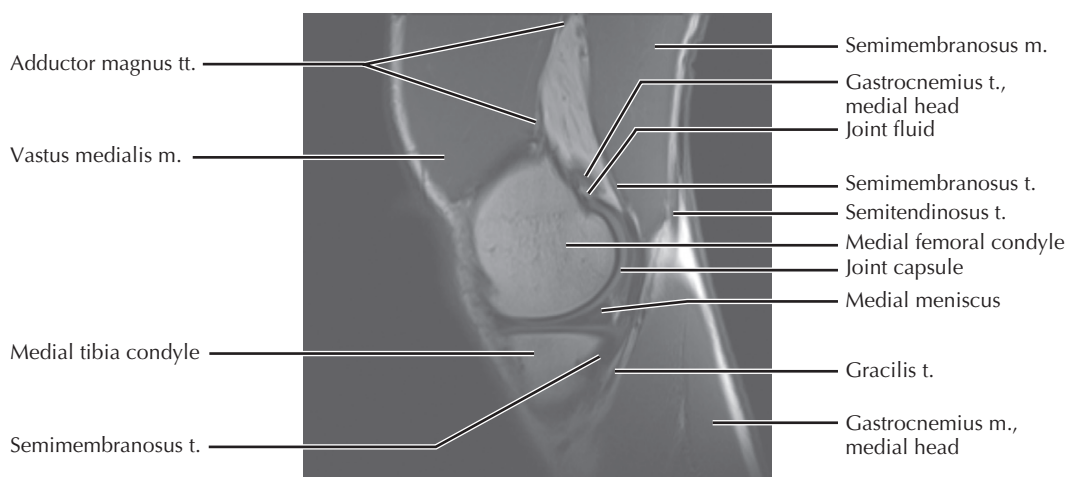
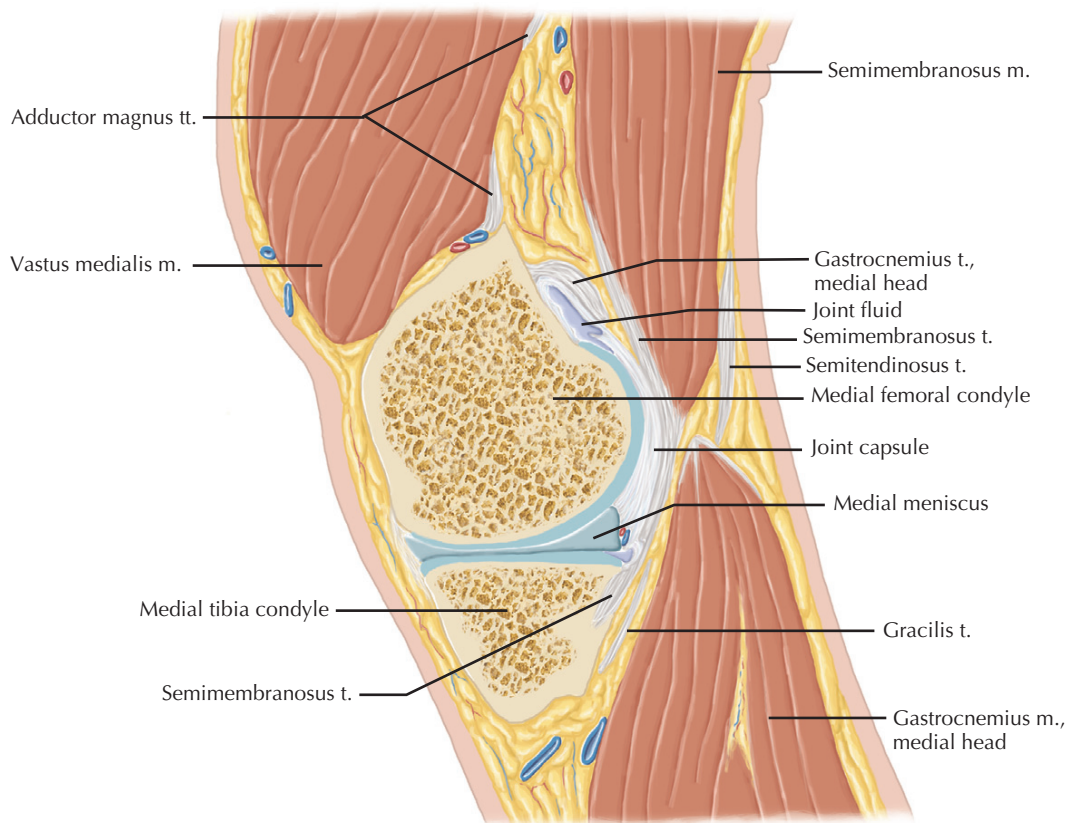












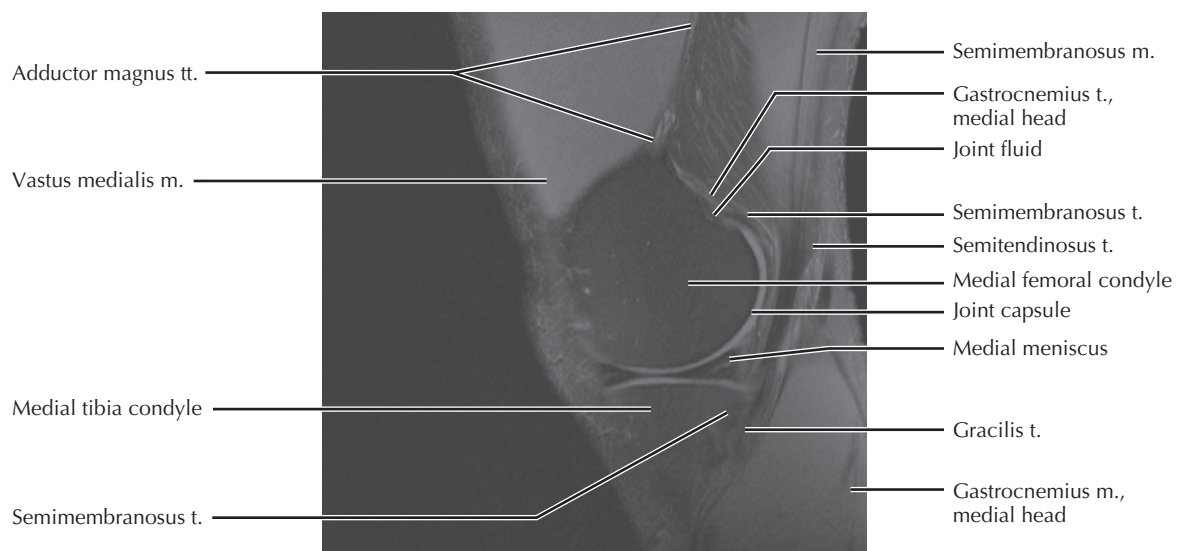
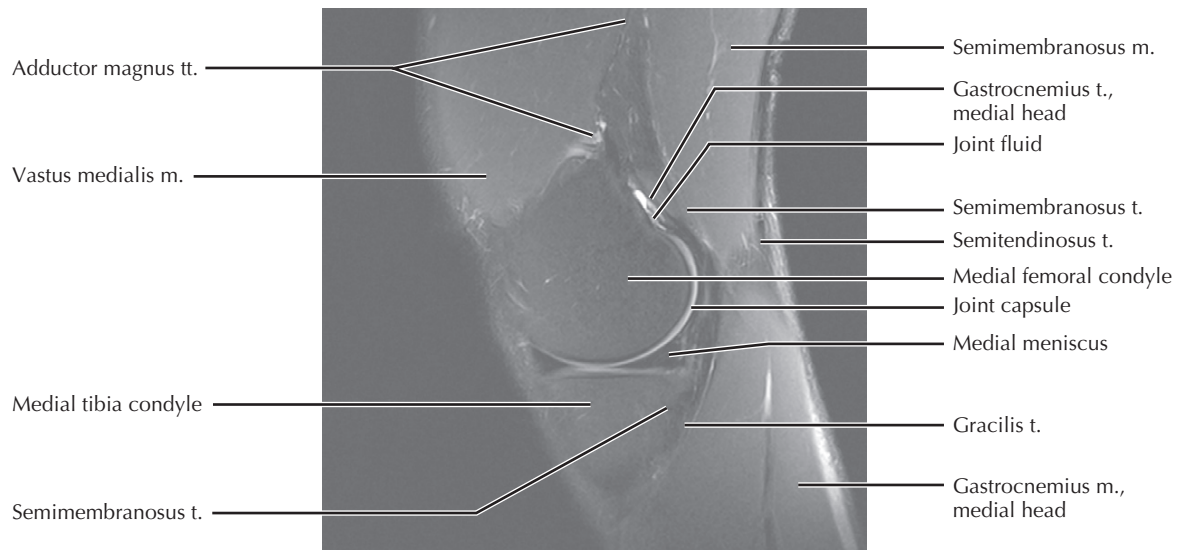
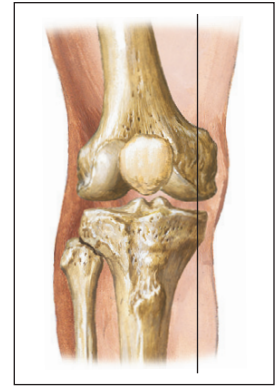
NORMAL ANATOMY

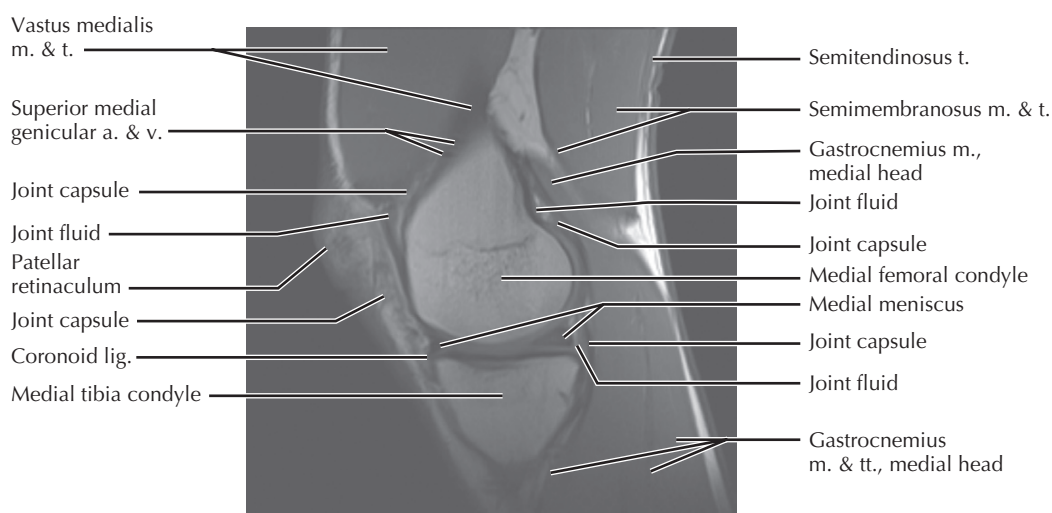
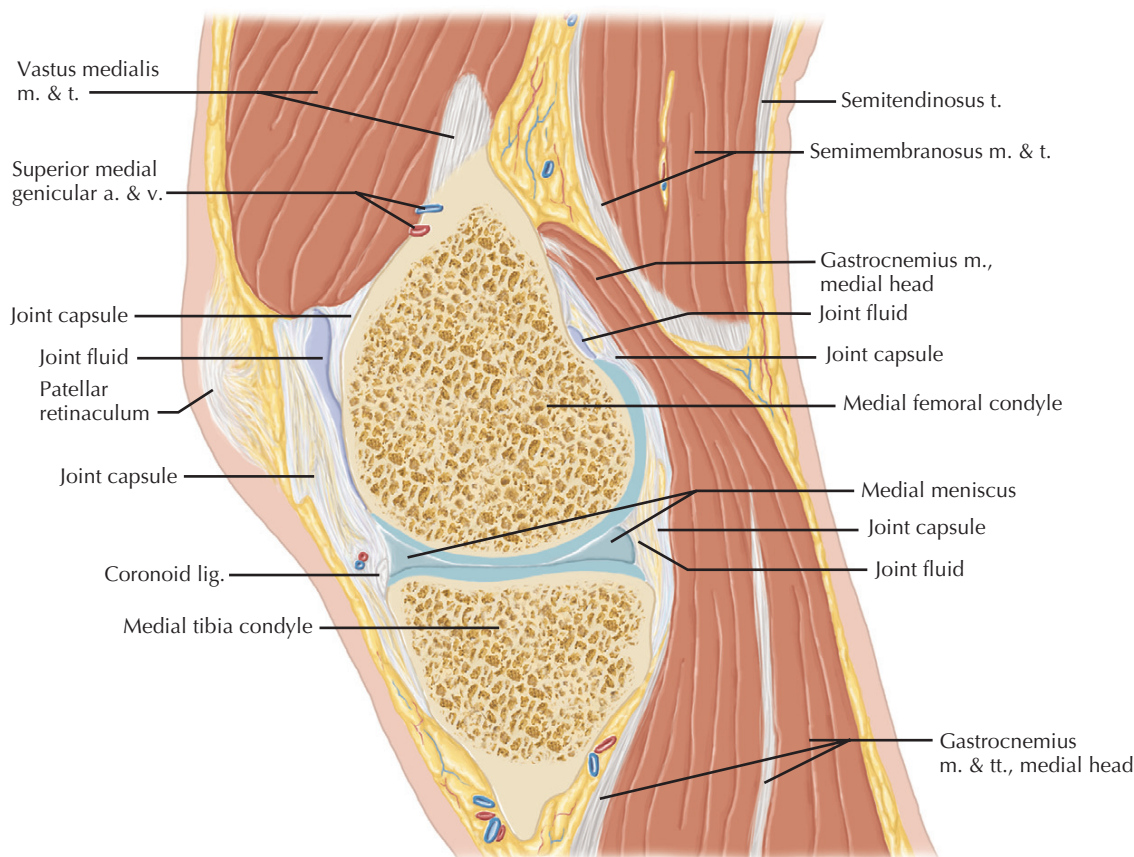
The posterior horn of the normal medial meniscus is larger than the anterior horn. In the medial meniscus, a posterior horn that is smaller than the anterior horn is postsurgical or torn.

The anterior and posterior horns are normally triangular in configuration.

DIAGNOSTIC CONSIDERATION

The insertion of the transverse ligament into the anterior horns of the meniscus may mimic a tear. Follow the transverse ligament across Hoffa's fat pad to the contralateral meniscus to verify normal configuration.



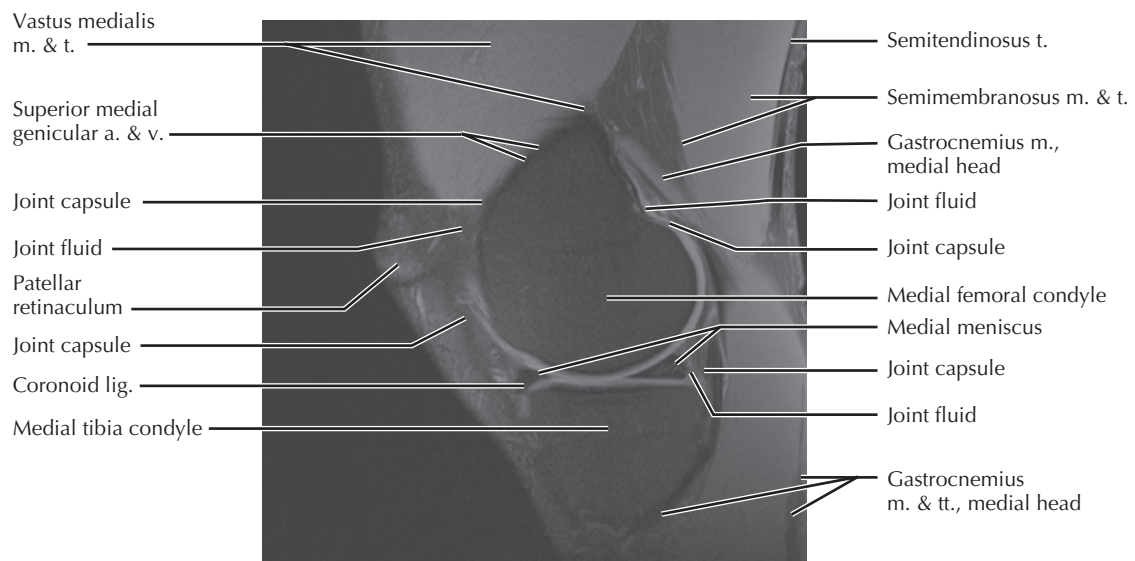
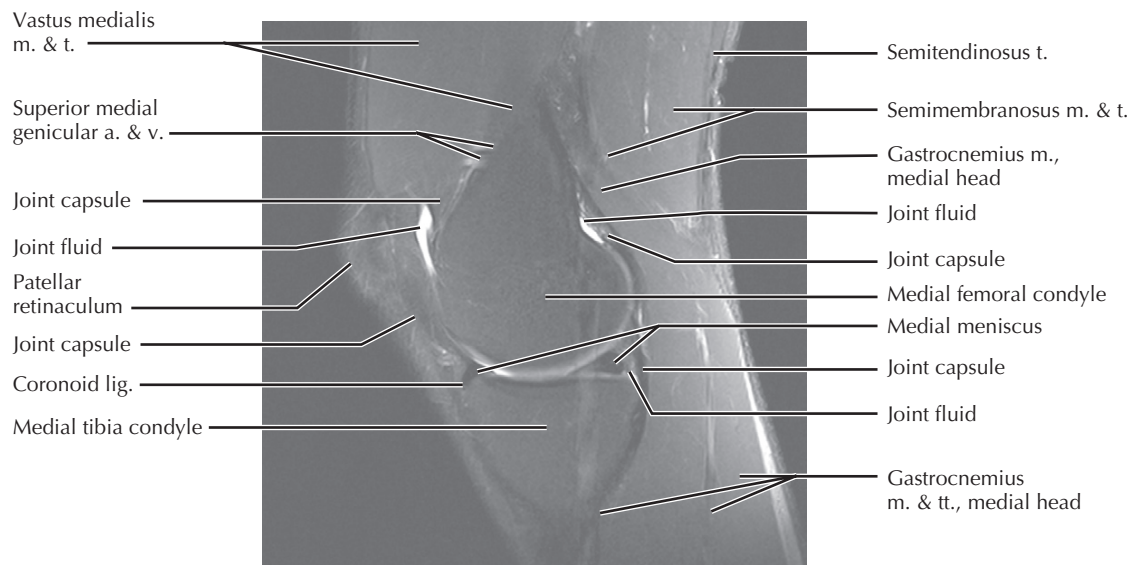
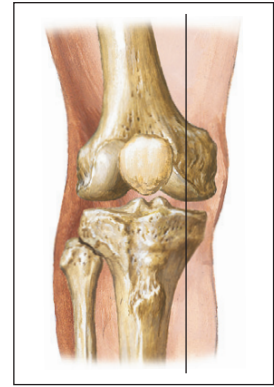


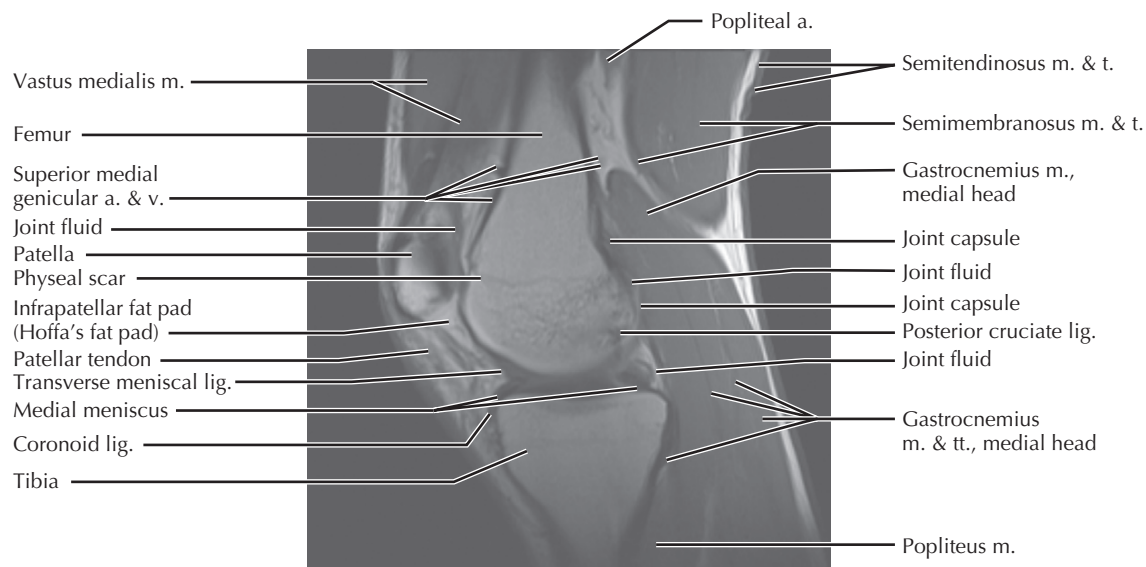
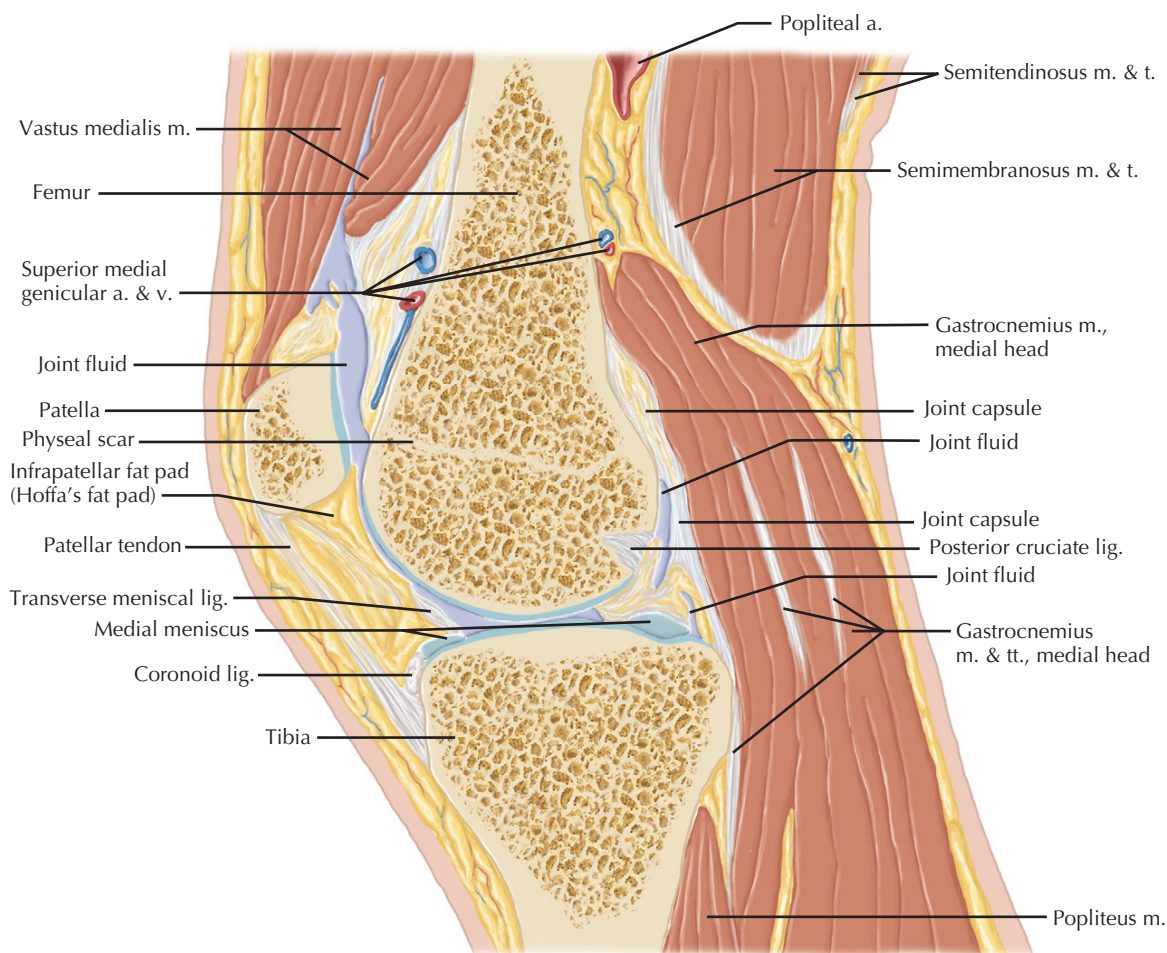
PATHOLOGIC PROCESS

Tears of the meniscus disrupt the articular surface. Signal within the meniscus that does not distort the meniscus or disrupt the articular surface indicates myxoid degeneration.

Tears in the meniscus as a result of degeneration are usually oriented obliquely and often affect the posterior horn of the medial meniscus.

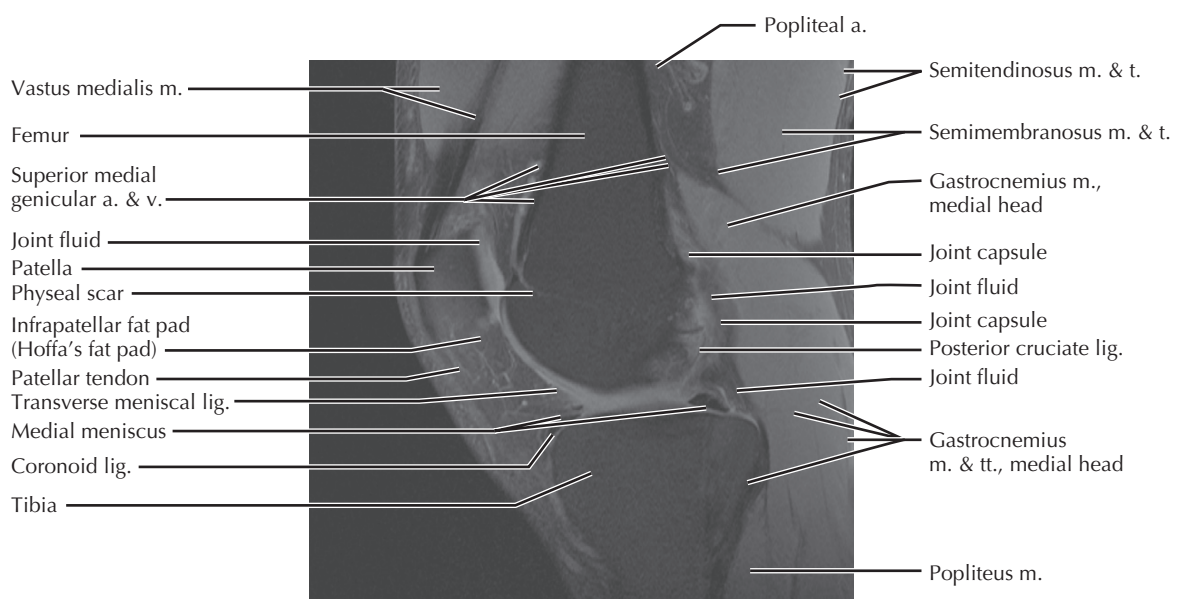
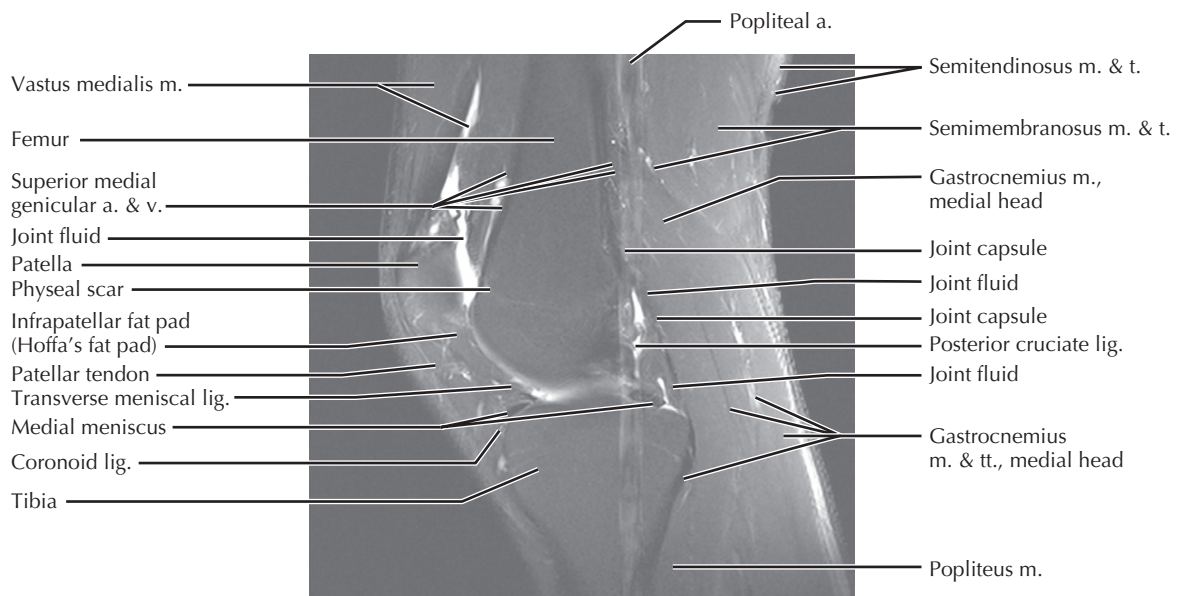
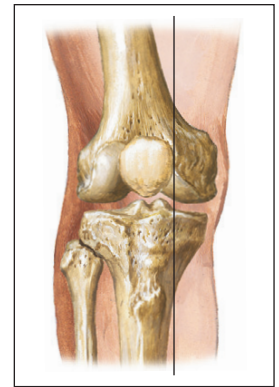
Contusions on the medial femoral condyle and posterior medial tibial plateau in the setting of an ACL tear suggest an injury to the peripheral medial meniscus at the capsular interface.

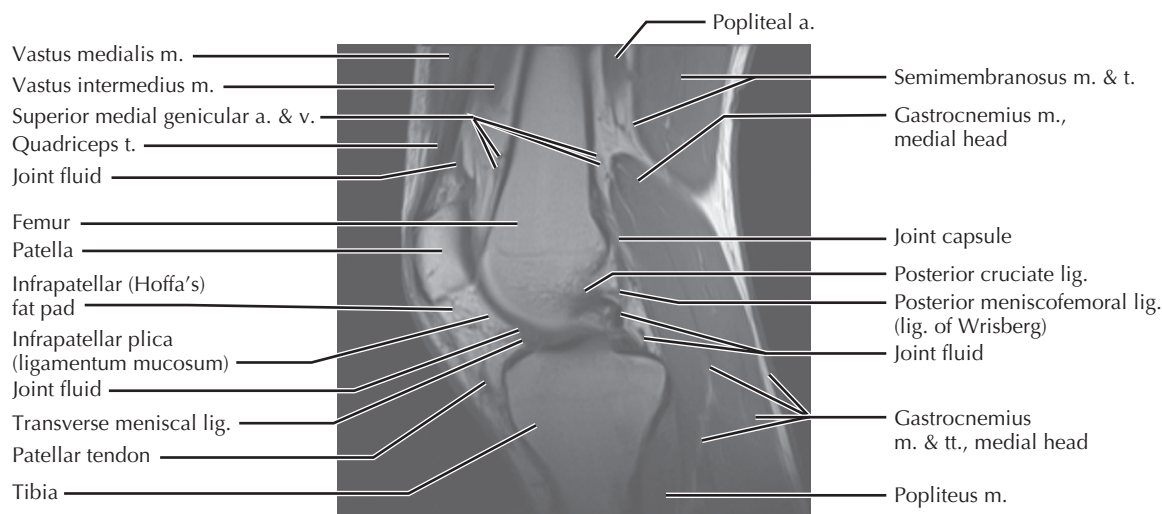
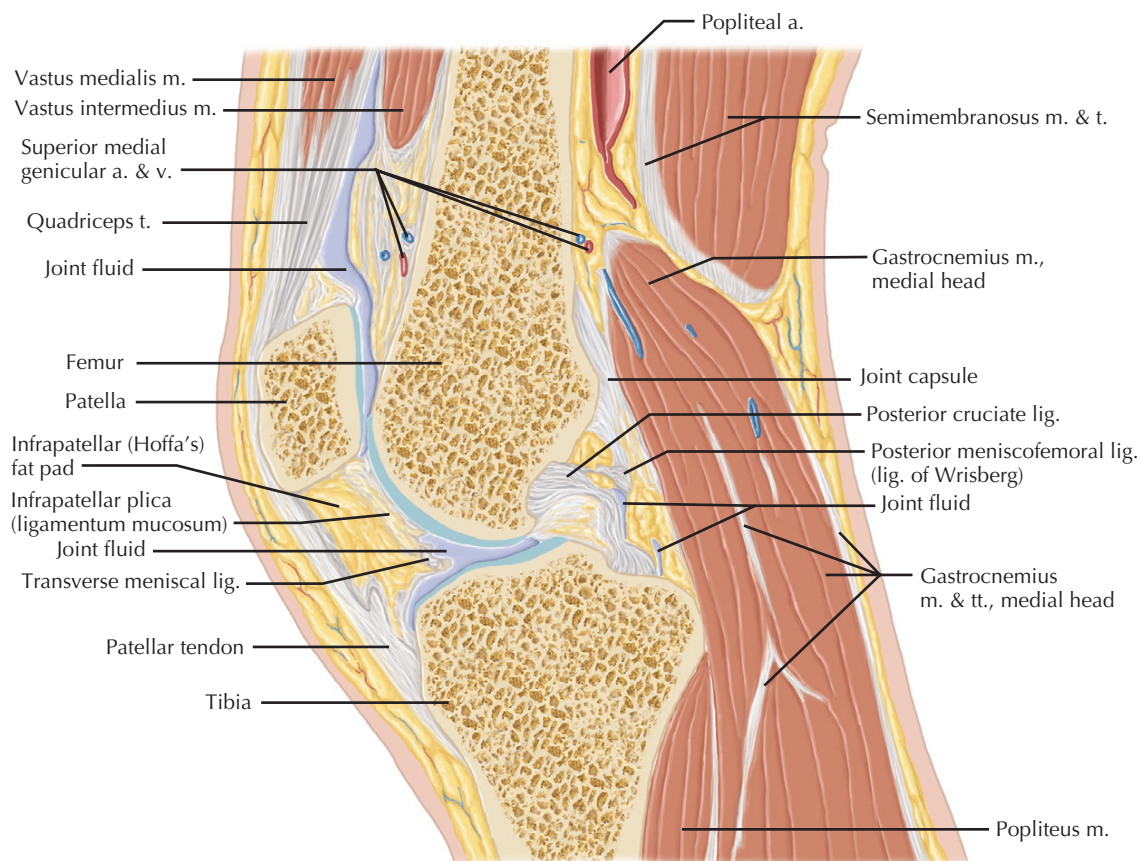




NORMAL ANATOMY

The infrapatellar plica is seen within Hoffa's fat pad and arises from the inferior surface of the patella, travels through Hoffa's fat pad, and engulfs the transverse ligament as it spreads along the anterior aspect of the ACL. Orthopedic surgeons refer to this structure as the "ligamentum mucosum," and it is easily resected at arthroscopy.



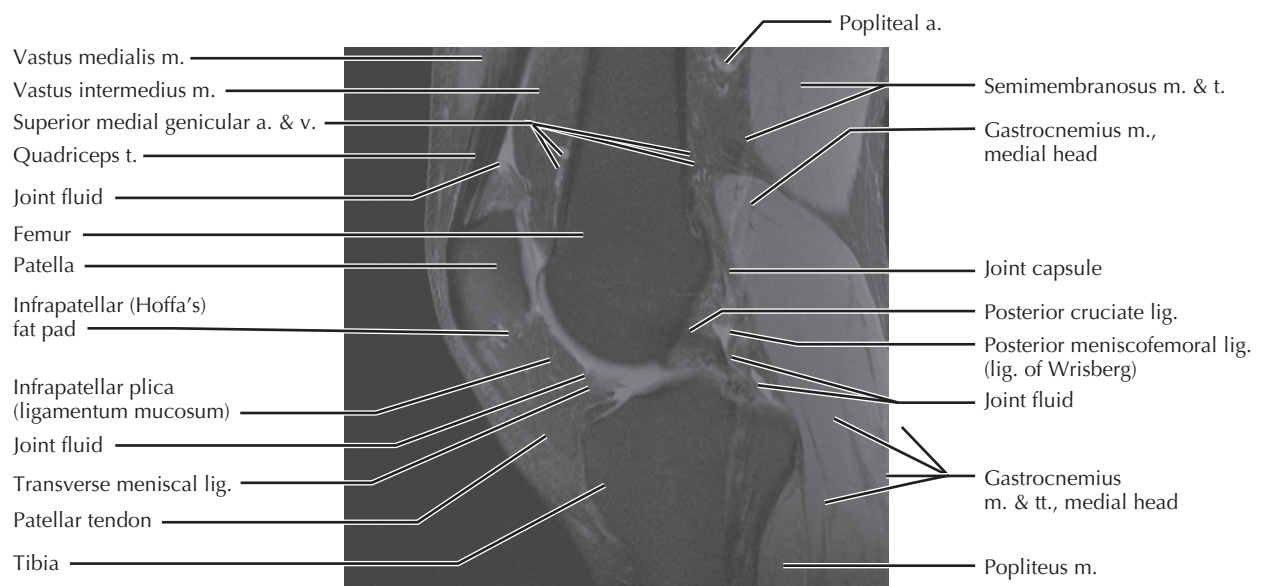
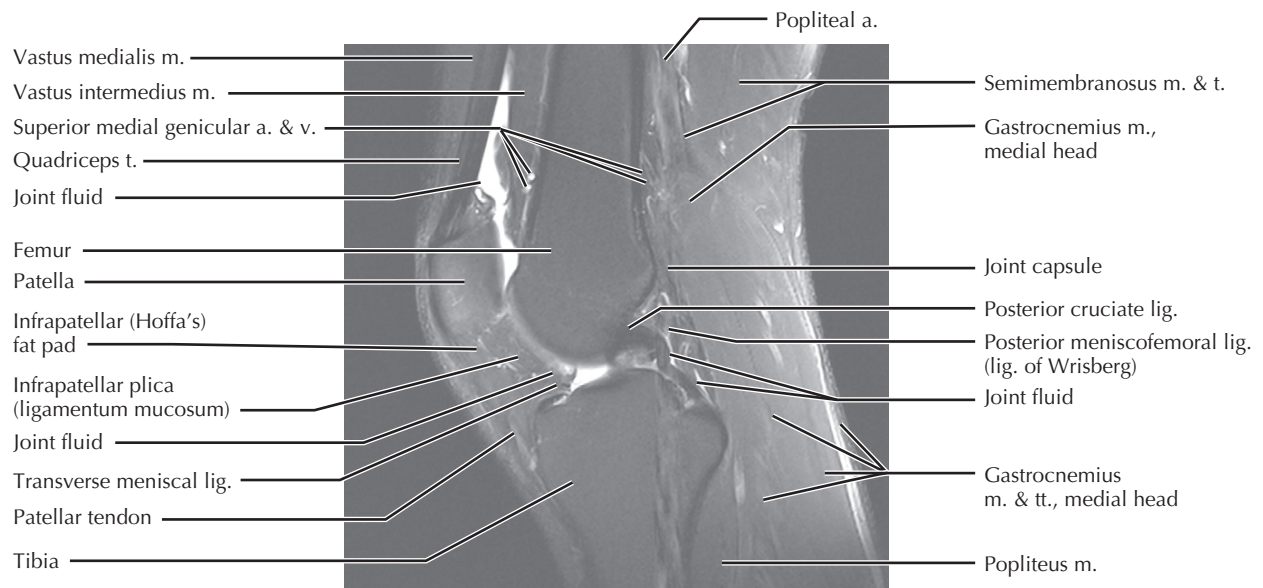
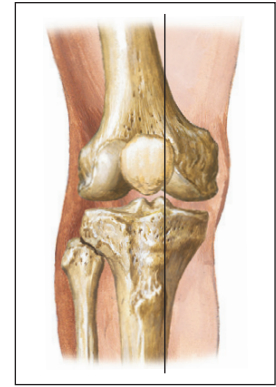


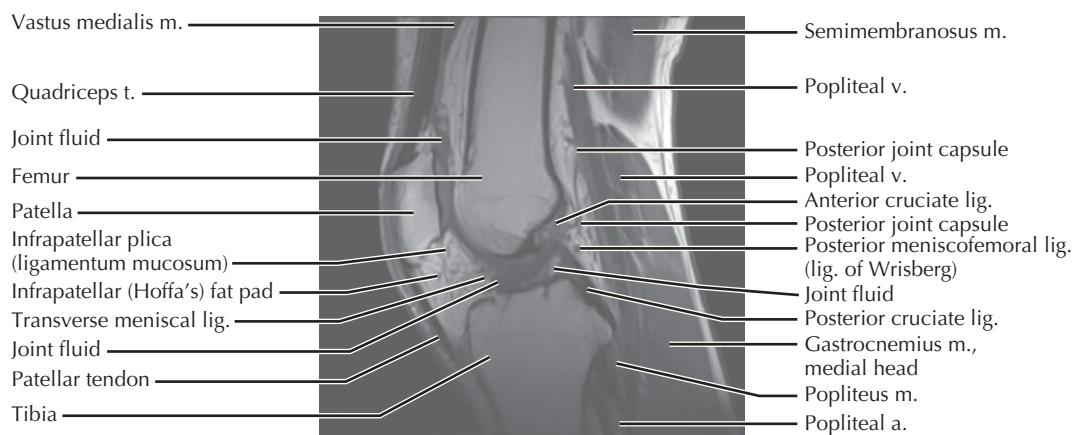
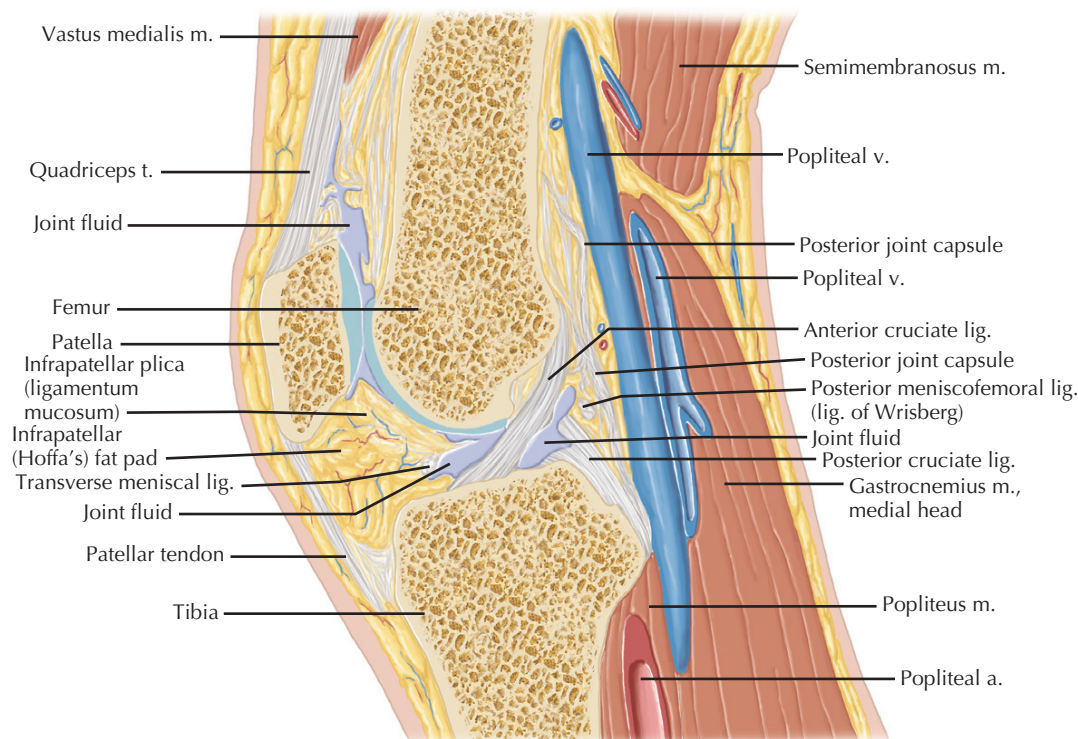
PATHOLOGIC PROCESS

"Bucket handle" tears are vertical longitudinal tears affecting the meniscus. The flipped portion of the meniscus is the "handle" of the bucket and may be located in various locations in the joint, but when "flipped" into the notch, it can appear as two PCLs. Therefore, this entity is also referred to as the "double PCL" sign.

NORMAL VARIANT

The meniscofemoral ligaments can be seen anterior (ligament of Humphry) or posterior (ligament of Wrisberg) to the PCL. A Humphry or Wrisberg ligament is present in 75% of cases on imaging.





PATHOLOGIC PROCESS

A torn ACL is usually obvious because no normal-appearing fibers of the ACL can be identified within the notch.

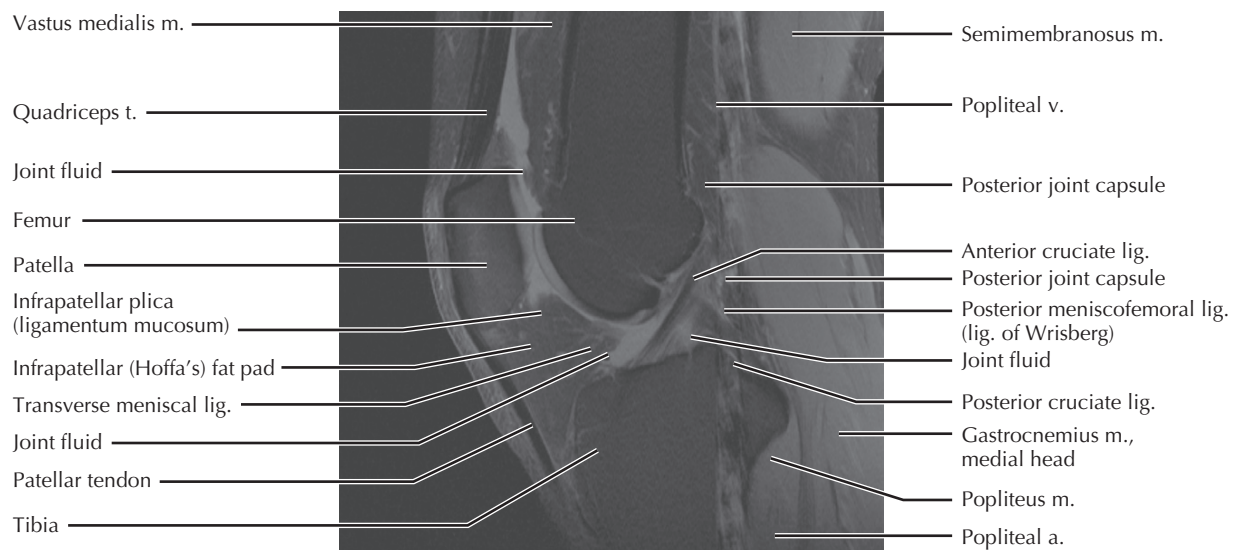
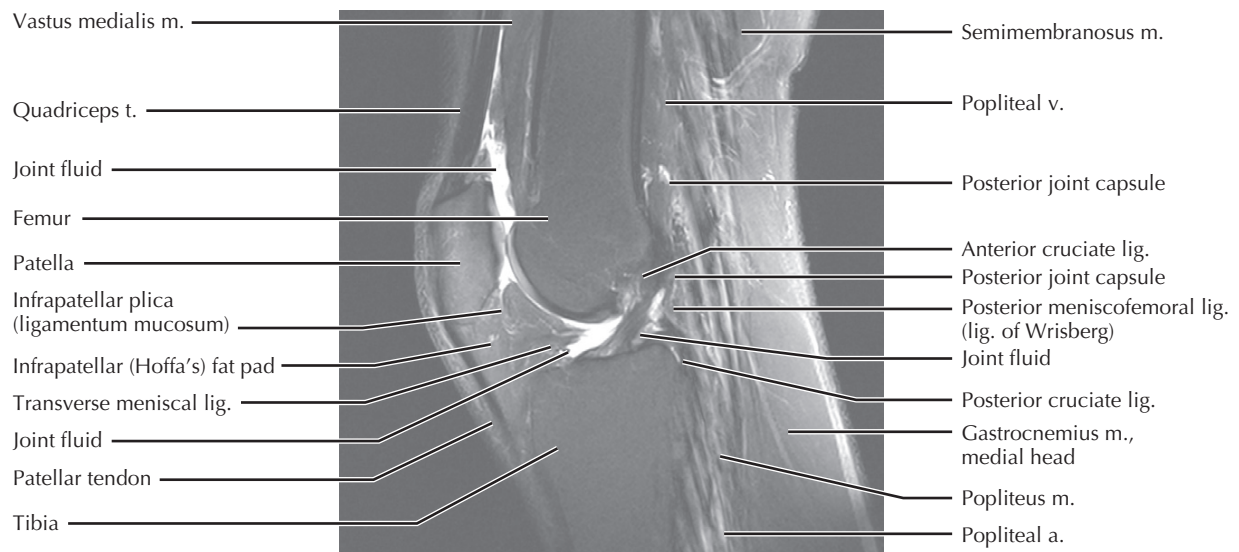
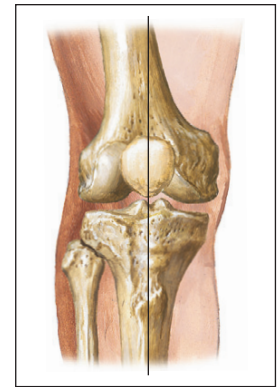
NORMAL ANATOMY

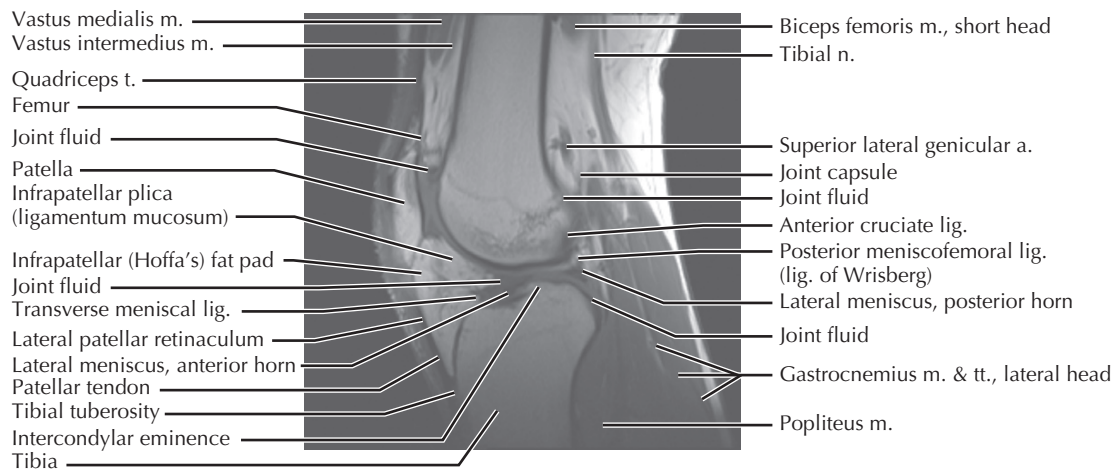
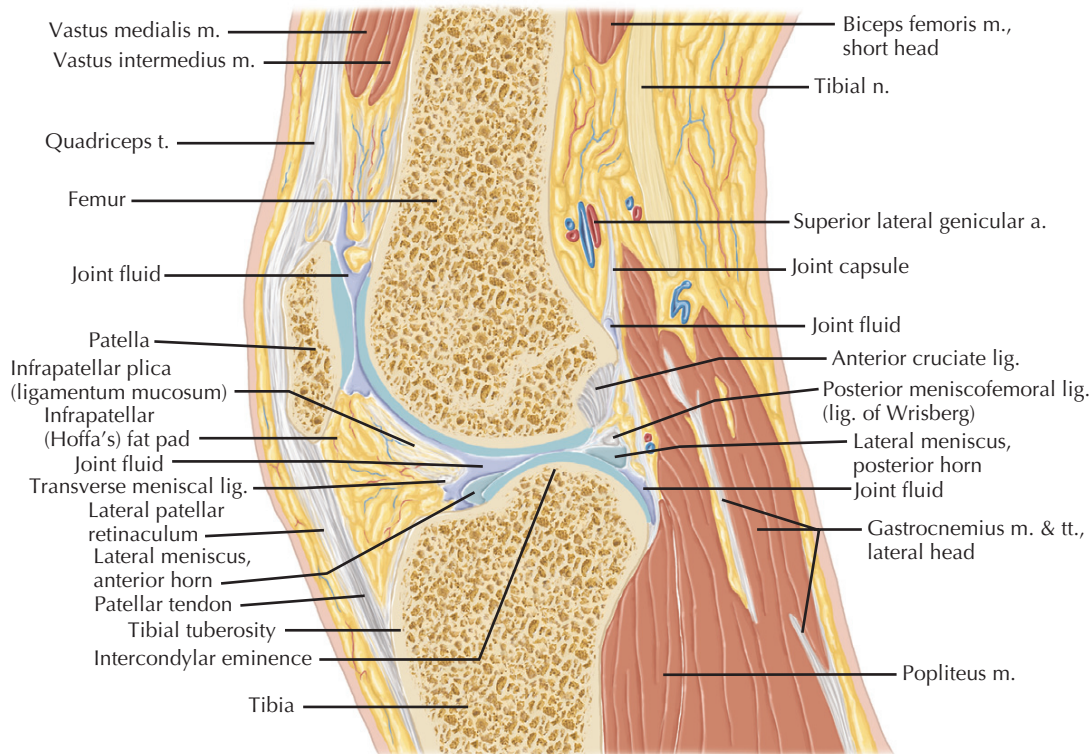
The ACL normally appears striated and runs parallel to the intercondylar notch.

DIAGNOSTIC CONSIDERATION

A partial tear of the ACL must be distinguished from mucinous degeneration of the ACL, which is an incidental finding. In a partial tear, the ACL appears lax. In mucinous degeneration, the ACL is swollen and contains fluid signal within its substance.

A tear of the PCL does not typically disrupt the fibers. On MRI, a tear of the PCL most often images as intermediate signal and increased thickness of the PCL on short-TE images. Often, a torn PCL can look normal on a T2-weighted image.





NORMAL VARIANT

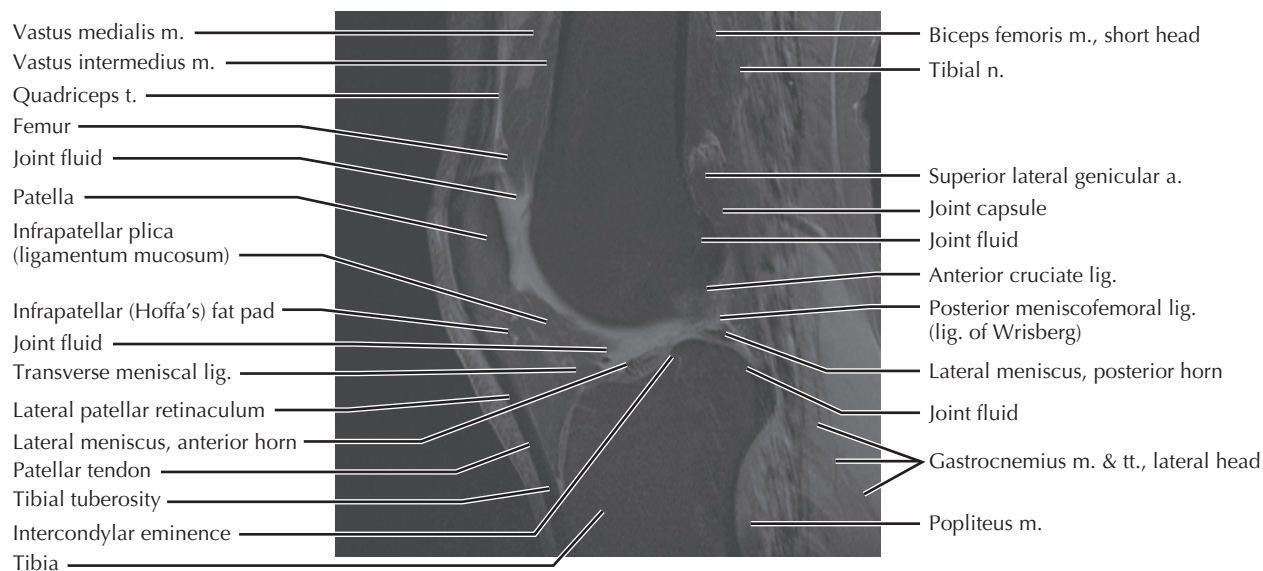
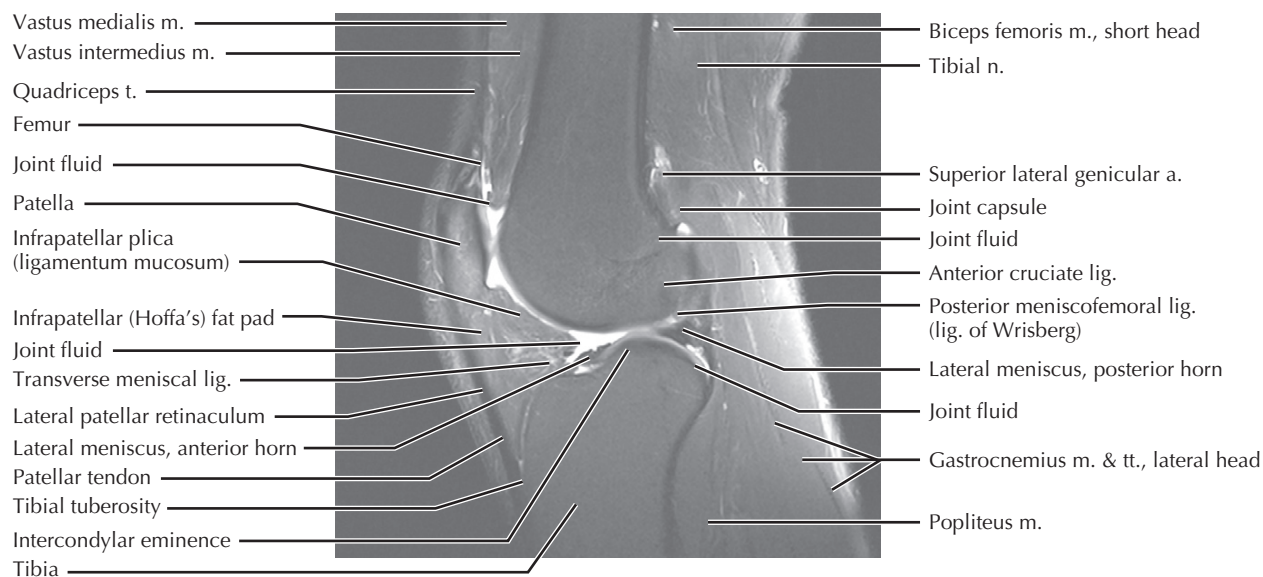
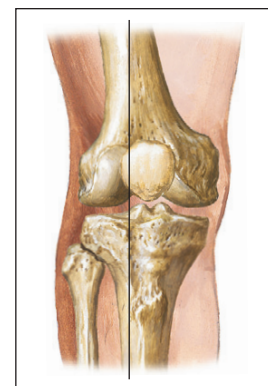
A Wrisberg variant of a discoid lateral meniscus lacks attachments to the joint capsule and tibia.

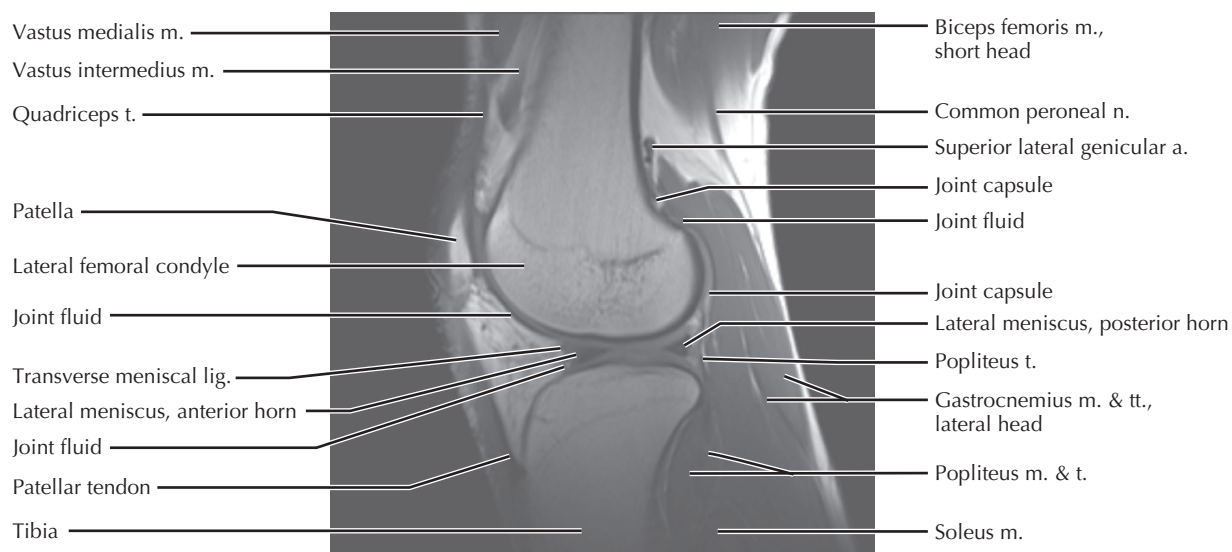
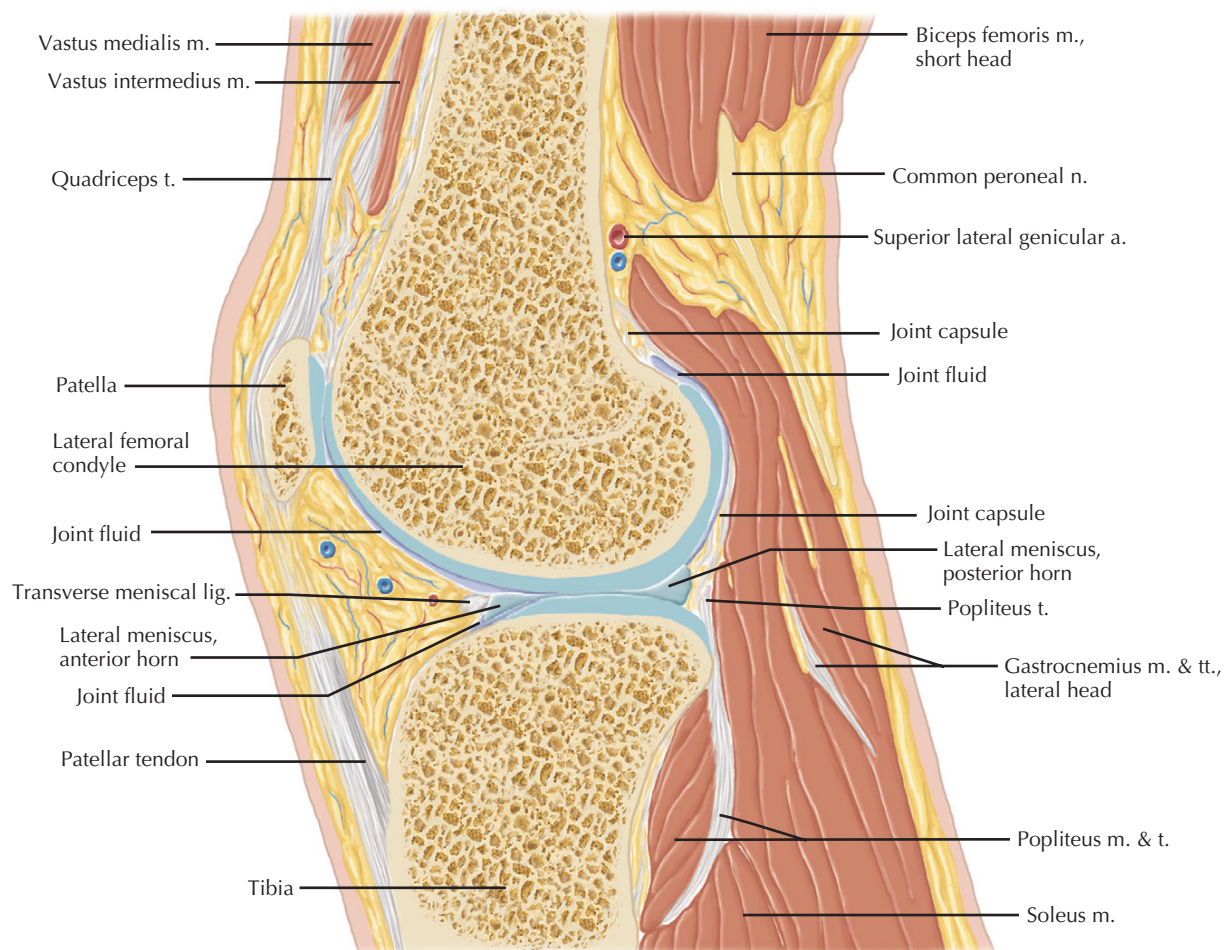
NORMAL ANATOMY

The anterior horn of the lateral meniscus may demonstrate a "speckled" appearance, resulting from fibers of the anterior horn of the ACL inserting into this location.

DIAGNOSTIC CONSIDERATION

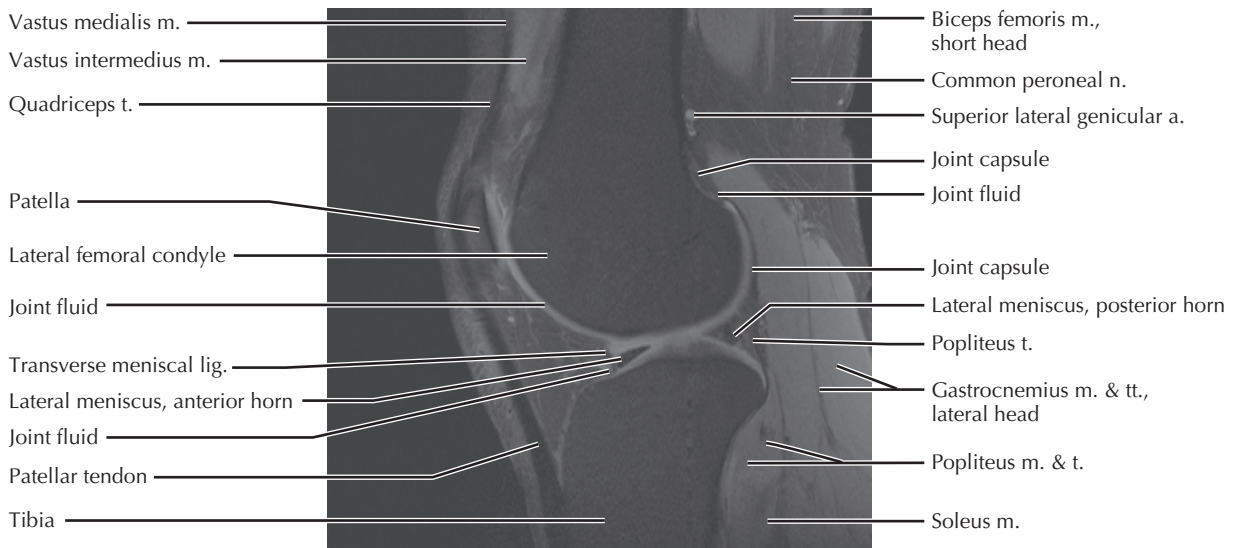
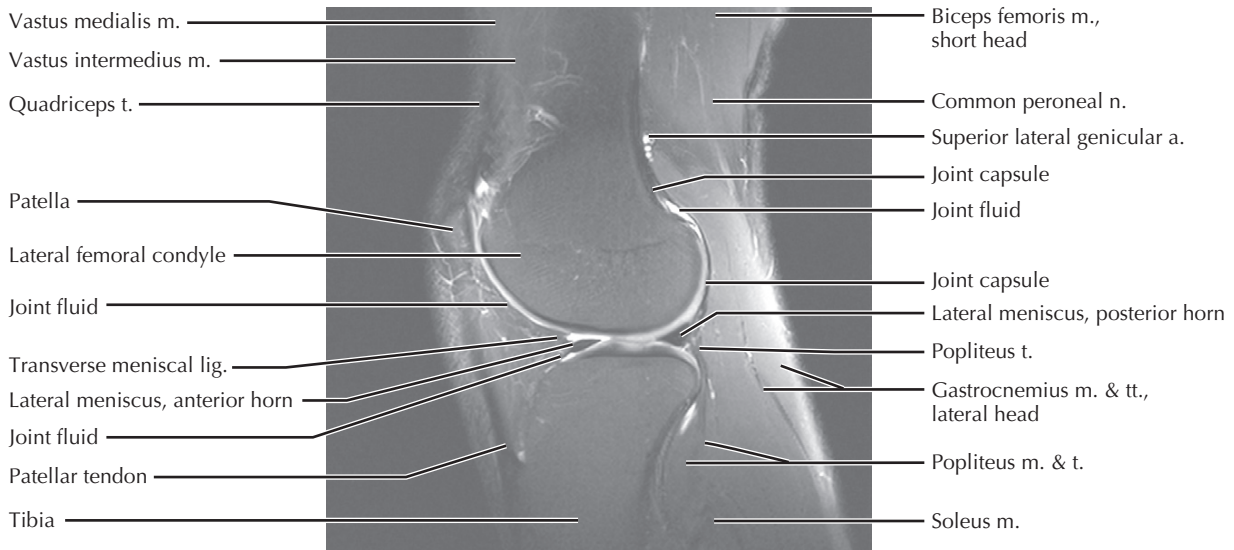
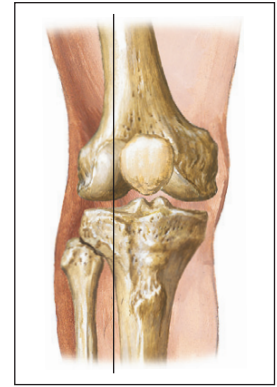
"Magic angle" phenomenon can affect the posterior horn of the lateral meniscus as it courses upward 55 degrees to the bore of the magnet. It is identified as a hazy, diffusely intermediate-signal abnormality on short-TE images. This phenomenon disappears on long-TE images. This is not generally mistaken for tears.

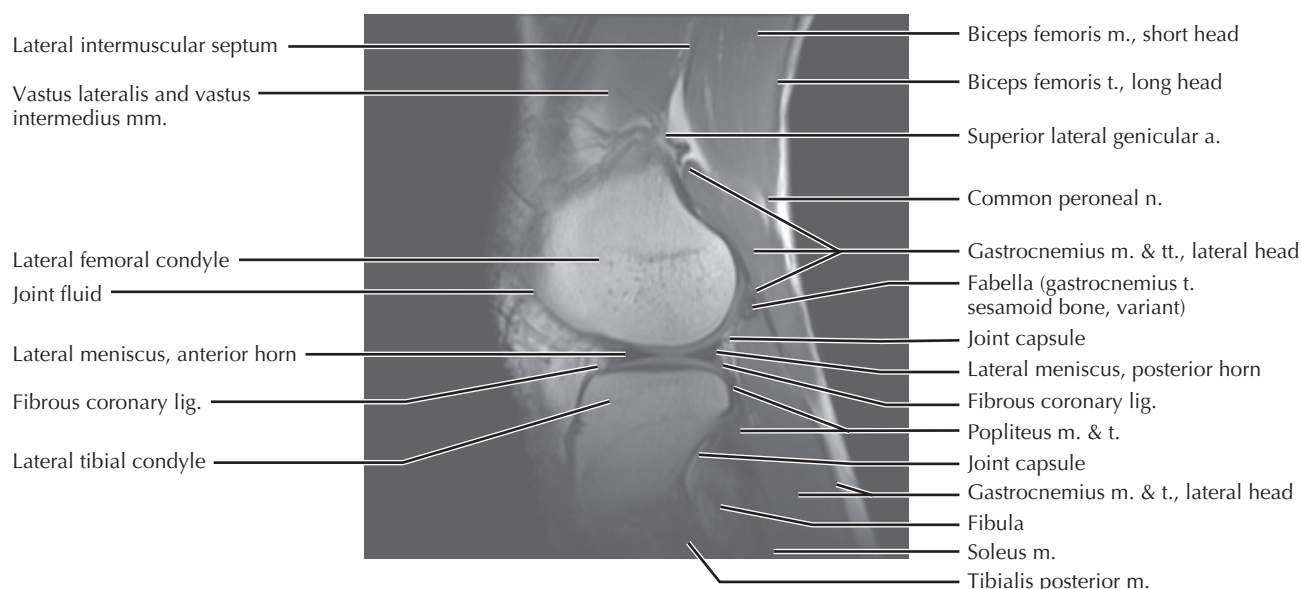
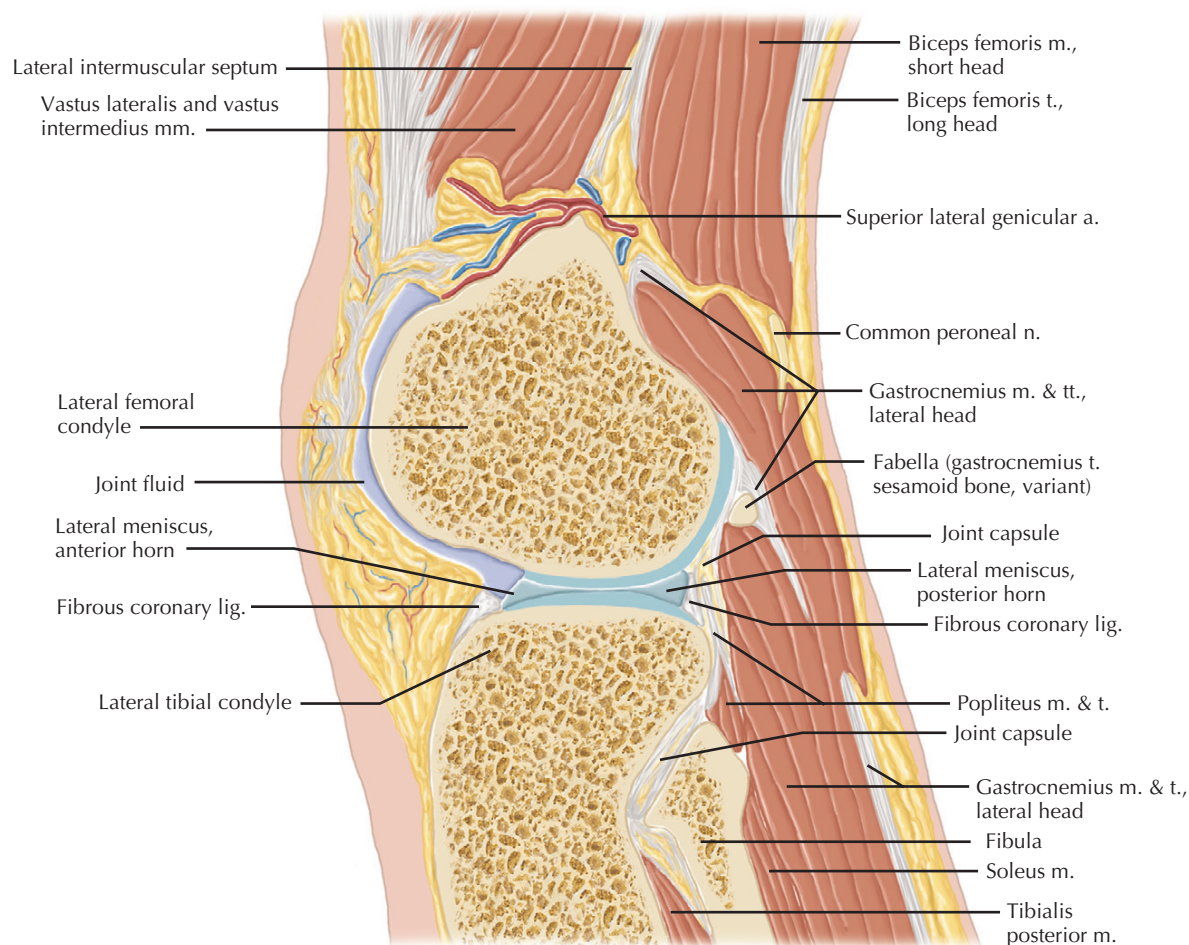




NORMAL ANATOMY

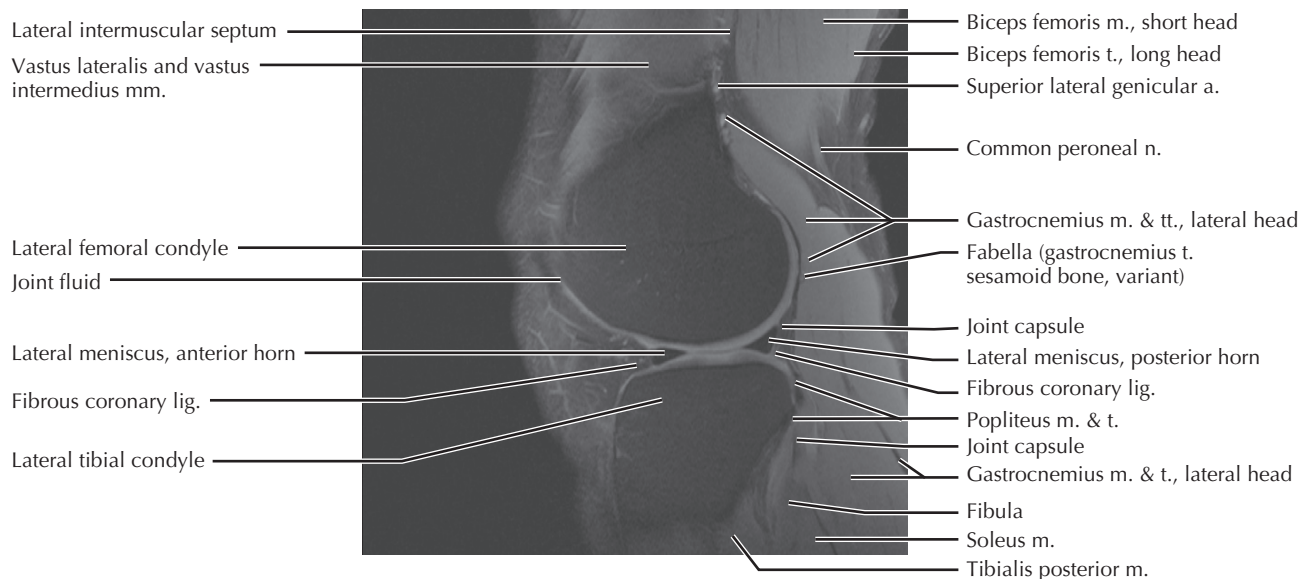
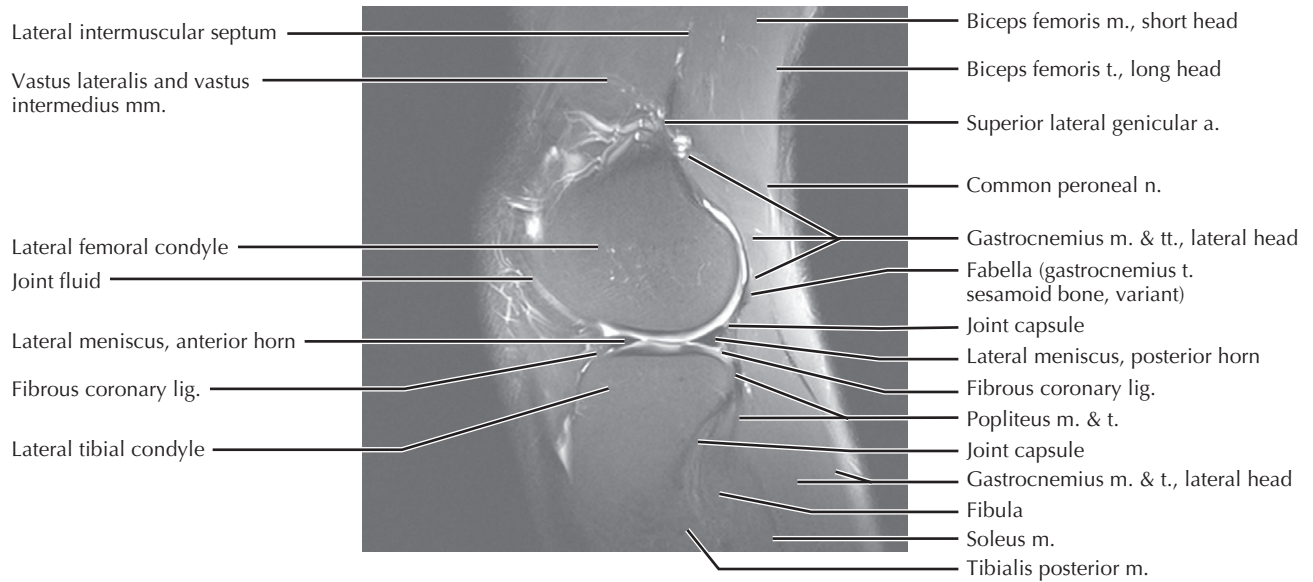
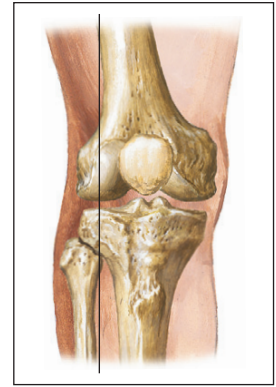
The posterior and anterior horns of the lateral meniscus are similar in size.

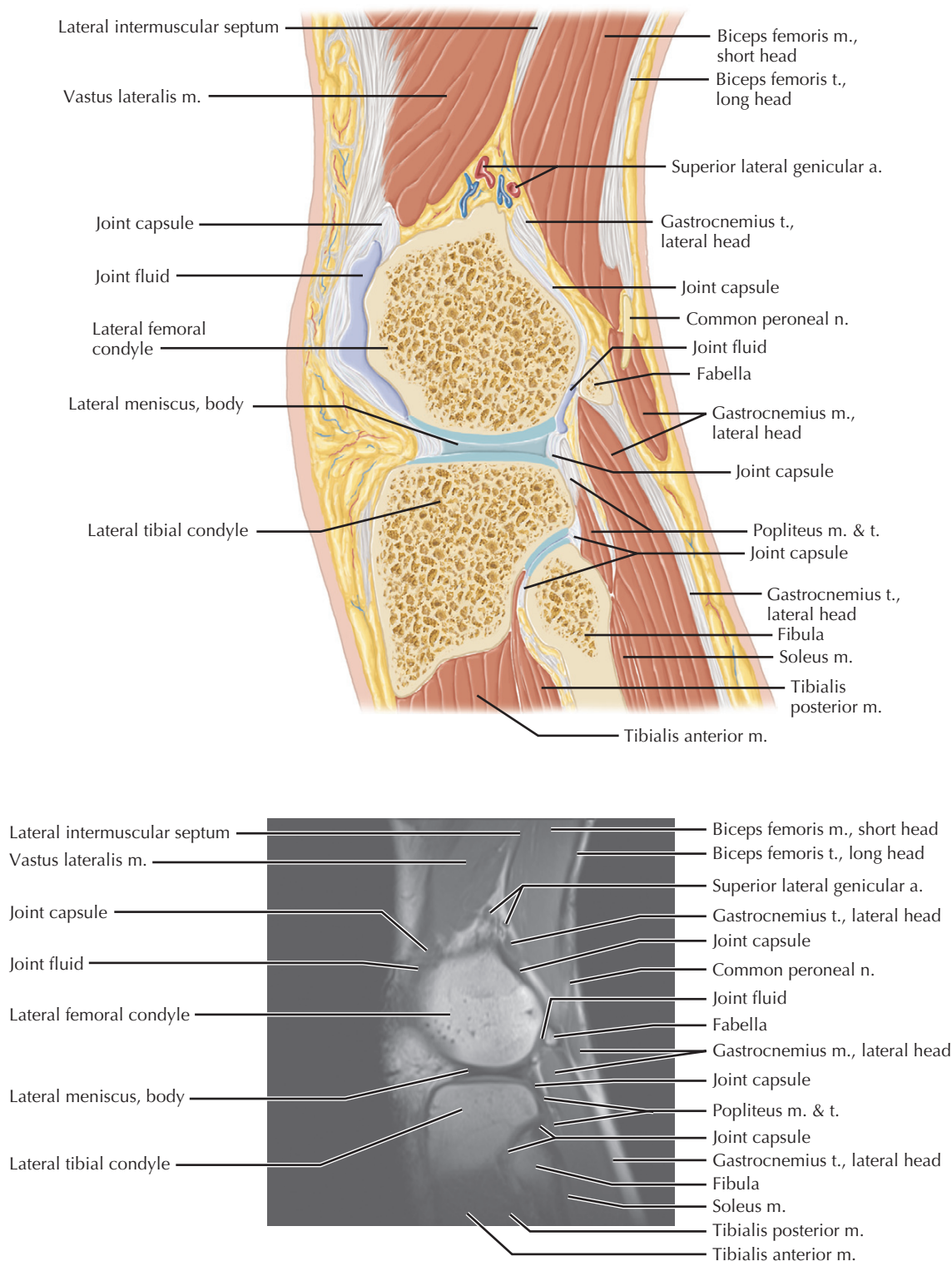




PATHOLOGIC PROCESS

Classic bone contusion patterns for an ACL injury affect the posterolateral tibial plateau and the middle aspect of the lateral femoral condyle at the area of the normal sulcus.



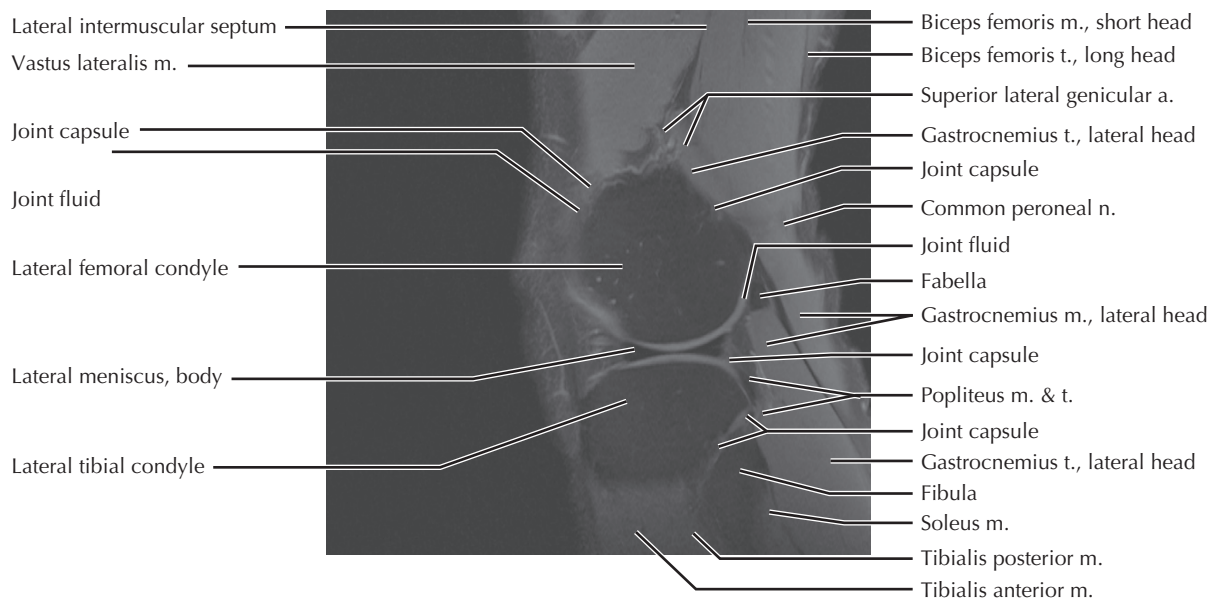
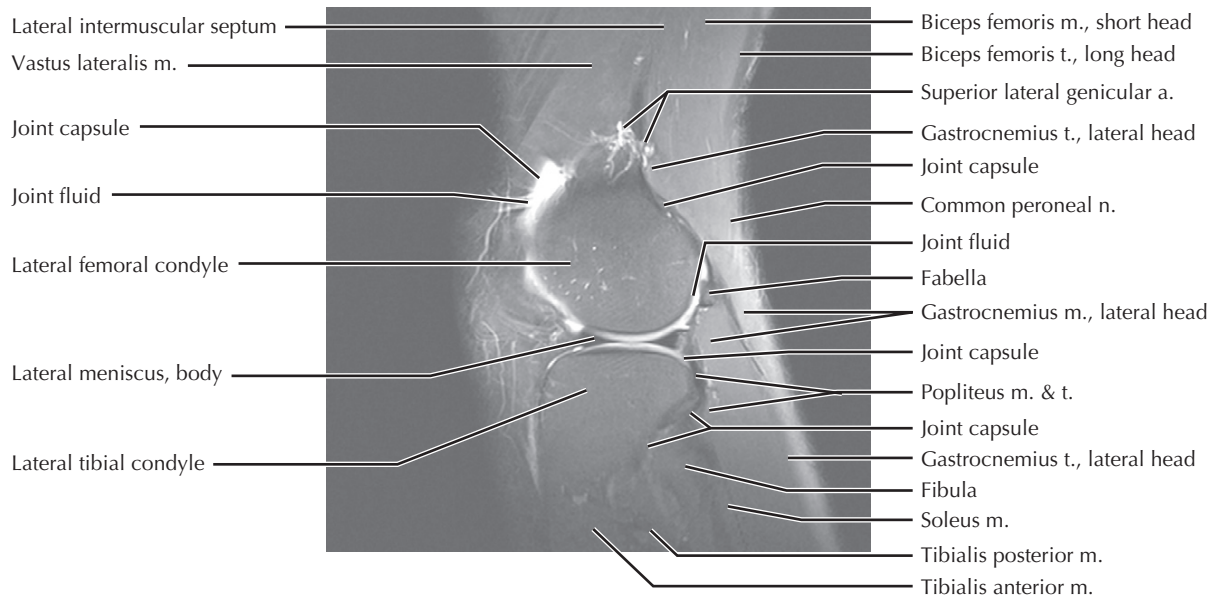
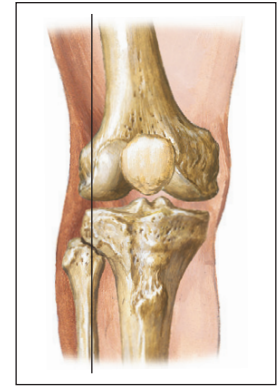


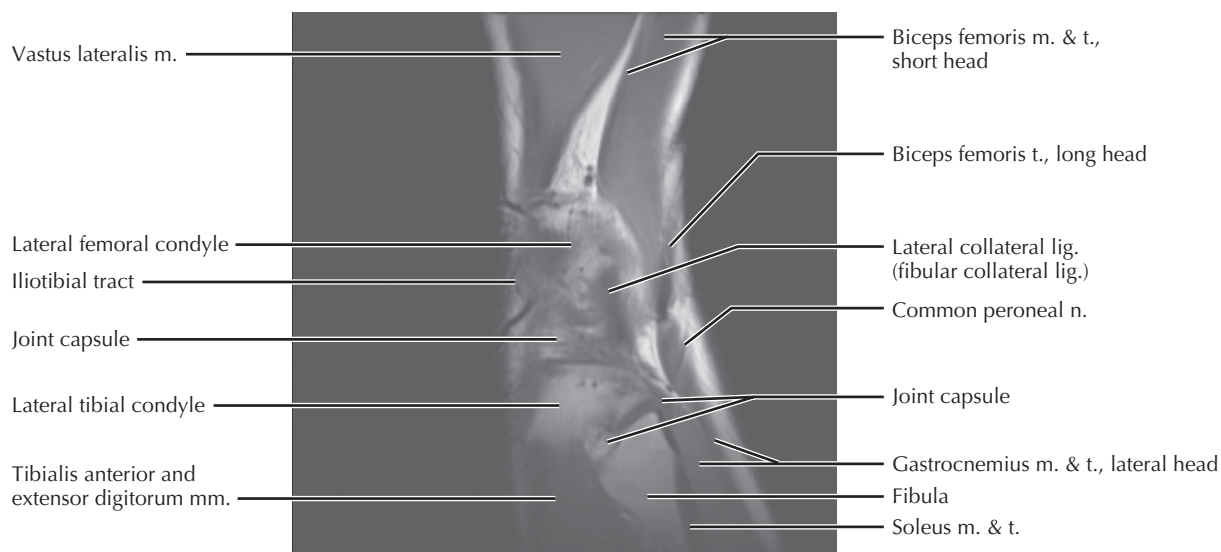
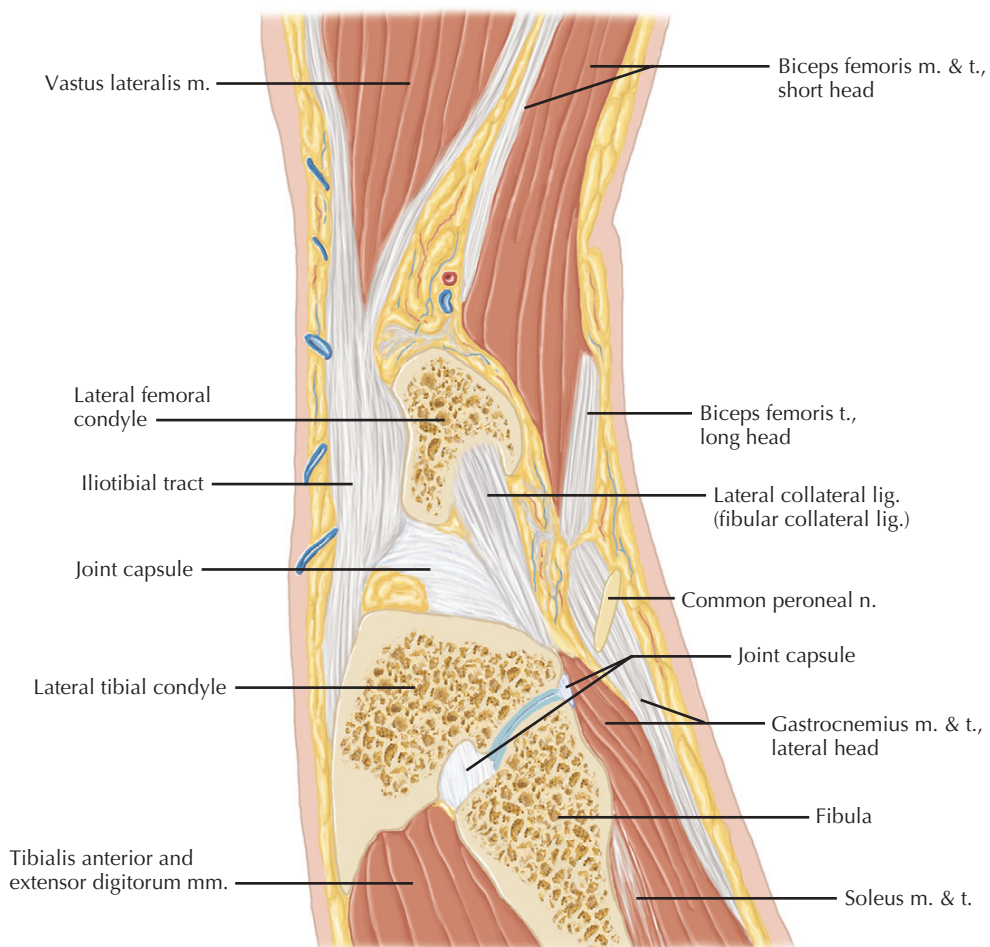
NORMAL ANATOMY

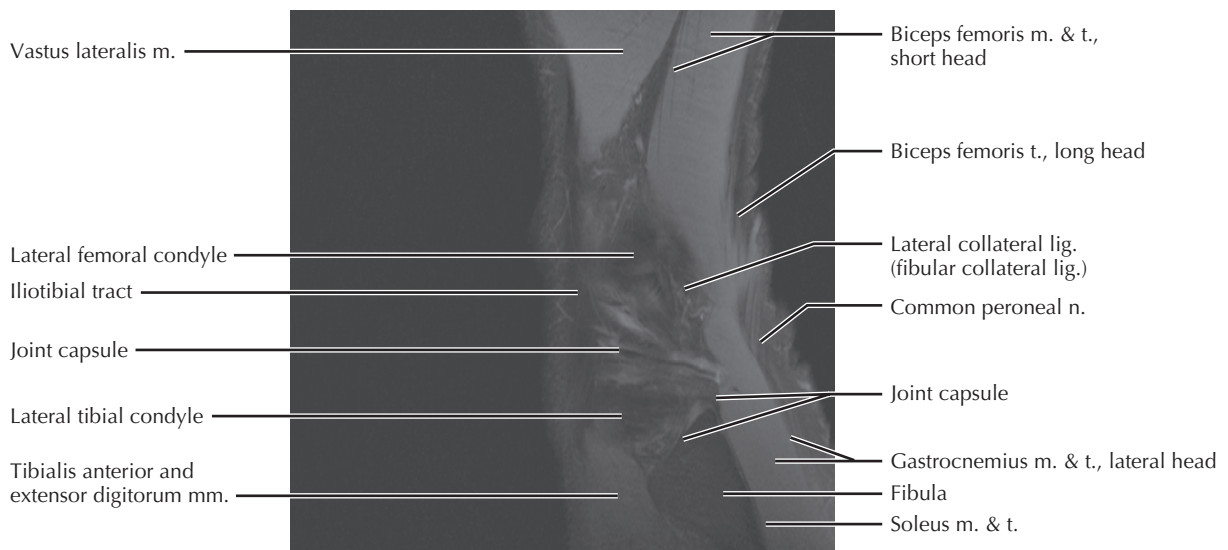
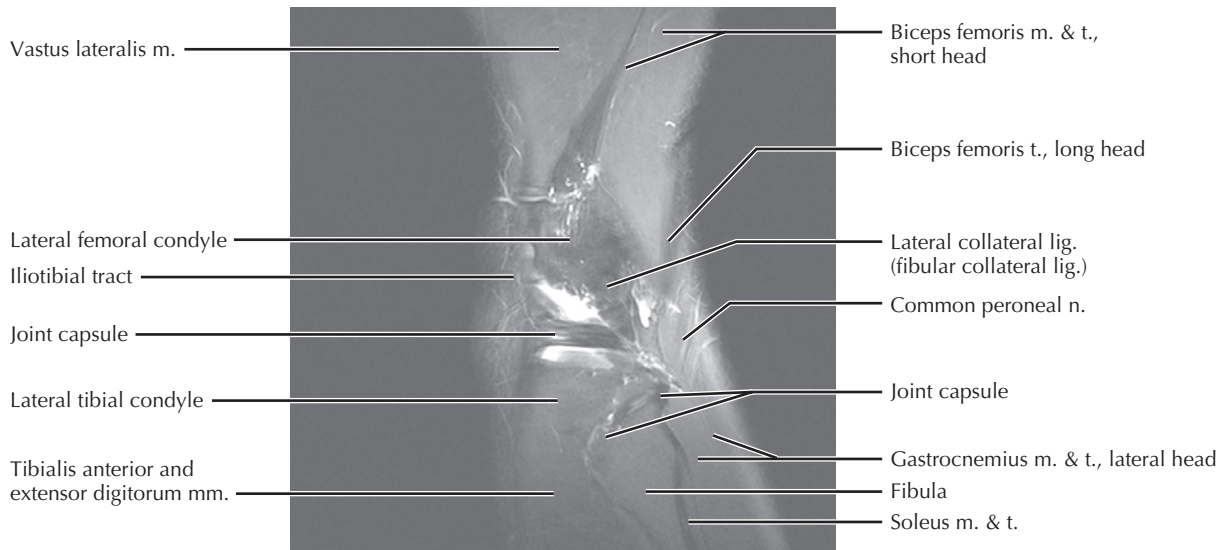
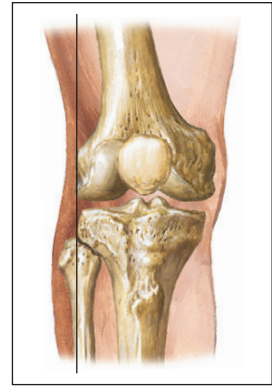
The normal appearance of the body of the meniscus is a rectangular "slab" of tissue.

NORMAL VARIANT

Too much meniscal tissue, as demonstrated by too many body segments (slabs of meniscal tissue), is termed a "discoid" meniscus and is susceptible to degeneration and tears.





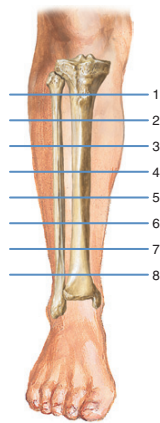


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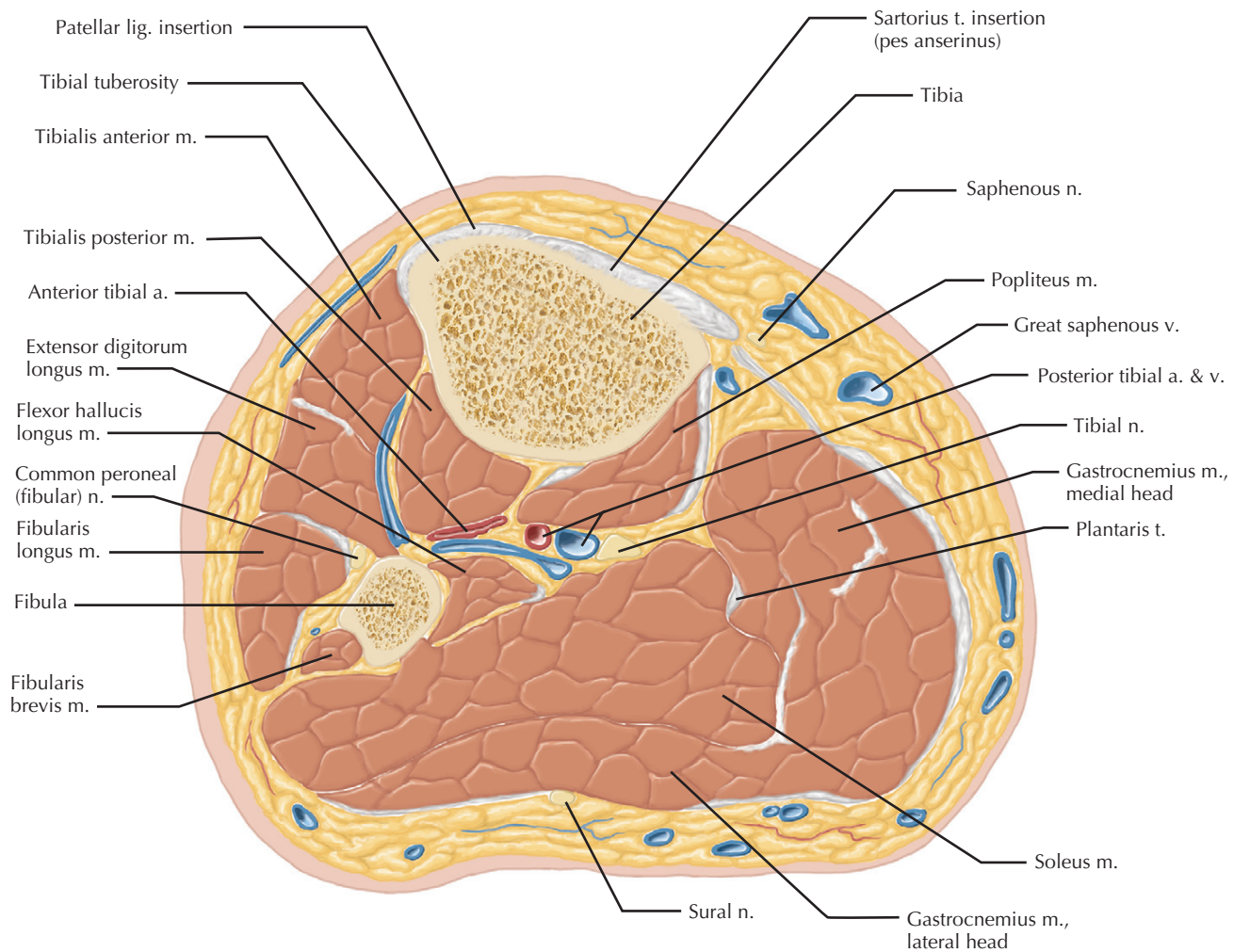
Chapter

13

LOWER LEG

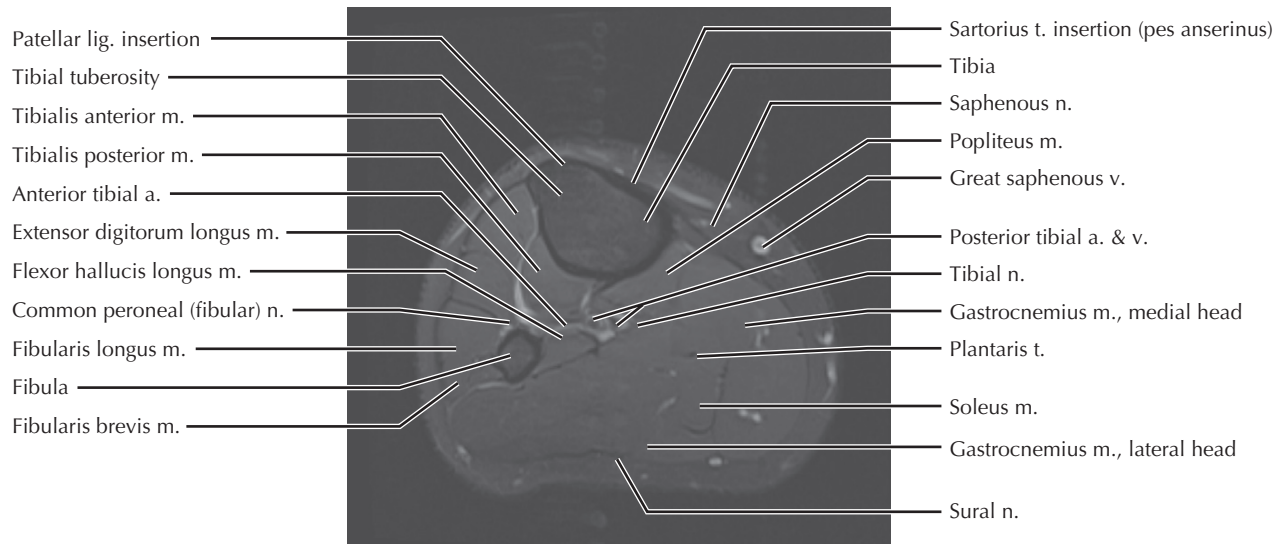
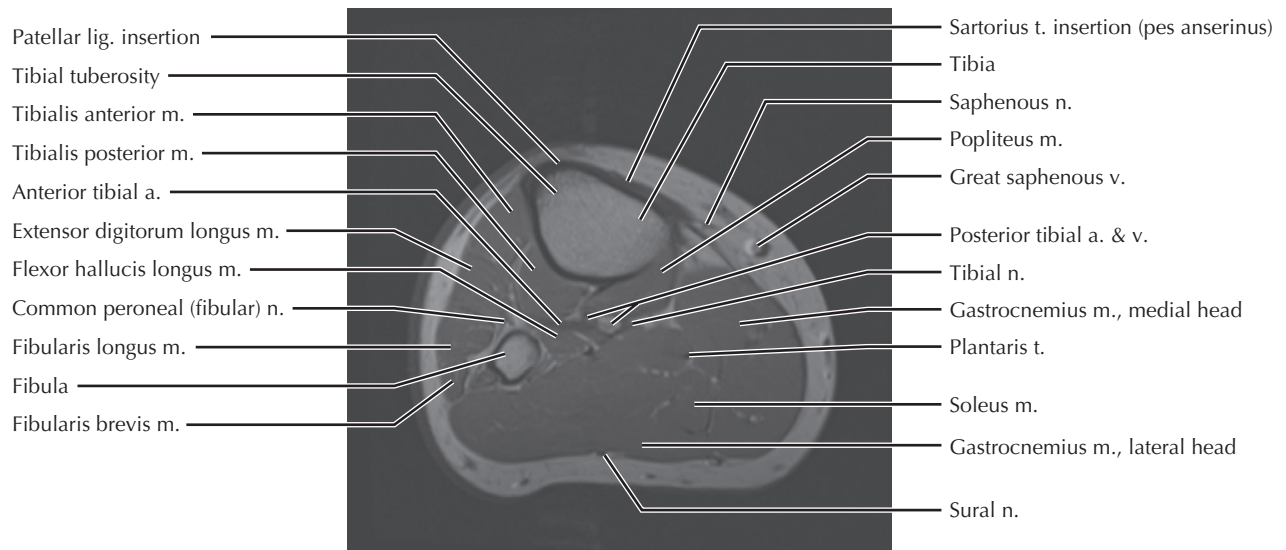
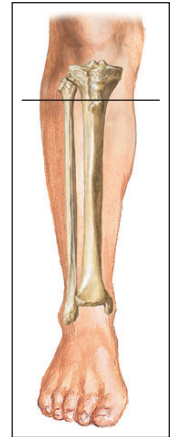


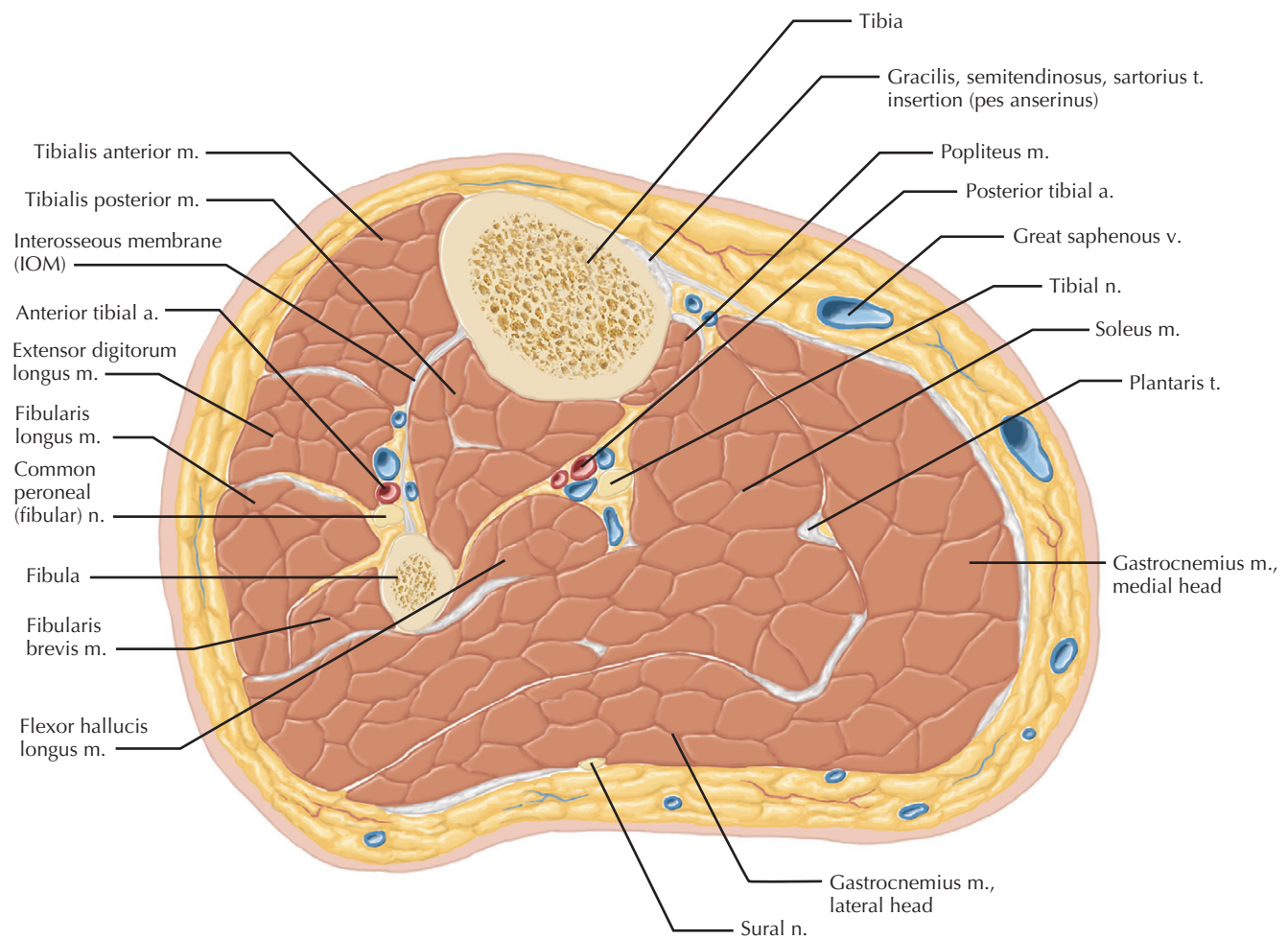
AXIAL 512

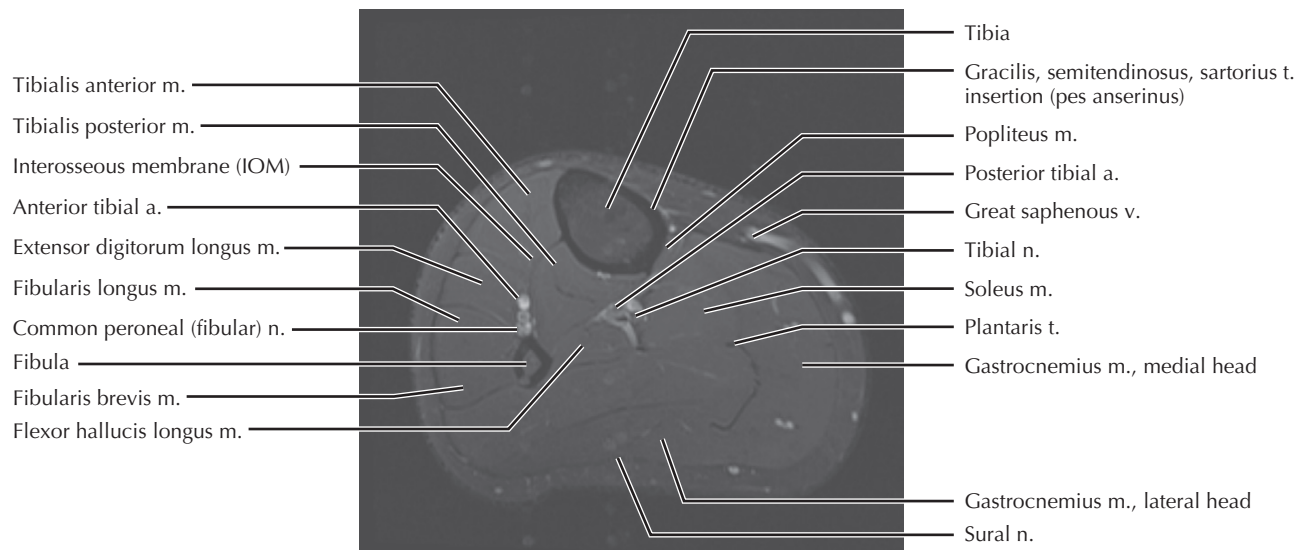
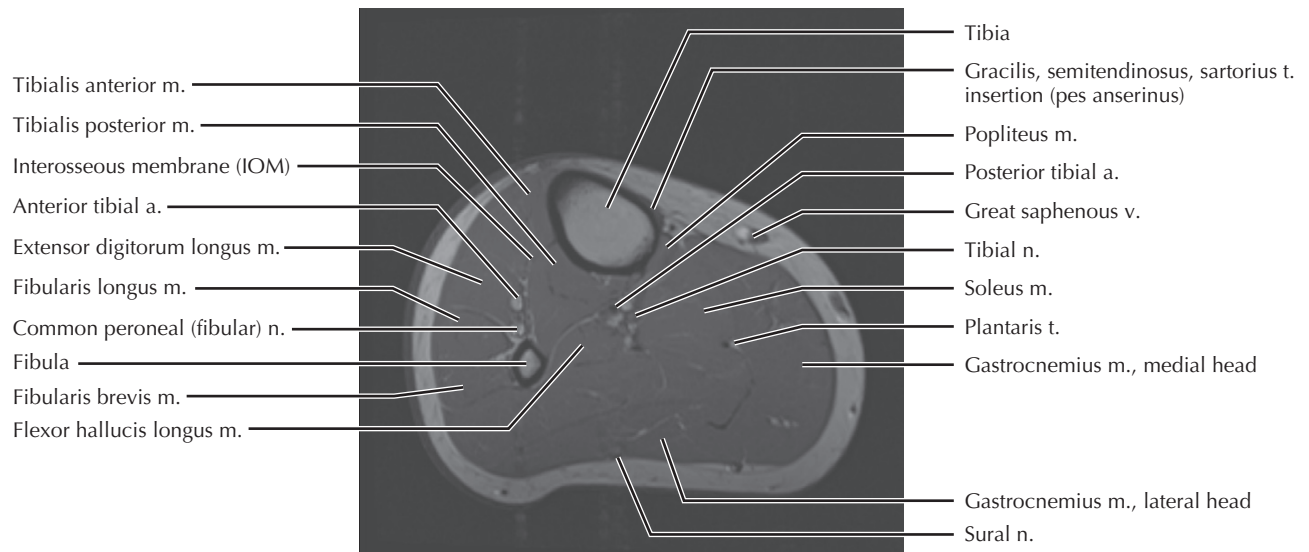
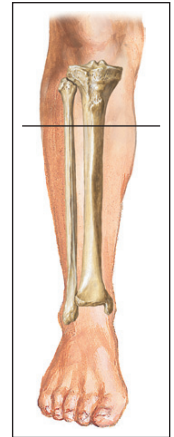


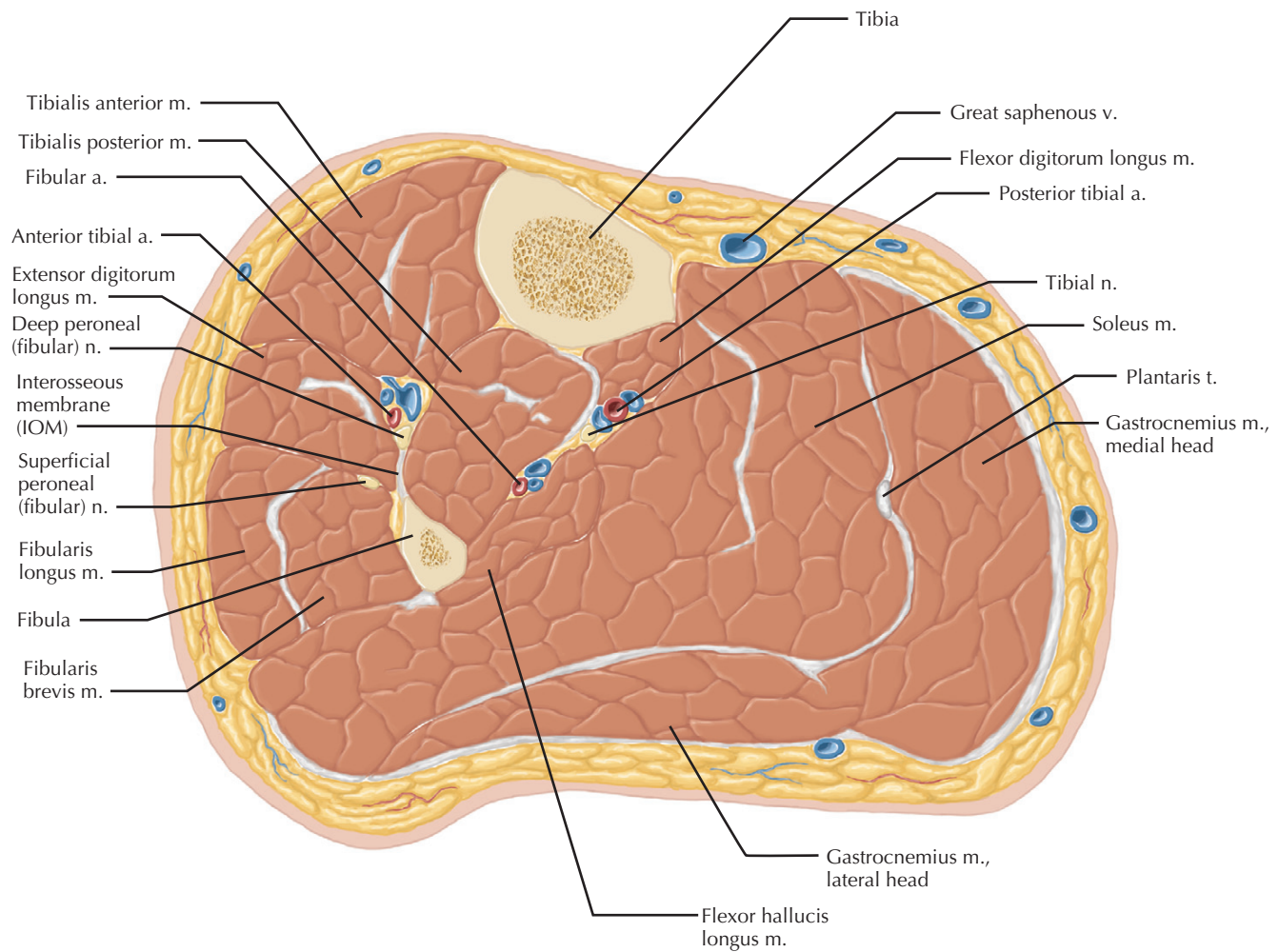
PATHOLOGIC PROCESS

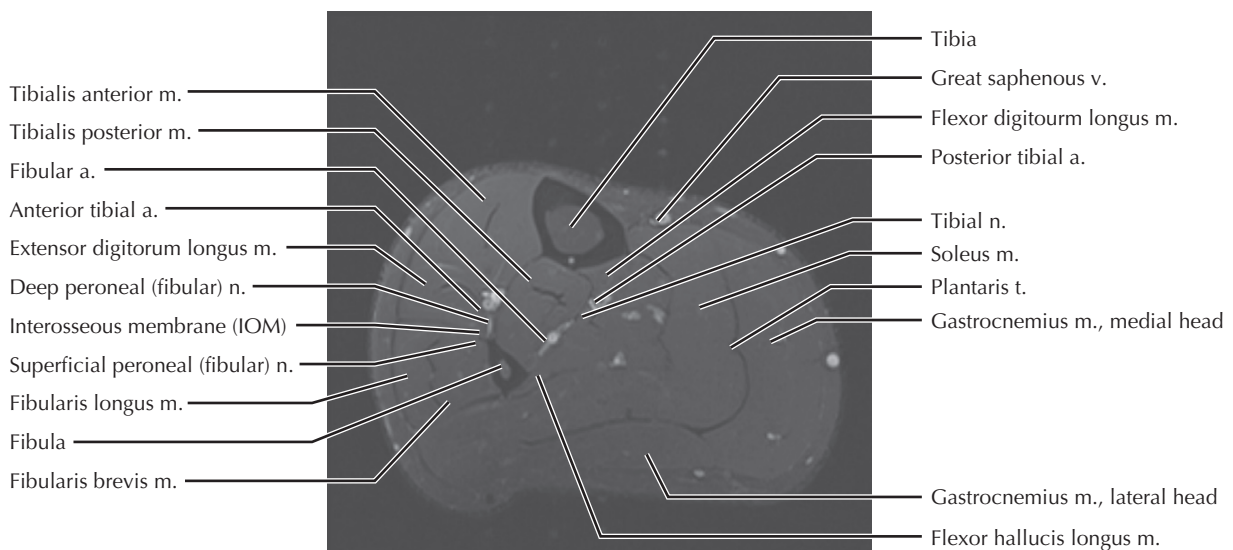
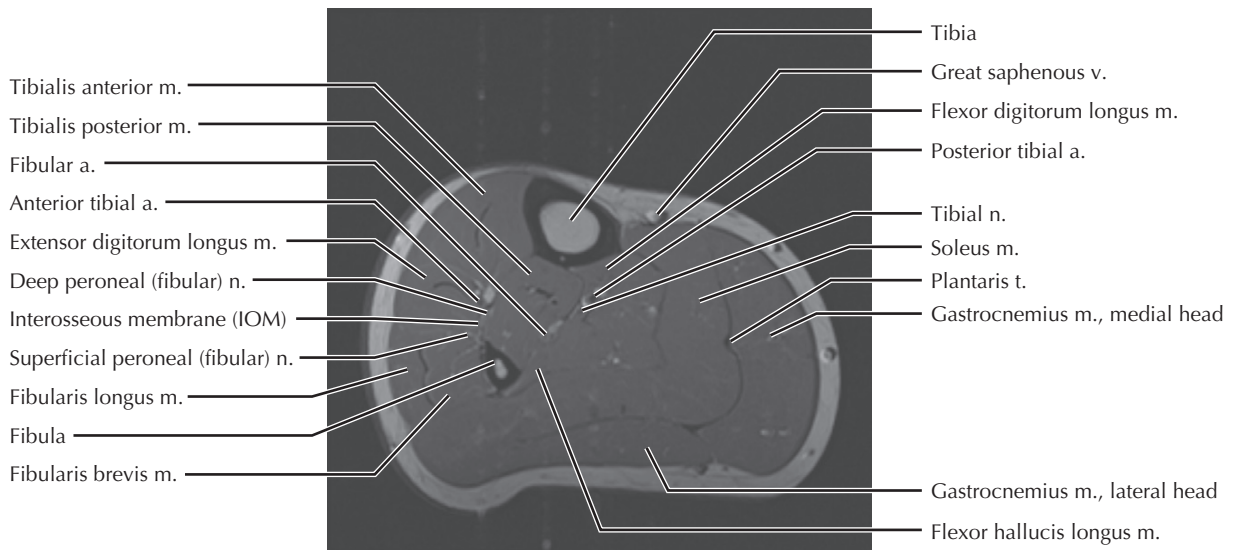
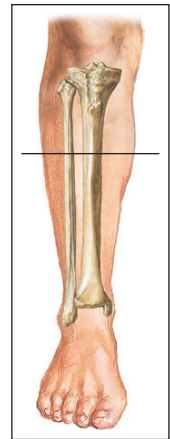
A torn plantaris tendon can be identified on MRI by a tubular collection of fluid between the gastrocnemius and soleus muscles.

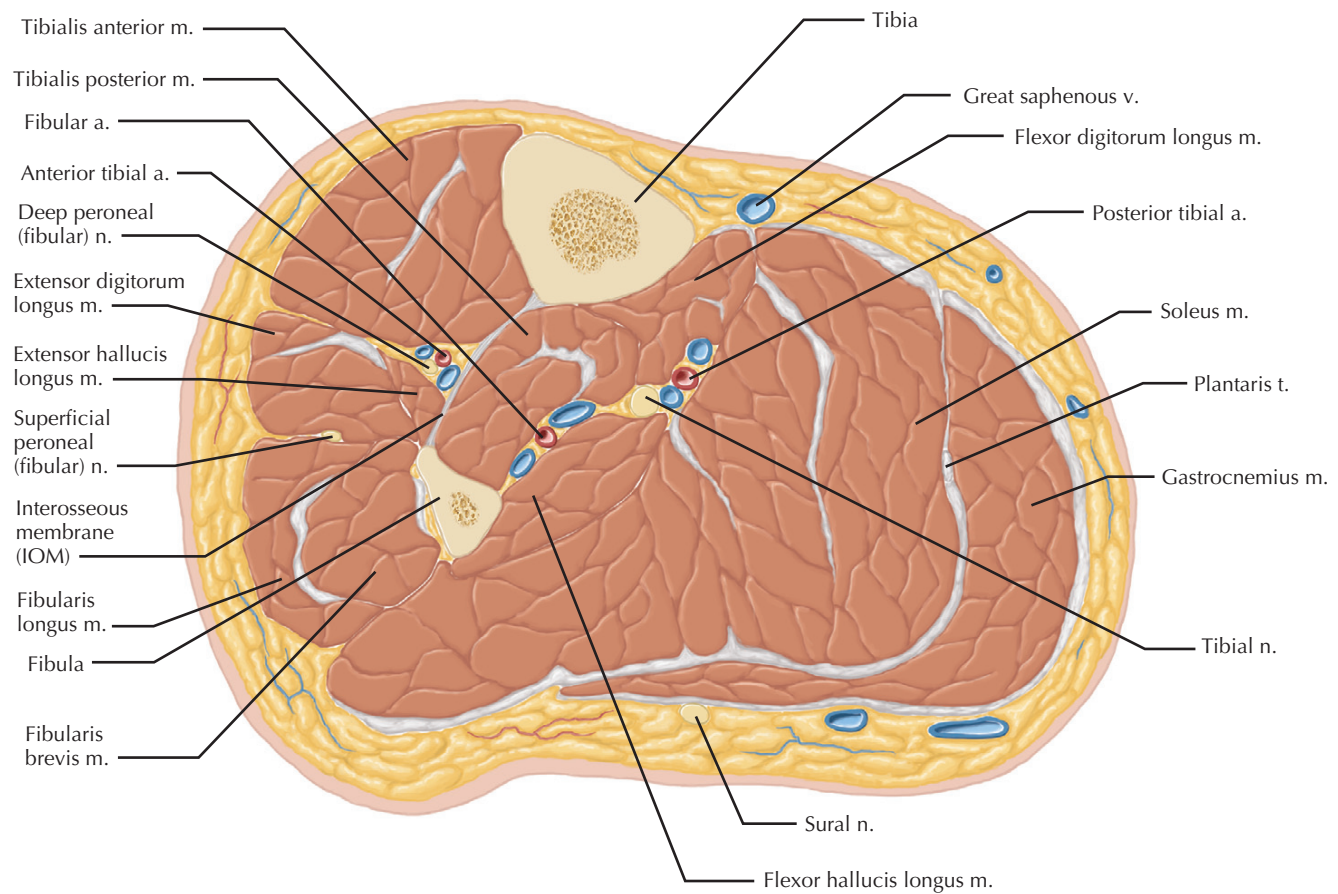


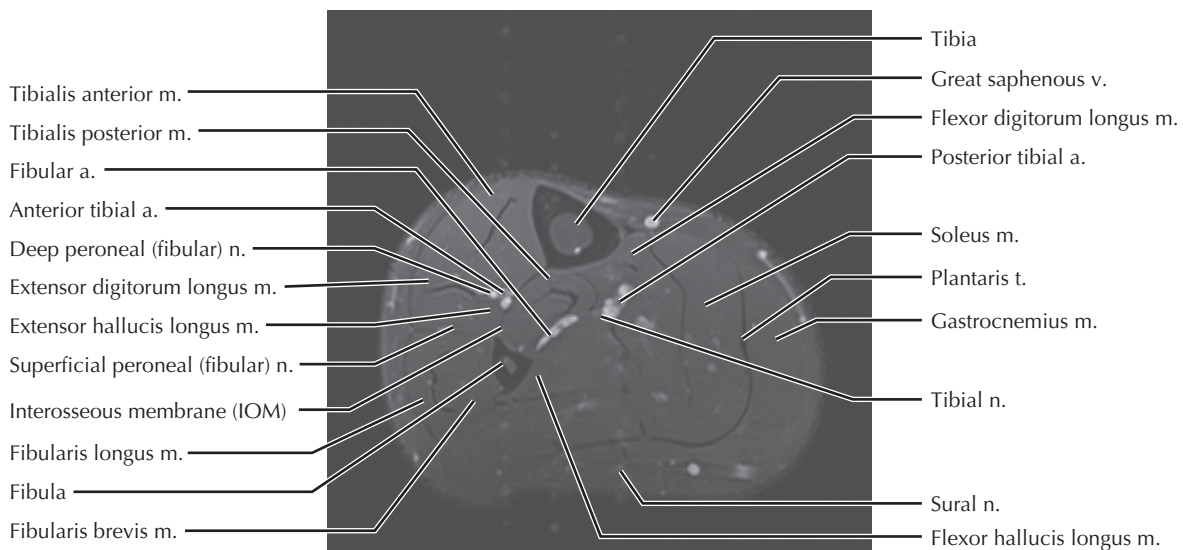
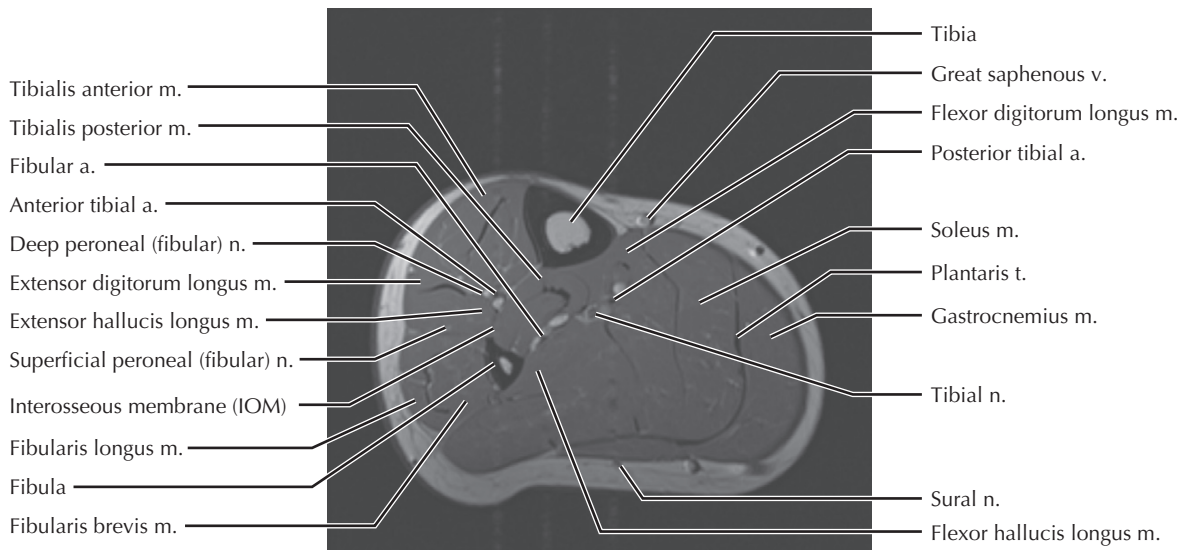
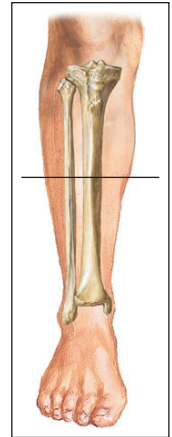


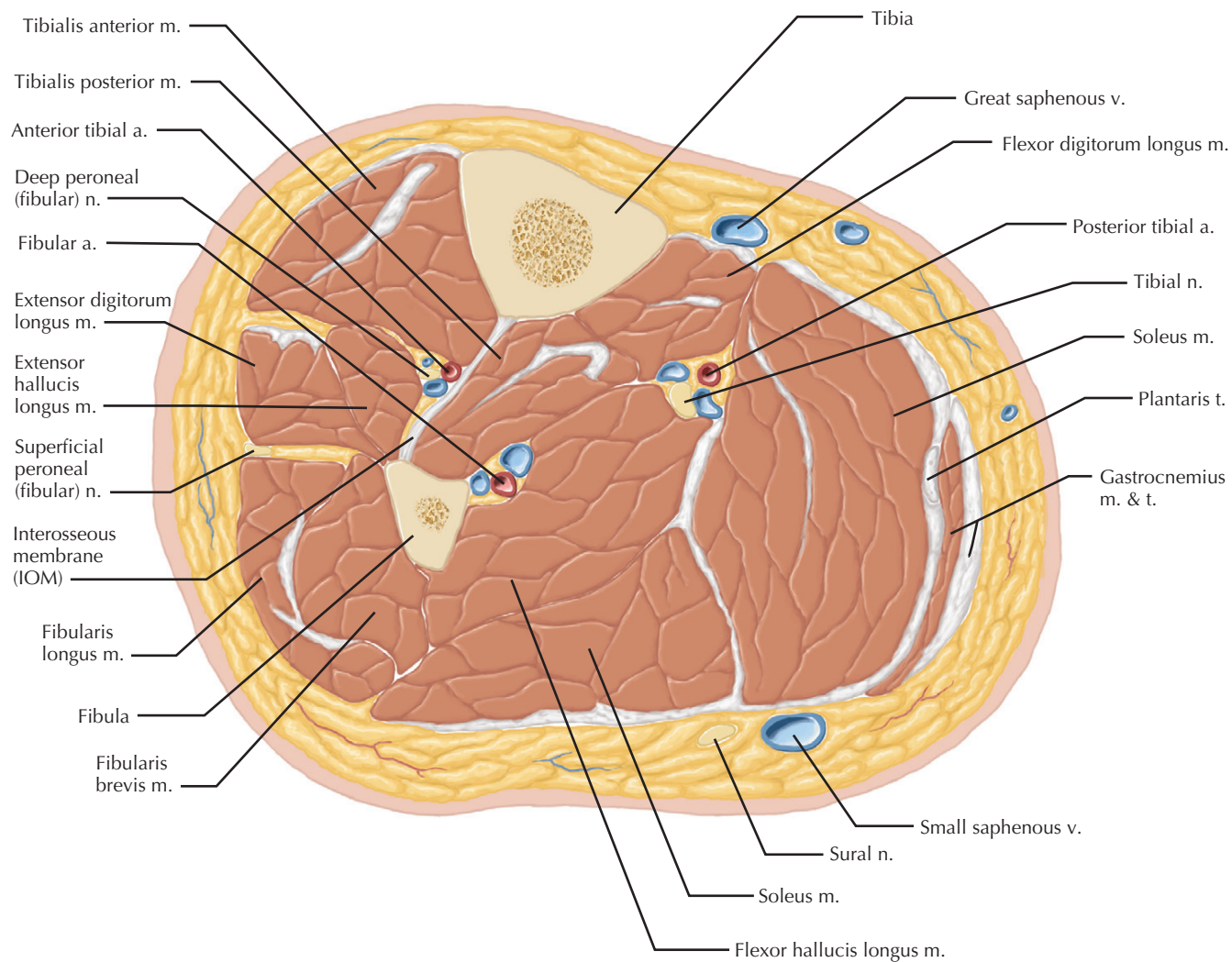


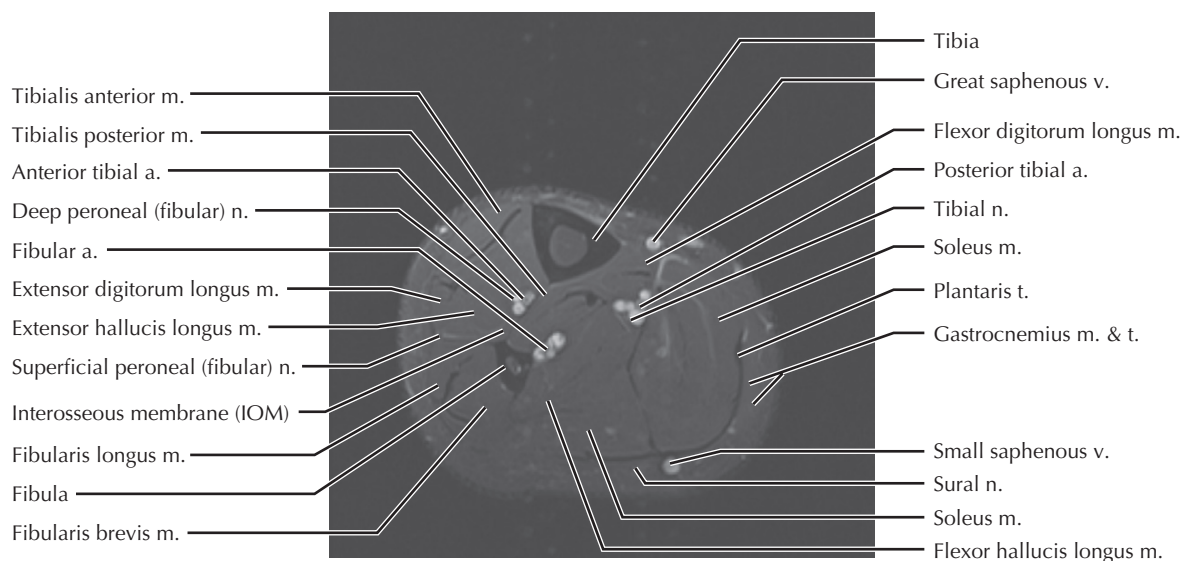
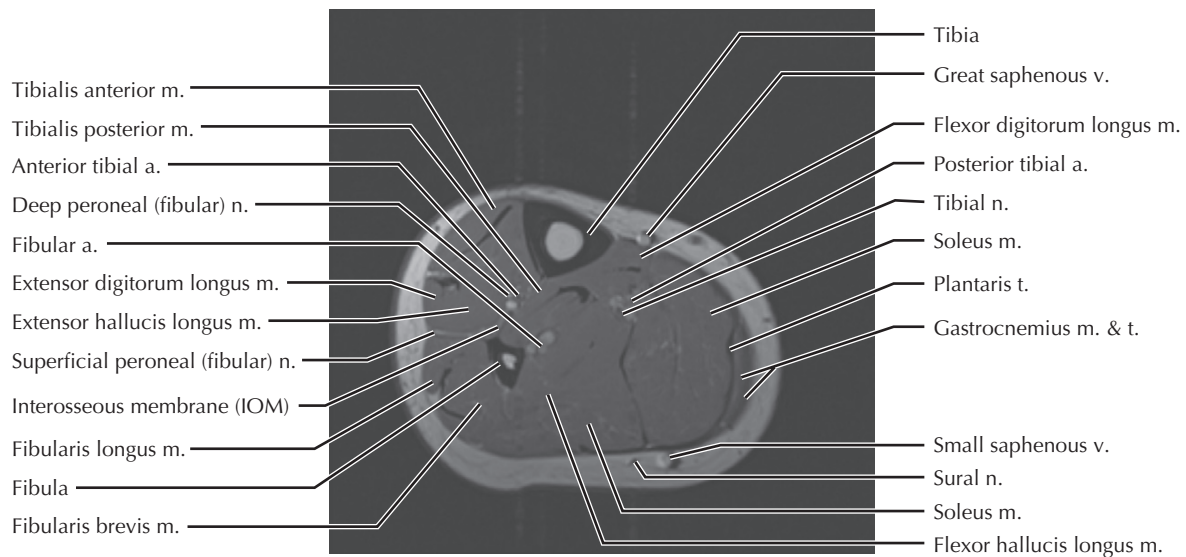
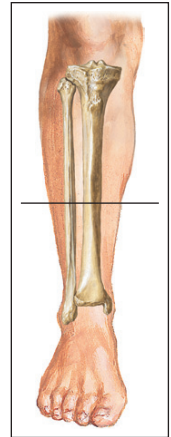


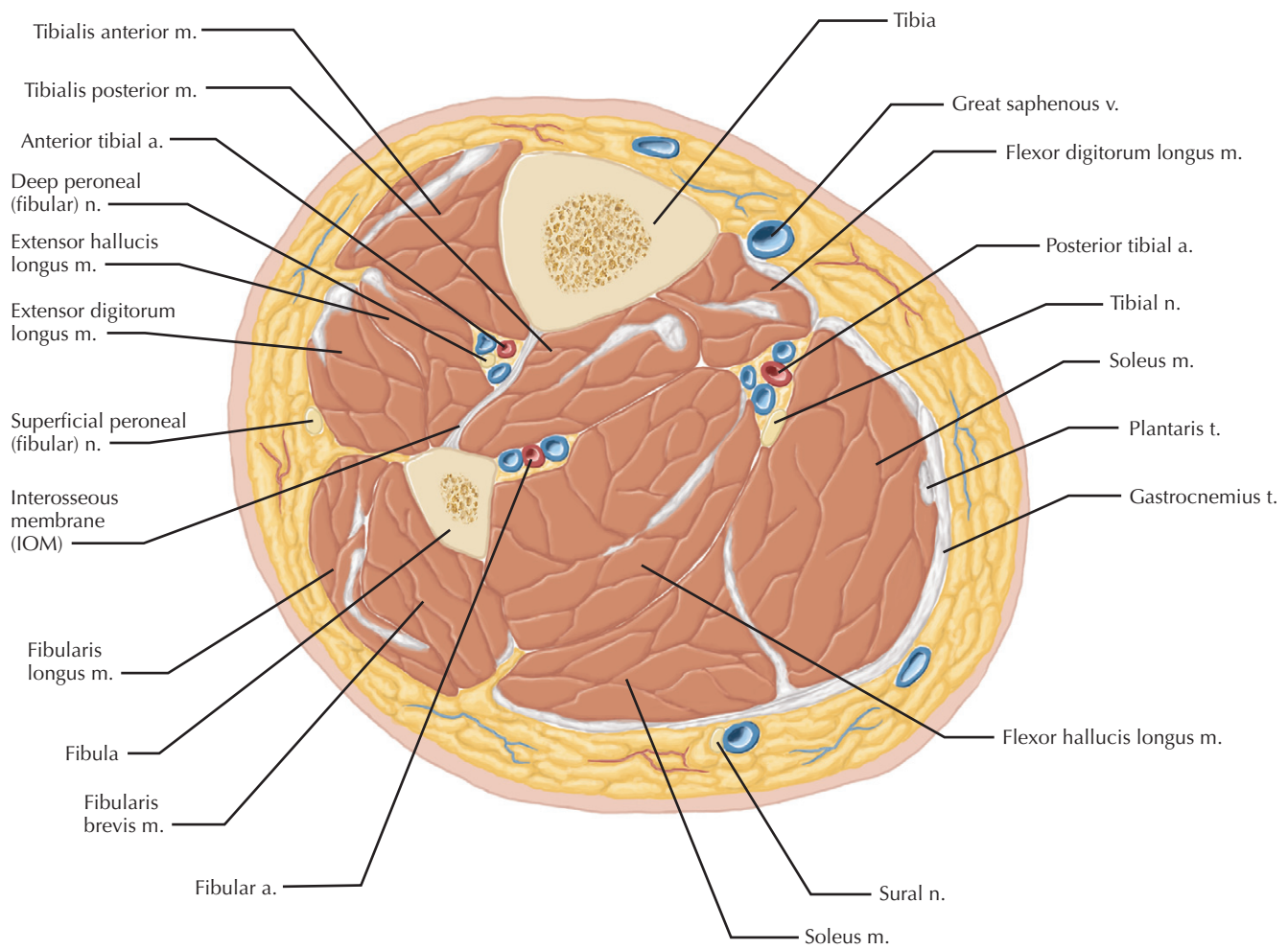


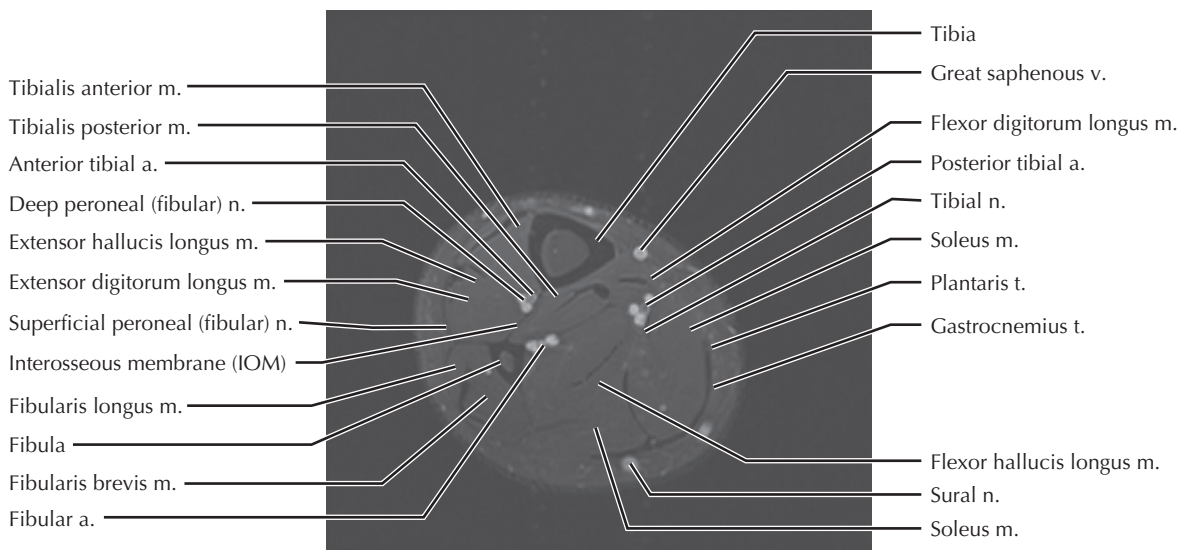
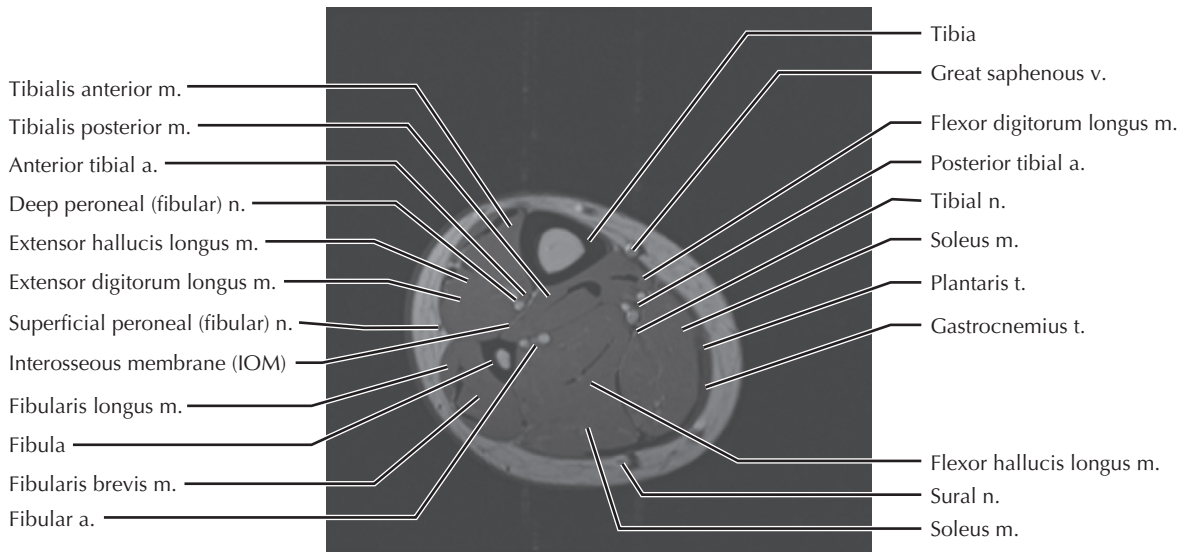
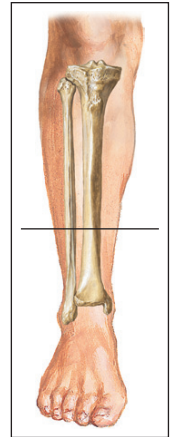


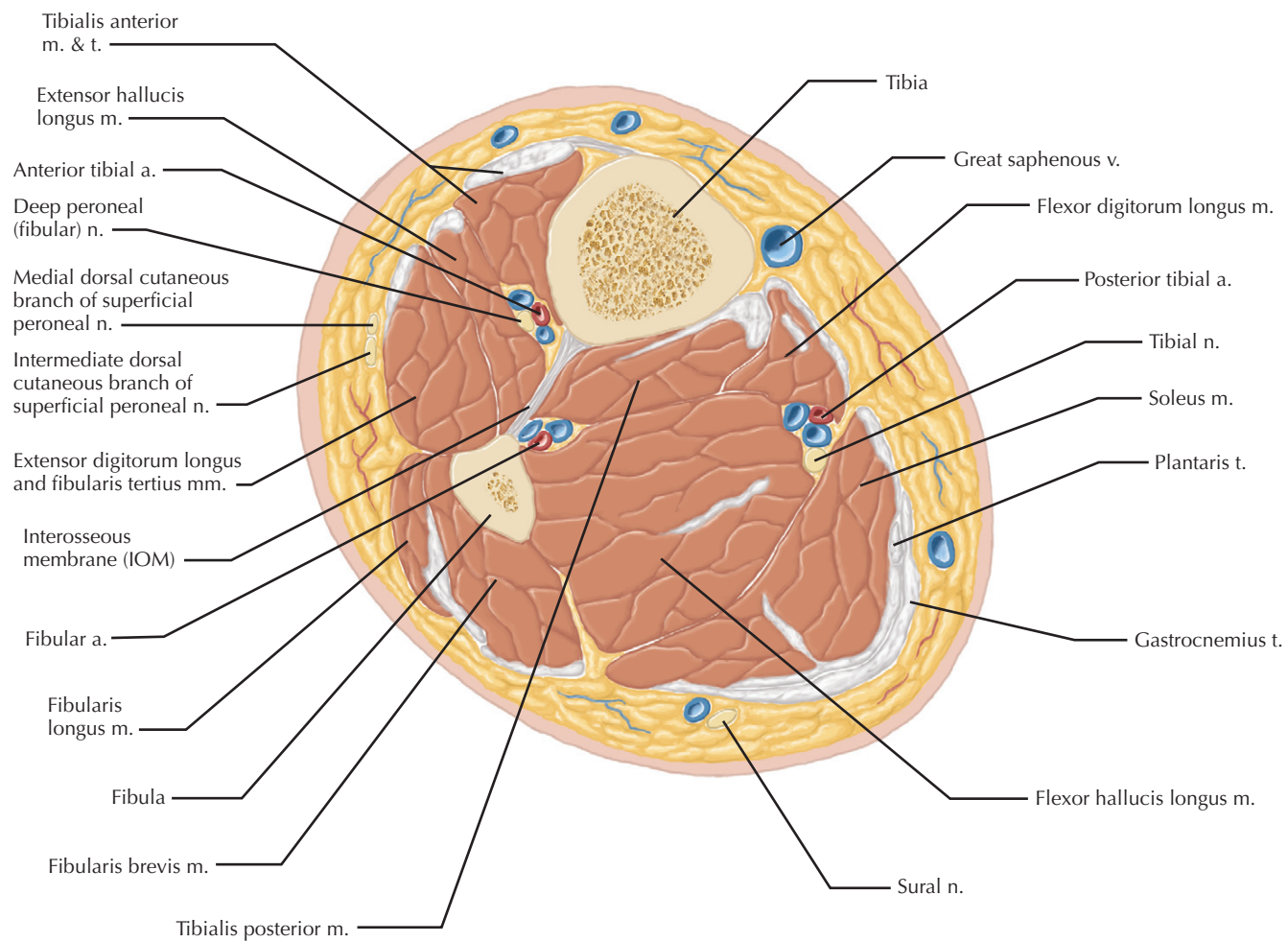


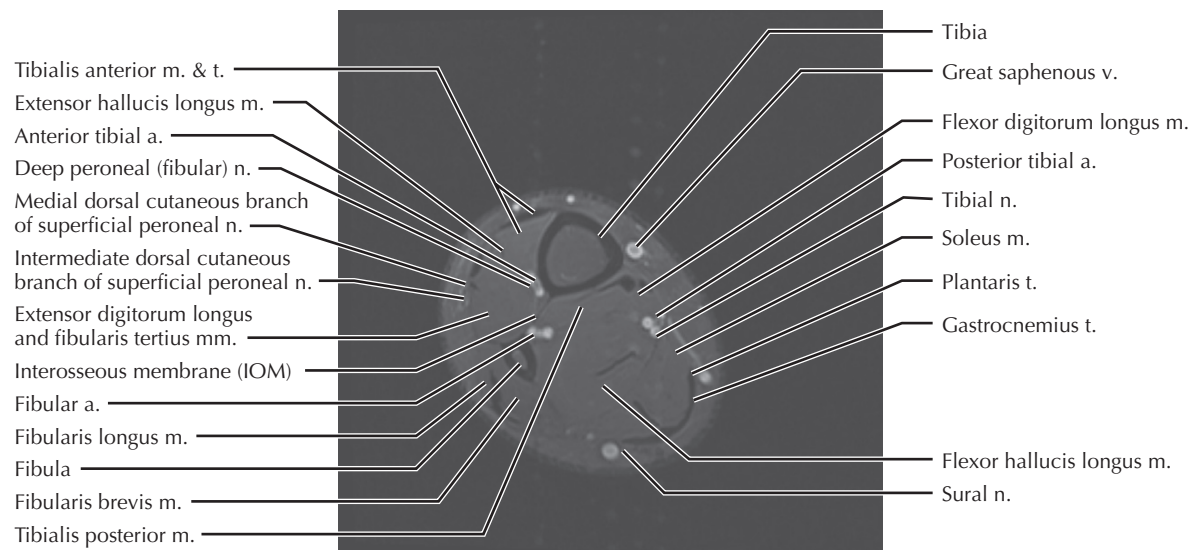
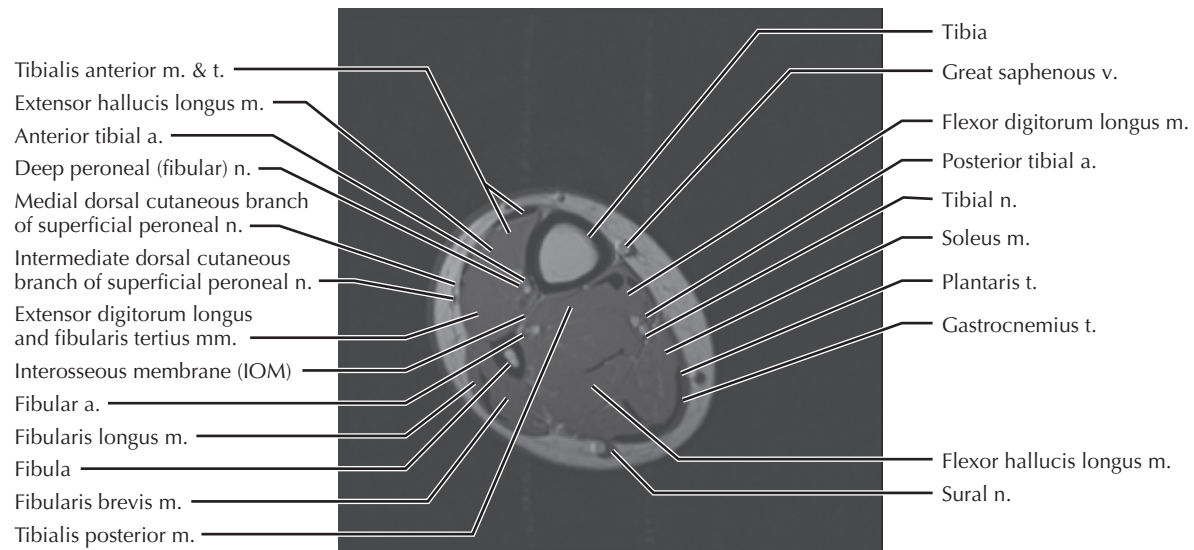
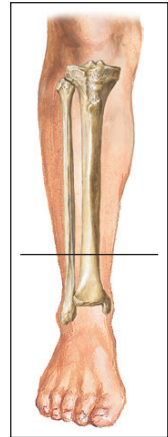


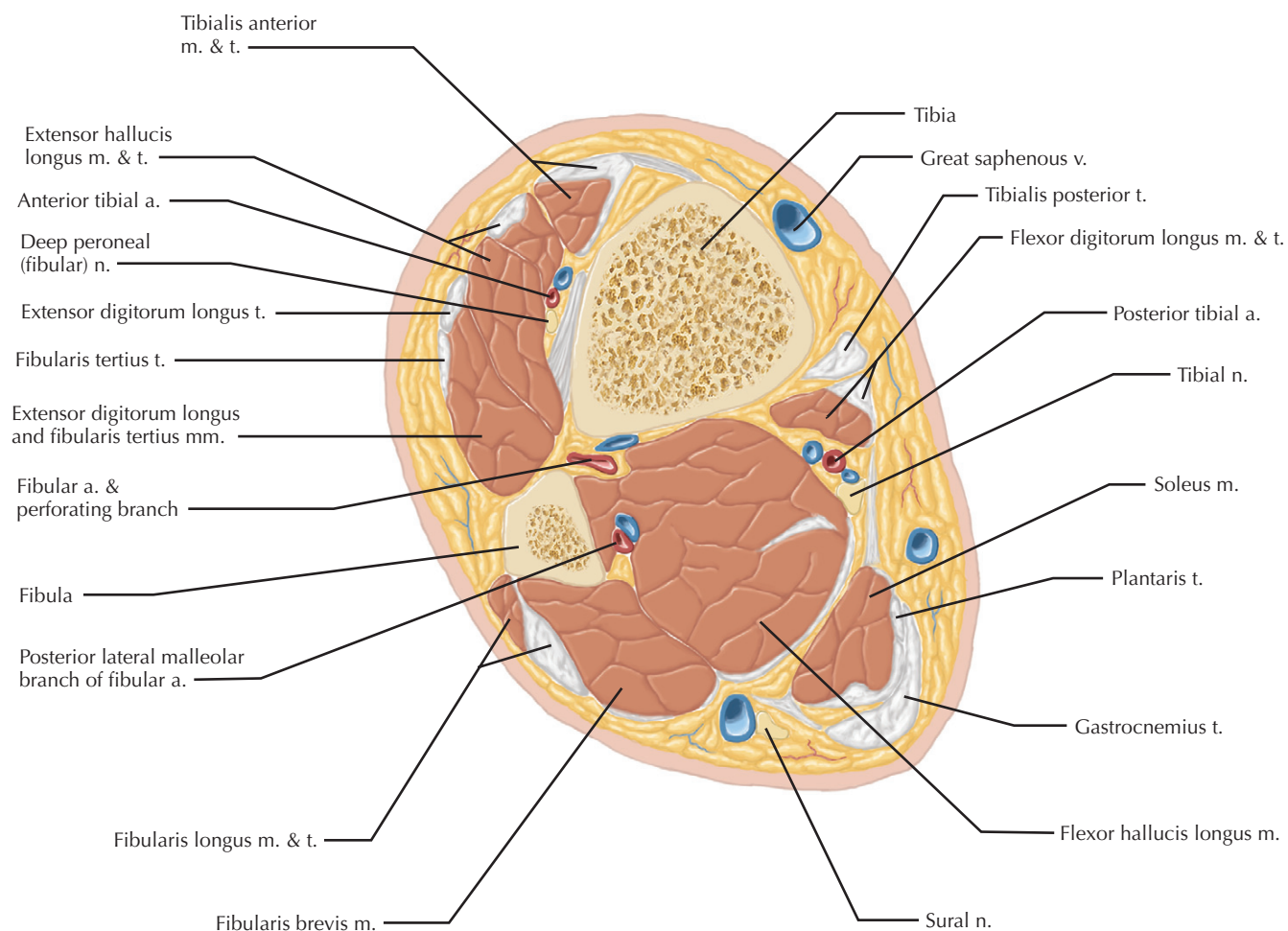






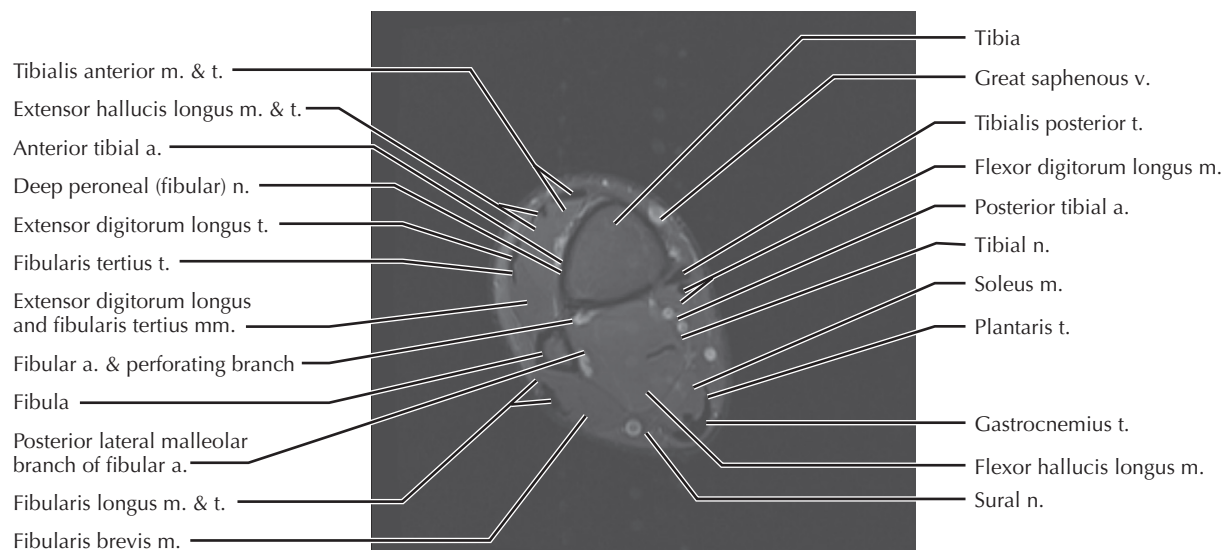
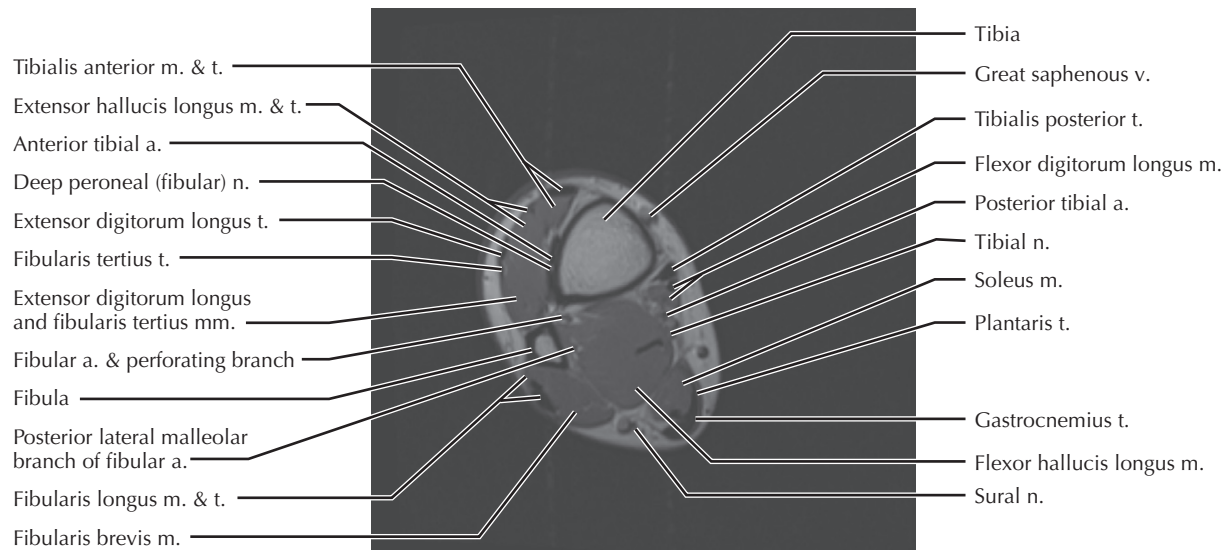
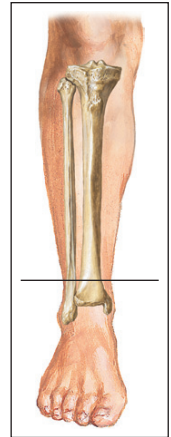






NORMAL ANATOMY

The muscle belly of the fibularis (peroneus) longus terminates more proximally than that of the fibularis (peroneus) brevis.



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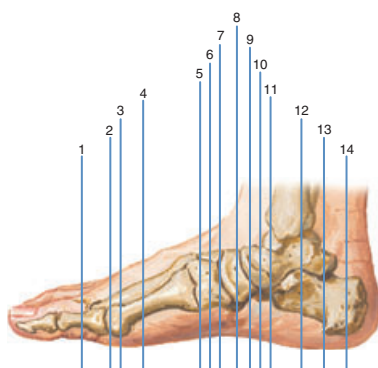
Chapter

14

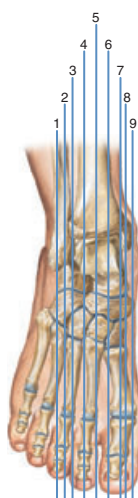
ANKLE AND FOOT



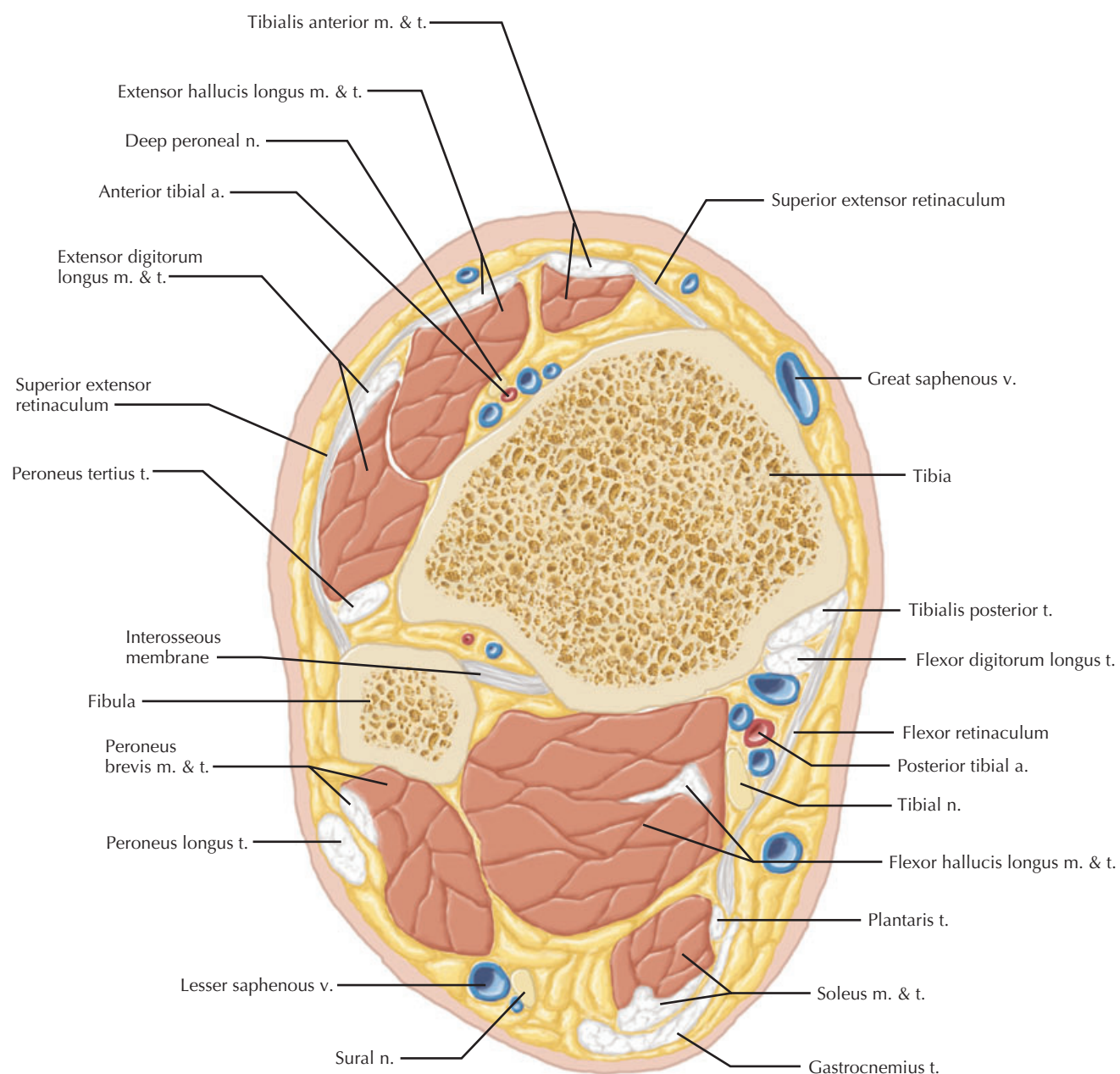
AXIAL (LONG AXIS) 530



CORONAL (SHORT AXIS) 554

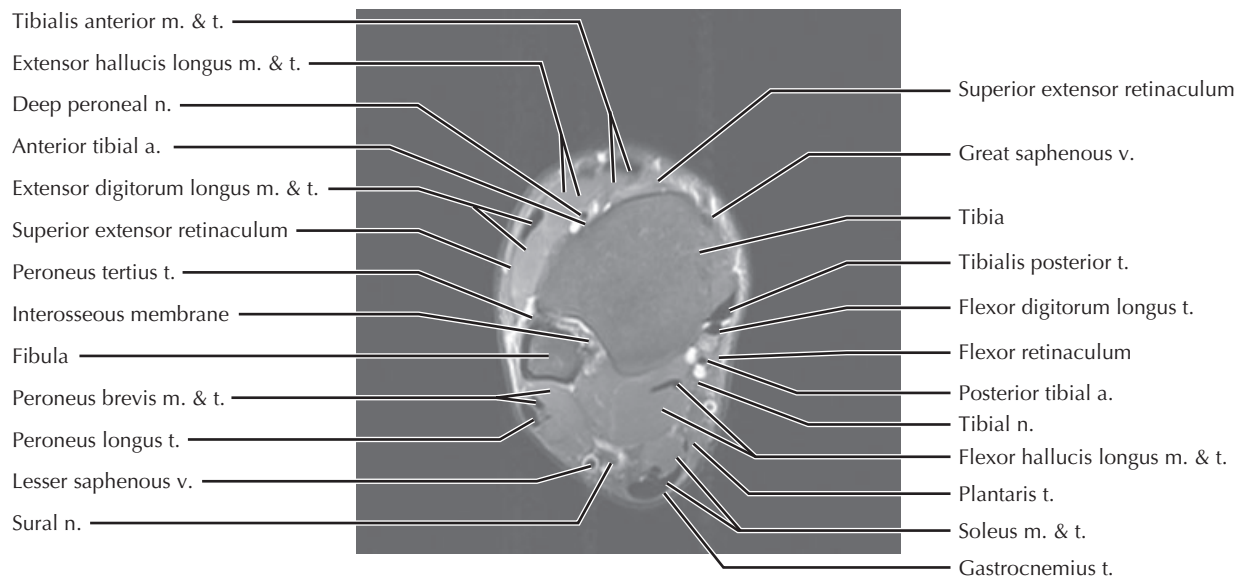
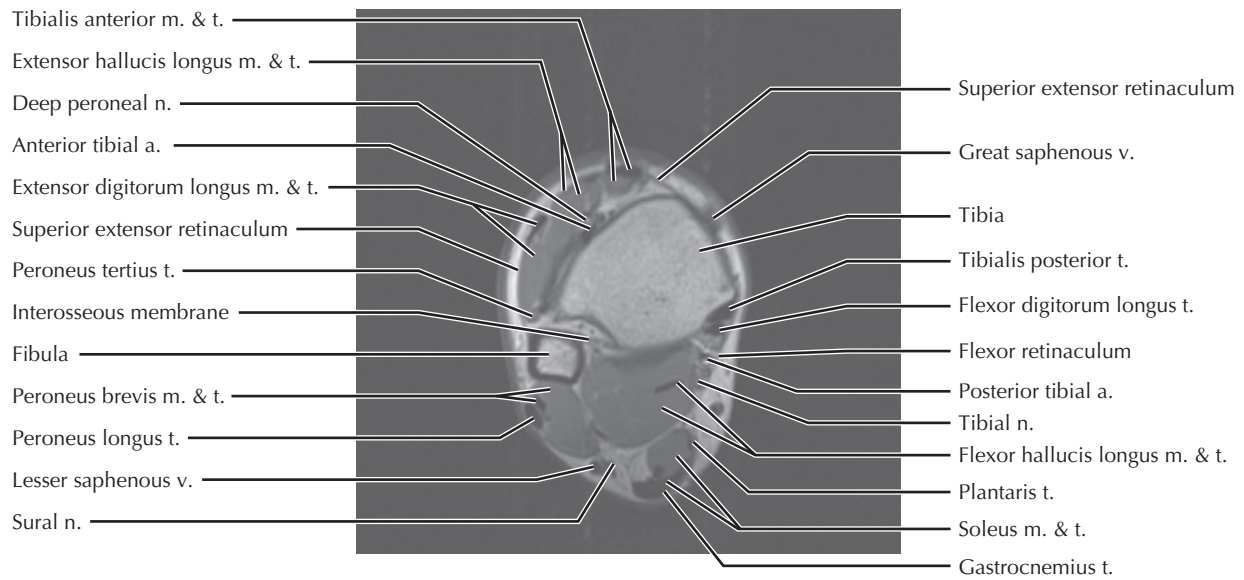


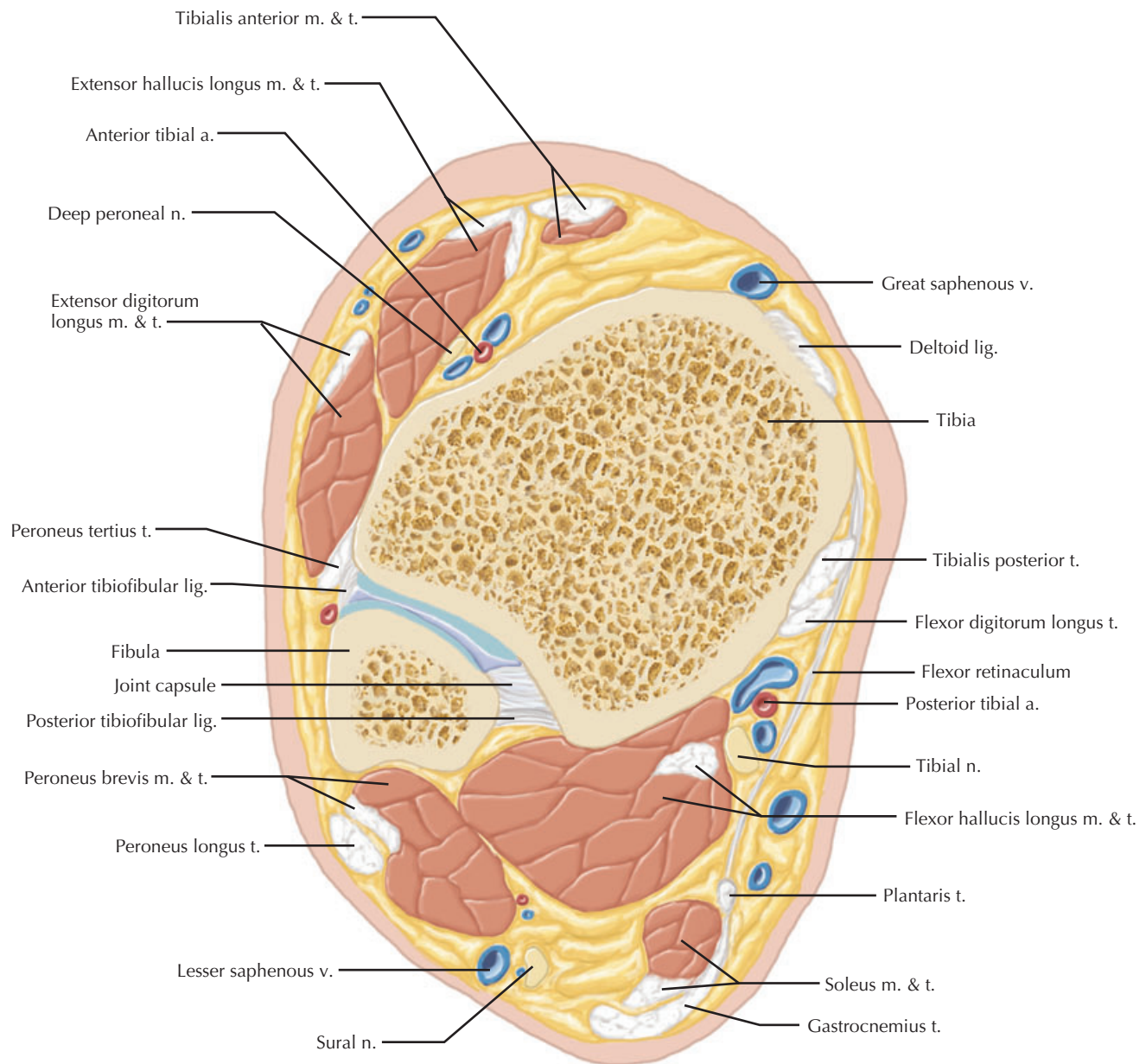
SAGITTAL 582

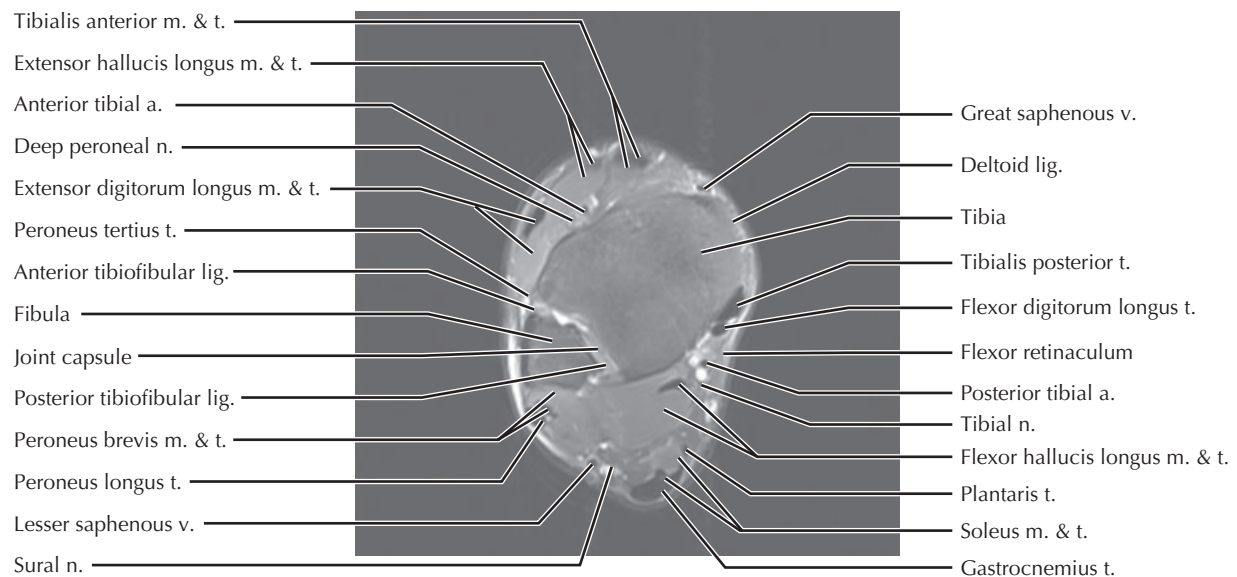
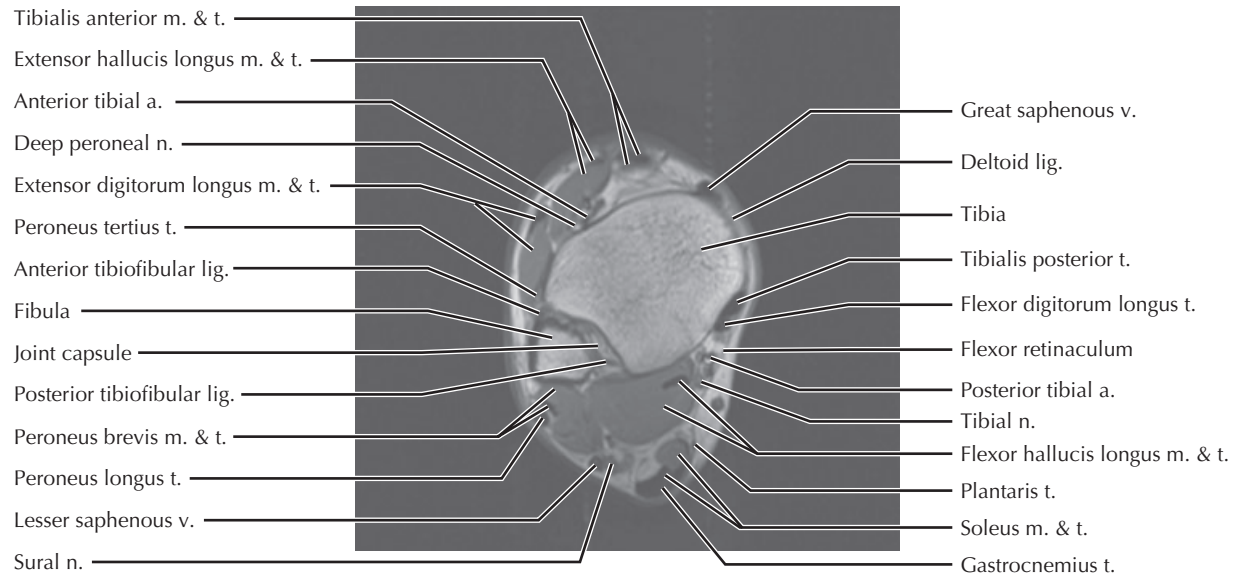


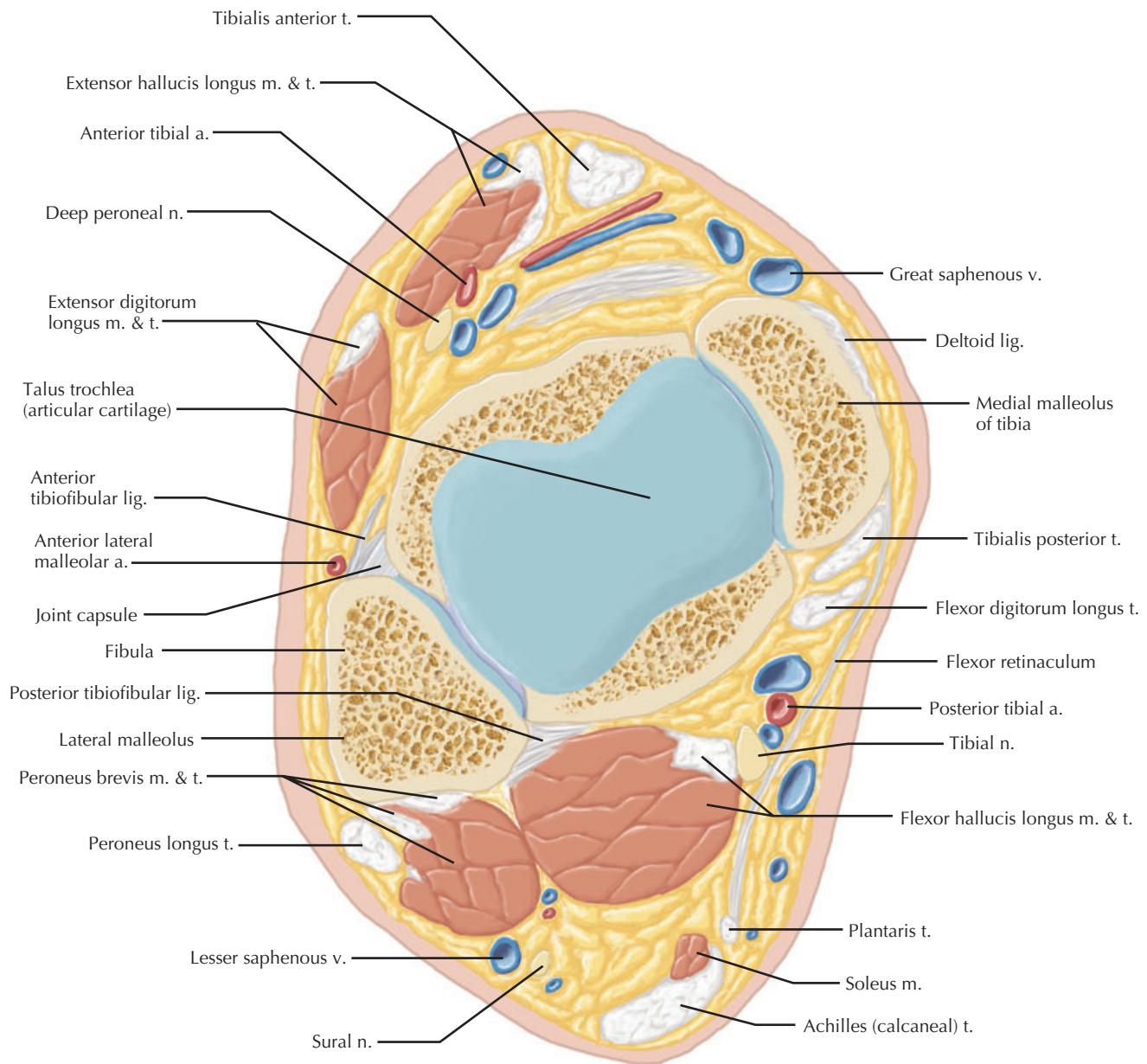
DIAGNOSTIC CONSIDERATION

The terms "axial" and "coronal" can be confusing when describing planes of imaging in the foot. Although the ankle has coronal and axial planes, sections through the foot are more easily described as *long axis* (parallel to long axis of the metatarsals) and *short axis* (perpendicular to long axis of the metatarsals).





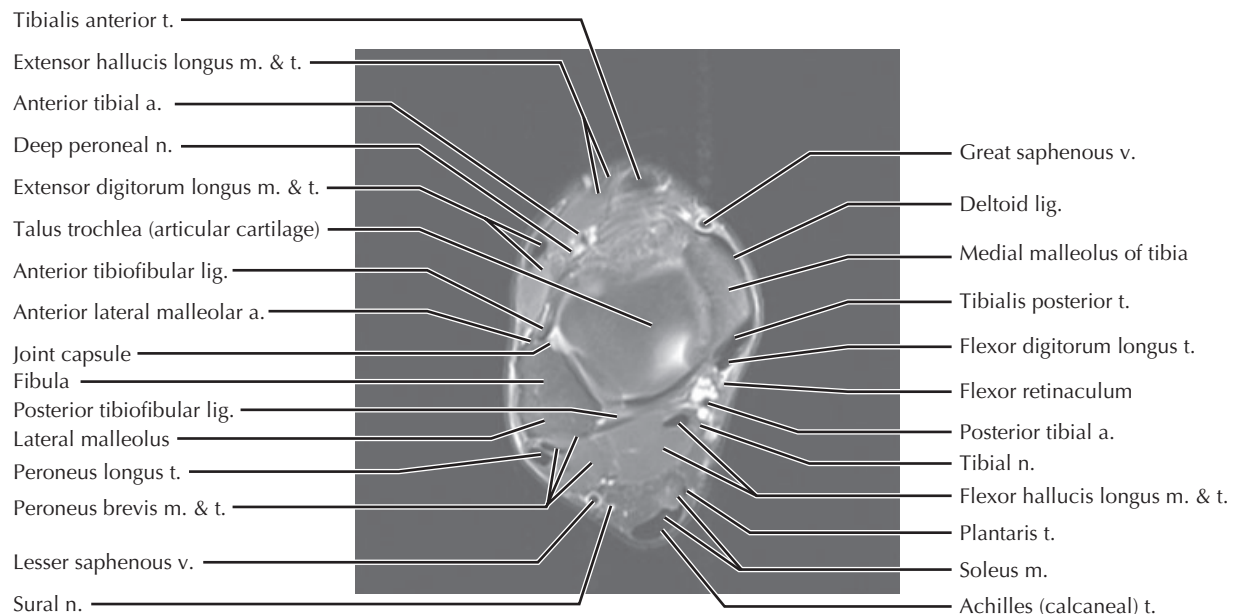
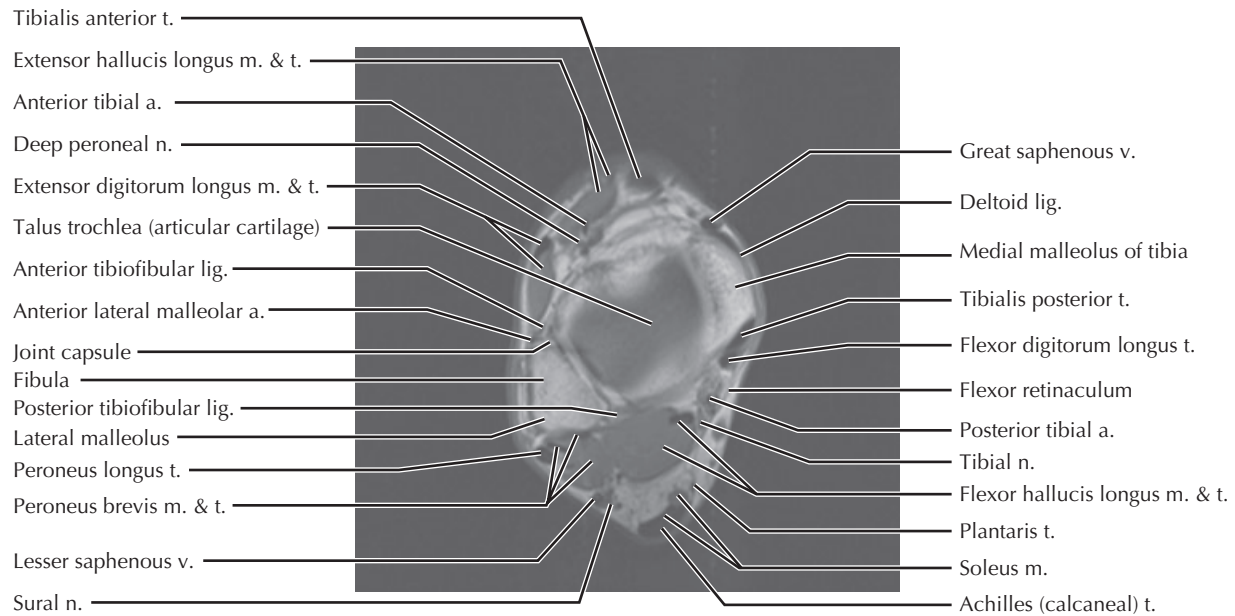


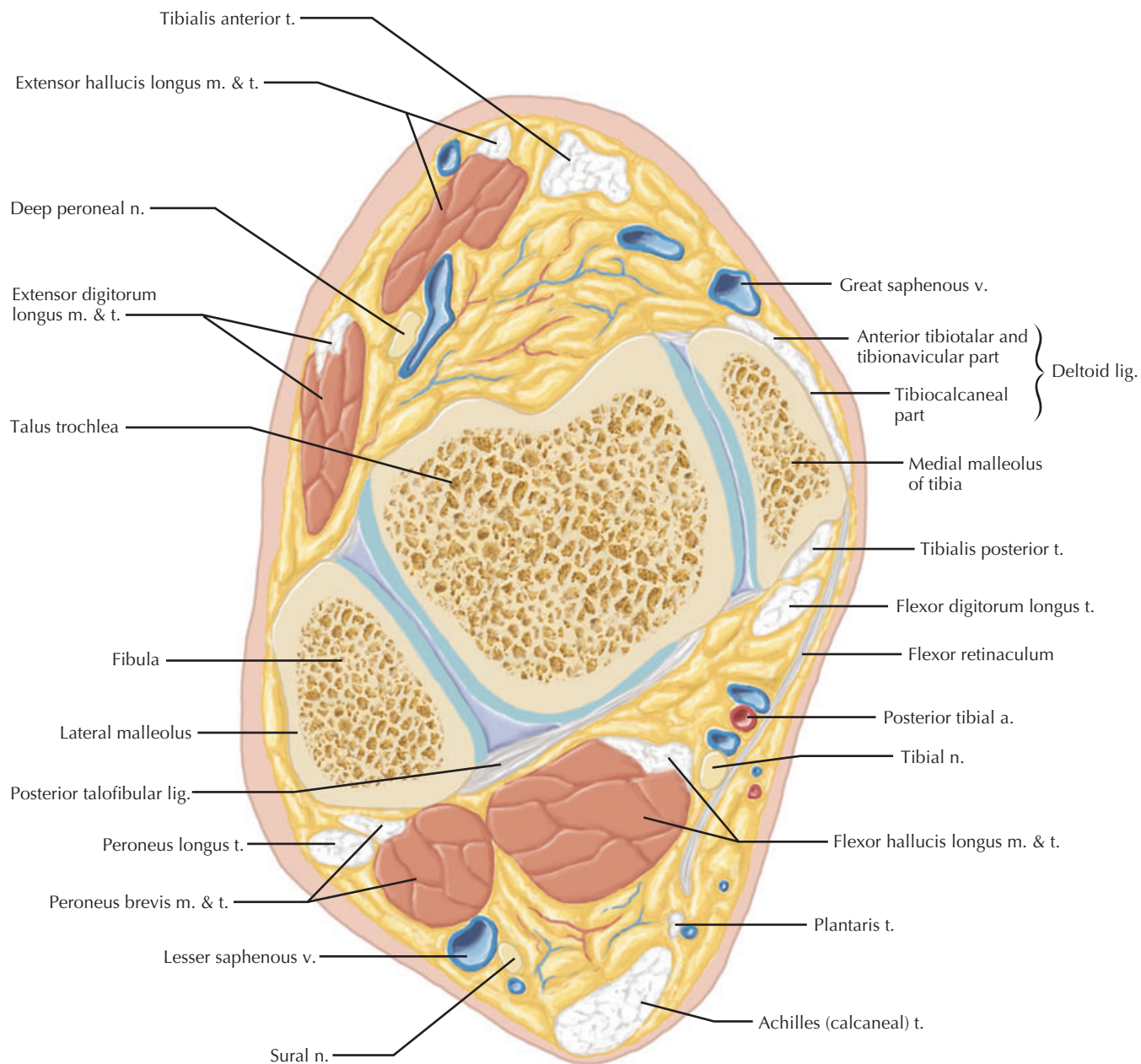


PATHOLOGIC PROCESS

Posterior tibial tendon tears usually occur at the level of the medial malleolus.

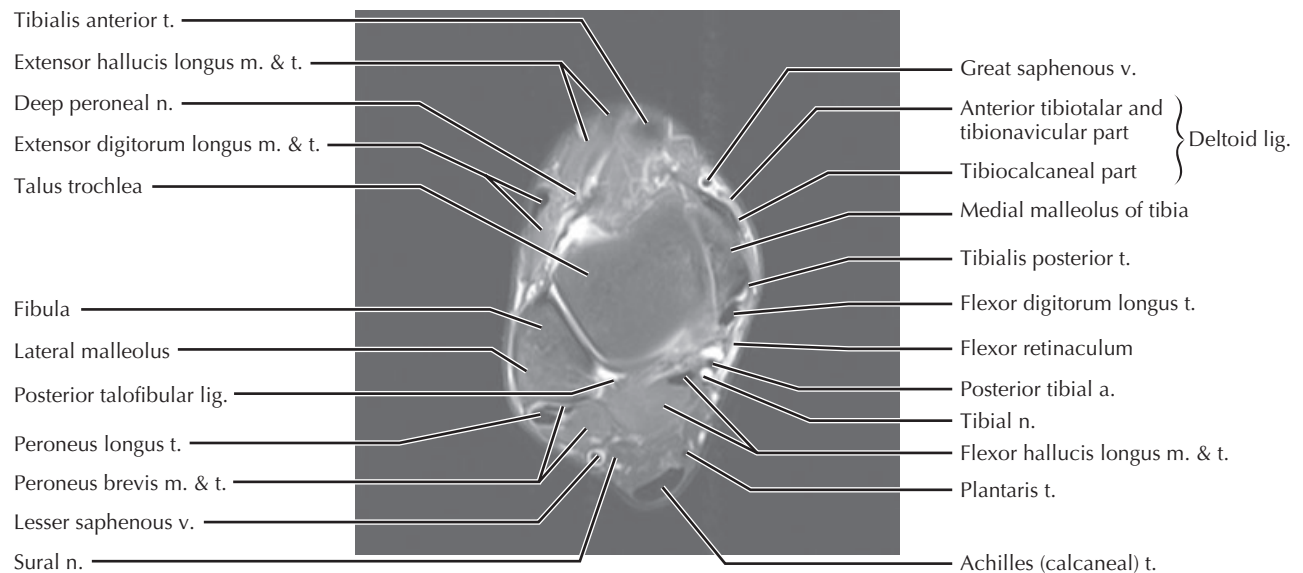
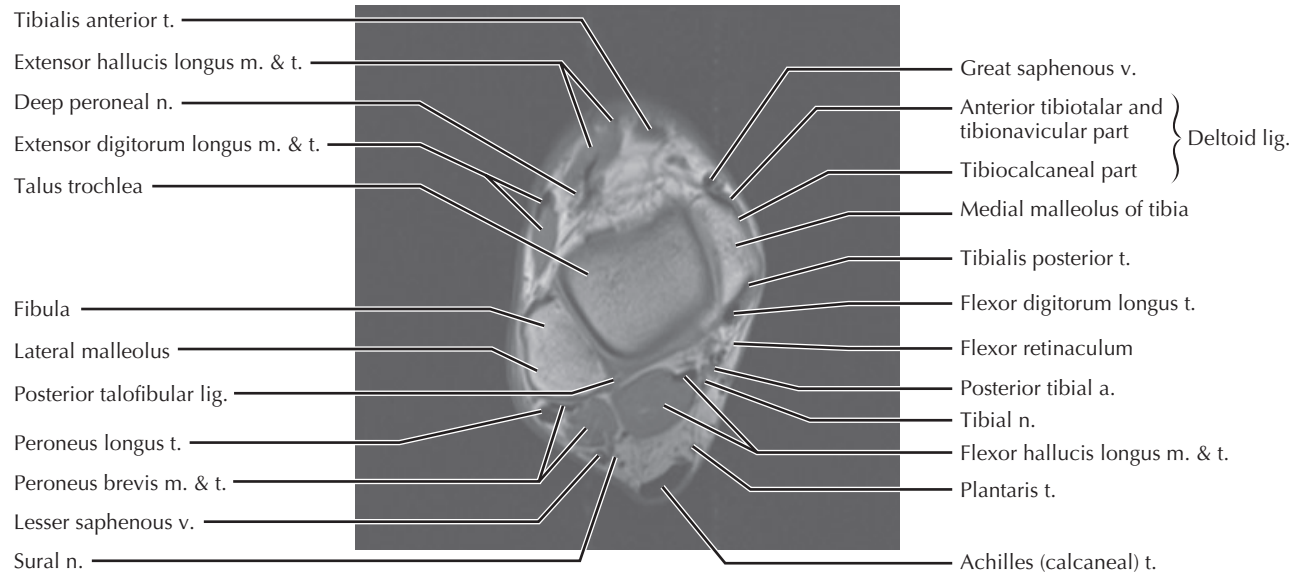
Tears of the posterior tibial tendon can lead to a flatfoot deformity because this tendon provides a significant contribution to the longitudinal arch of the foot.

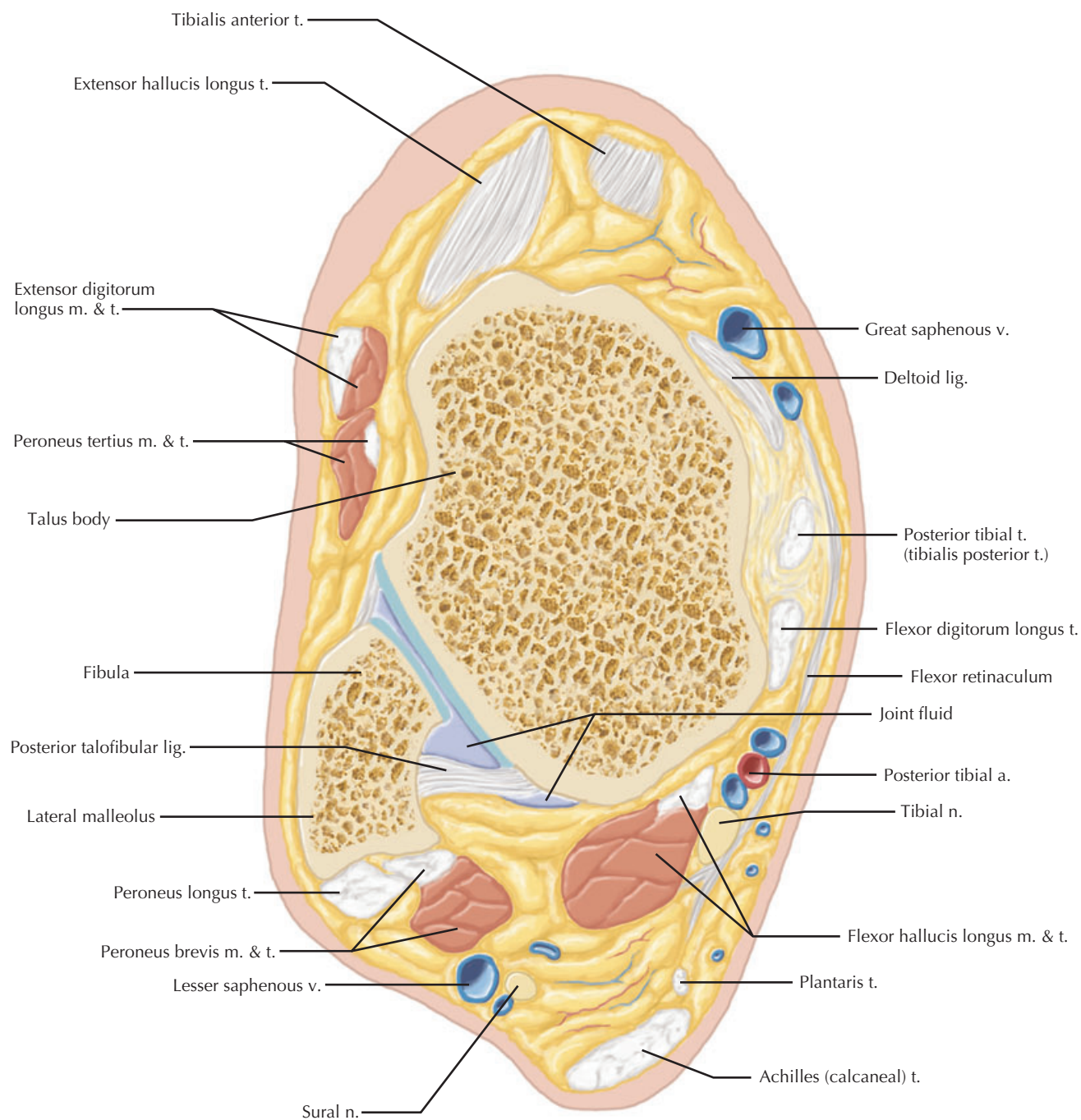




PATHOLOGIC PROCESS

"High ankle sprains" involve disruption of the anterior tibiofibular ligament.





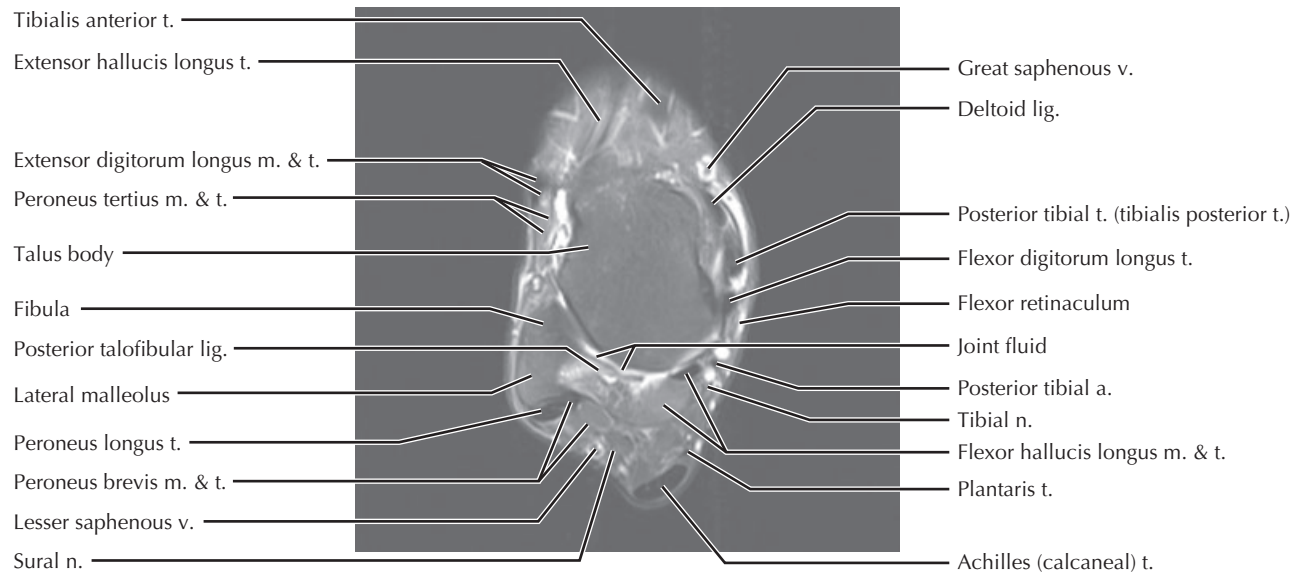
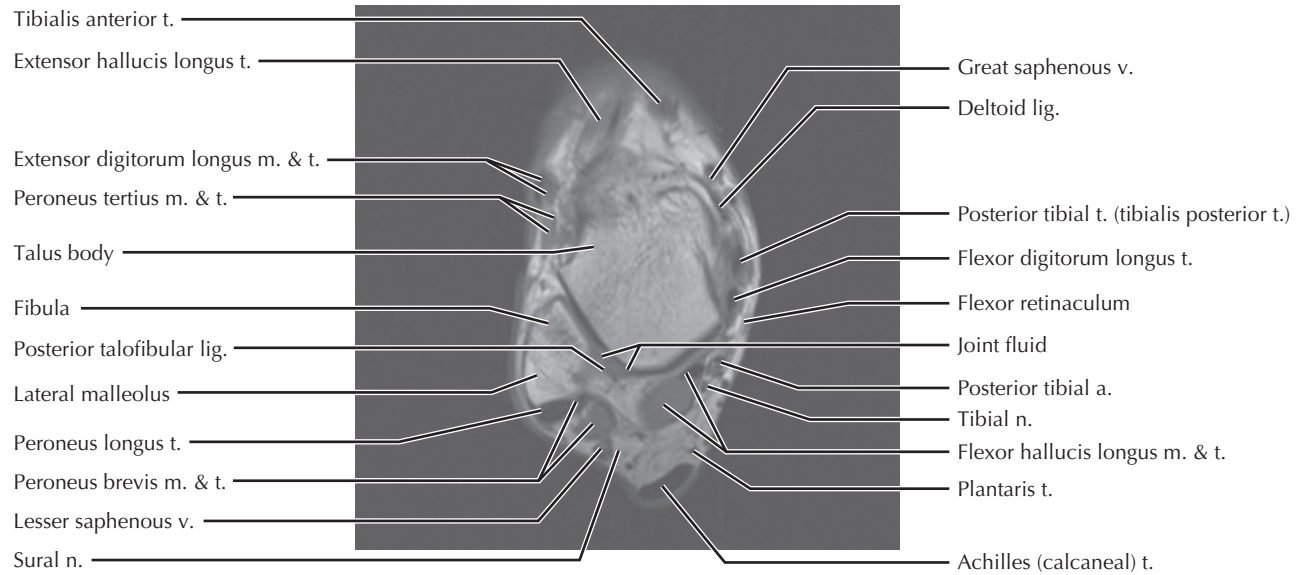
NORMAL ANATOMY

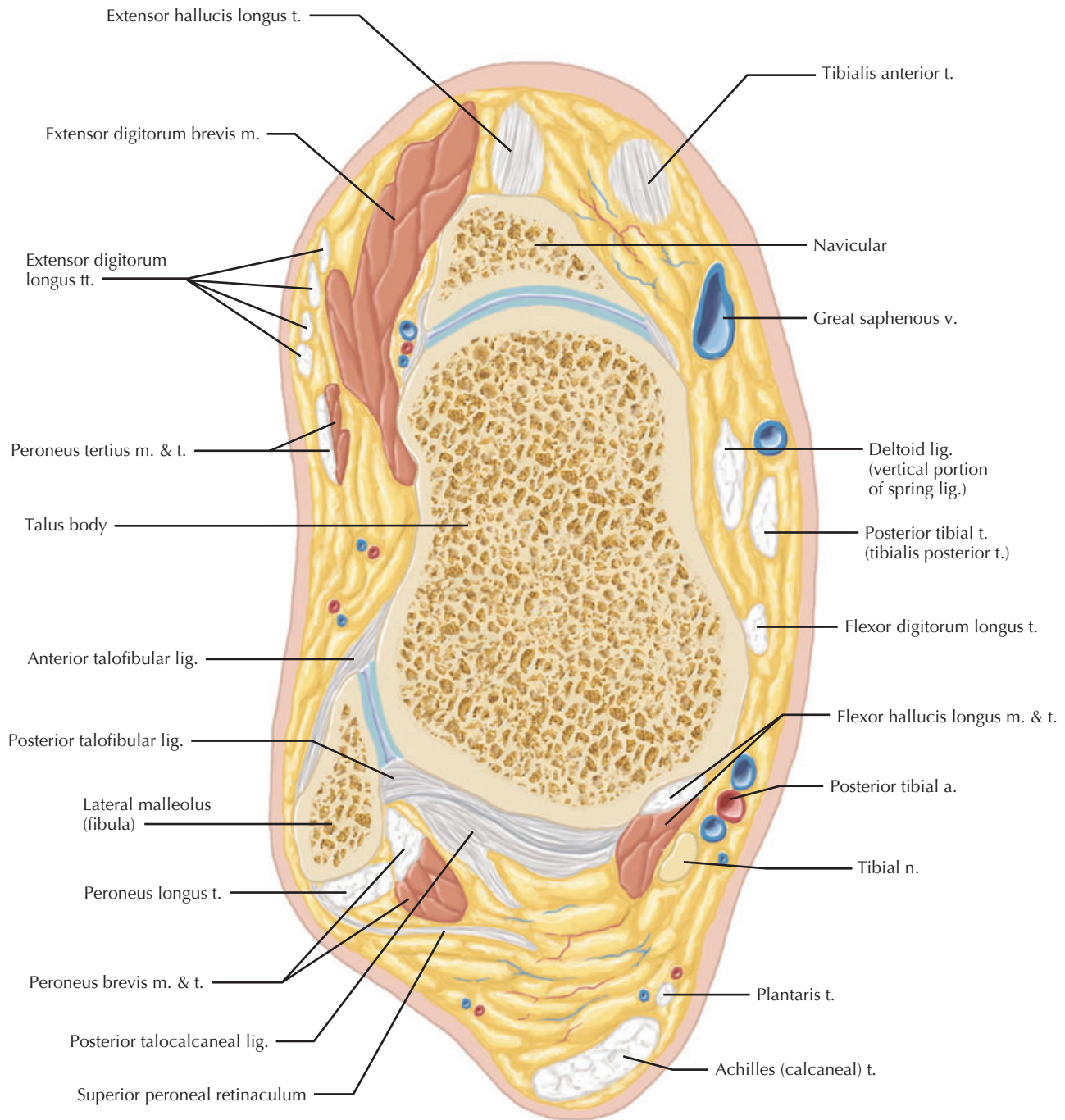
The Achilles (calcaneal) tendon is normally shaped like a kidney bean on axial images.

Below the tibiofibular joint space, the fibula is shaped like a comma on axial images. Above the joint, the fibula's medial side appears flat.

PATHOLOGIC PROCESS

Peroneal tendons can dislocate if the superior retinaculum is torn or lax. The tendons will be identified lateral to the fibula.





NORMAL VARIANT

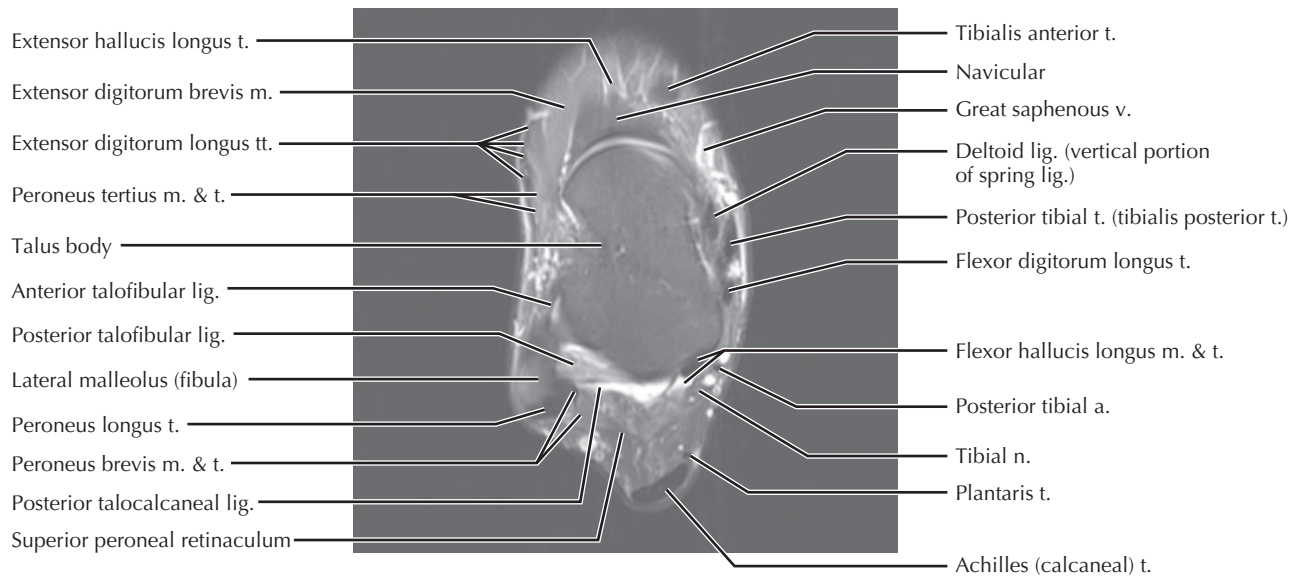
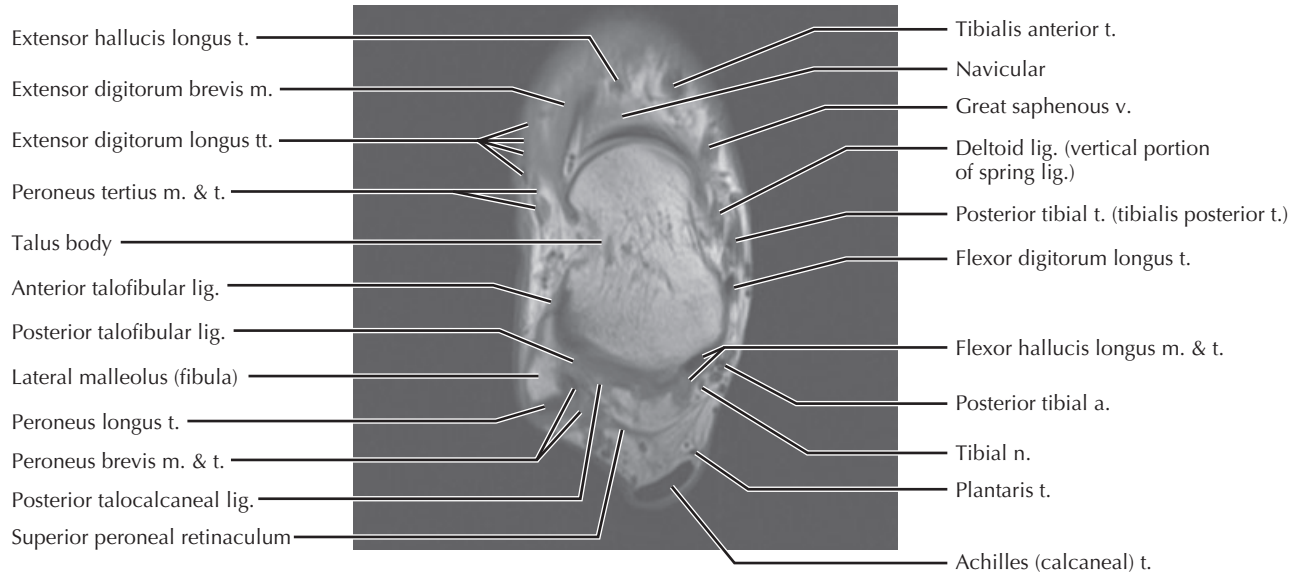
The plantaris tendon is present in 90% of individuals.

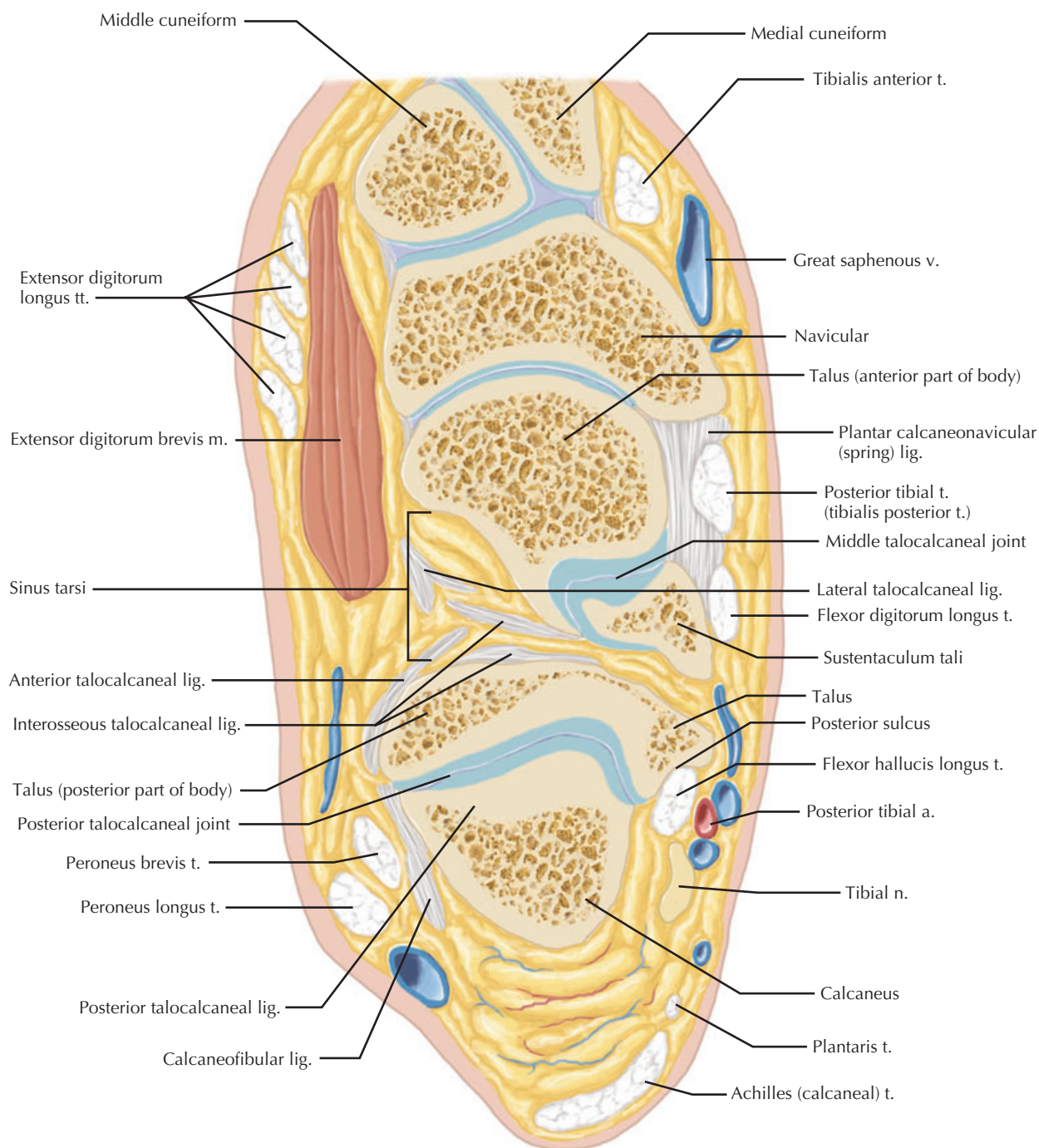
PATHOLOGIC PROCESS

The anterior talofibular ligament is the most frequently torn ankle ligament.

DIAGNOSTIC CONSIDERATION

The vertical portion of the spring ligament and the posterior tibial tendon should appear similar in size. A spring ligament tear will make the ligament appear attenuated; a posterior tibial tendinopathy can increase or decrease the size of the tendon.





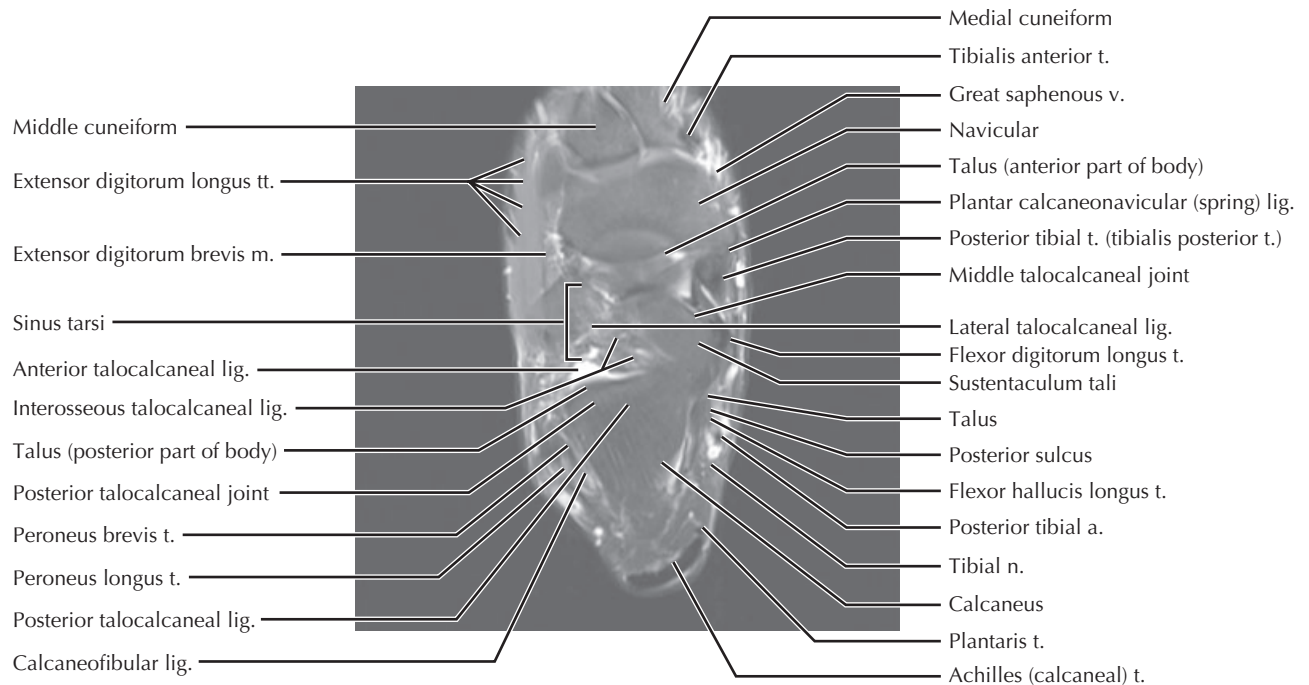
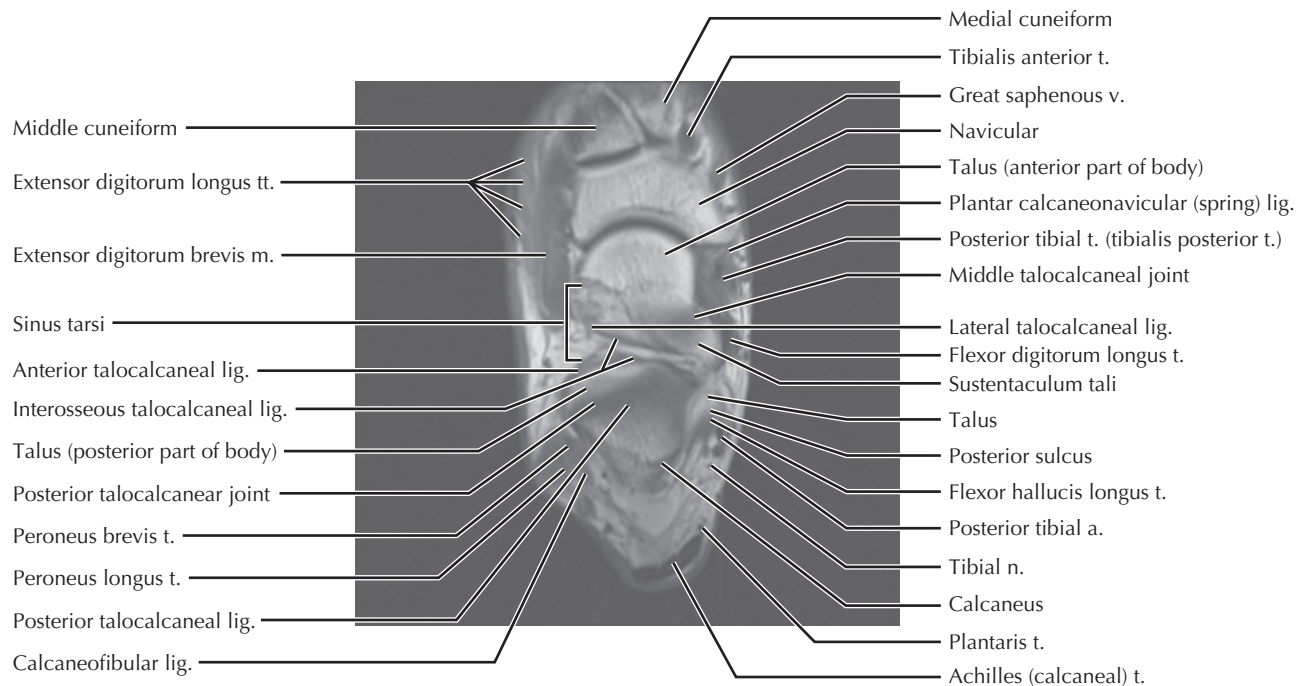
NORMAL ANATOMY

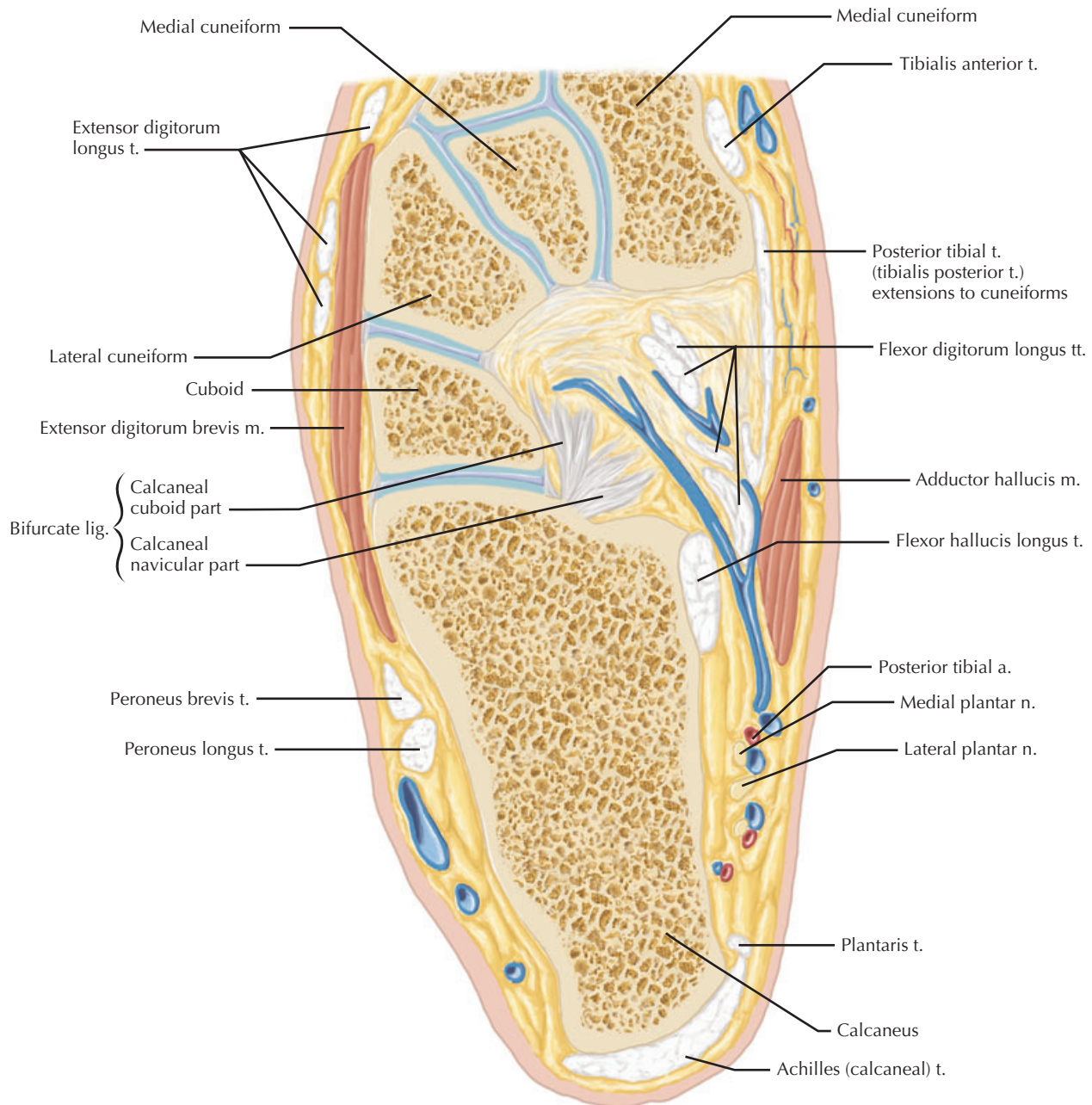
The Achilles (calcaneal) tendon may have intermediate signal between the gastrocnemius and soleus components.

DIAGNOSTIC CONSIDERATION

High signal can be seen normally between the plantaris tendon and the Achilles tendon and should not be mistaken for an abnormality of the Achilles tendon. Similarly, if the Achilles tendon is completely torn, the intact plantaris should not be mistaken for intact fibers of the Achilles tendon.

It is normal to see intermediate signal and an increase in size of the posterior tibial tendon just proximal to its insertion on the navicular bone.





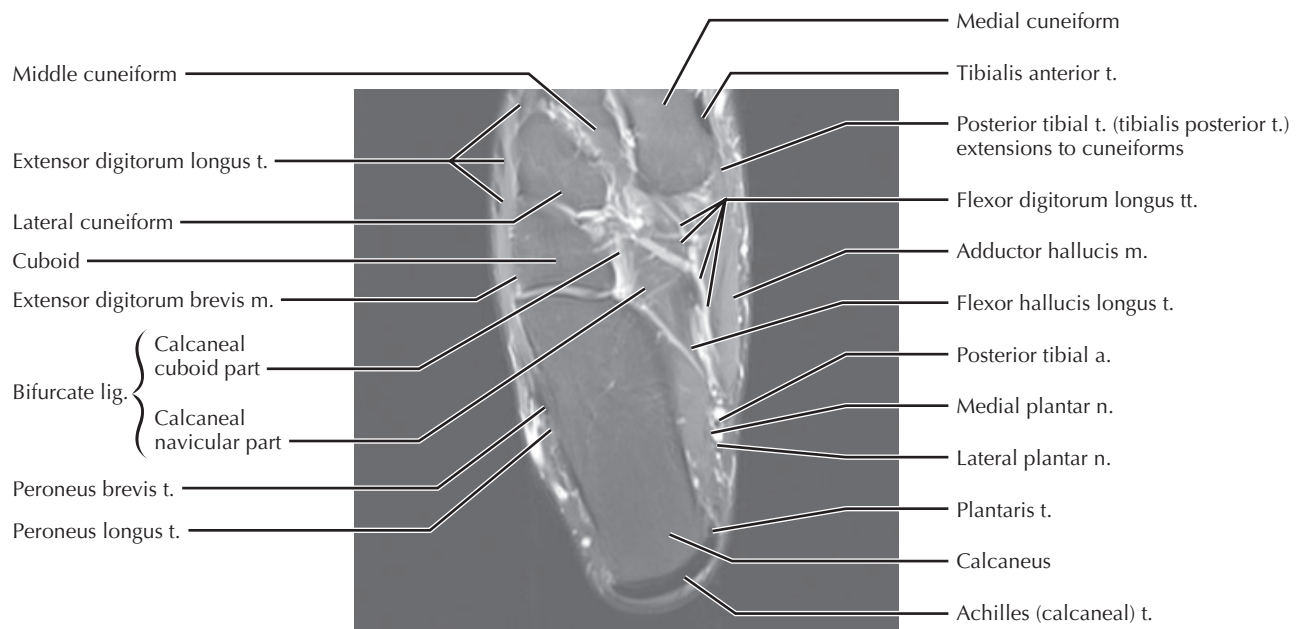
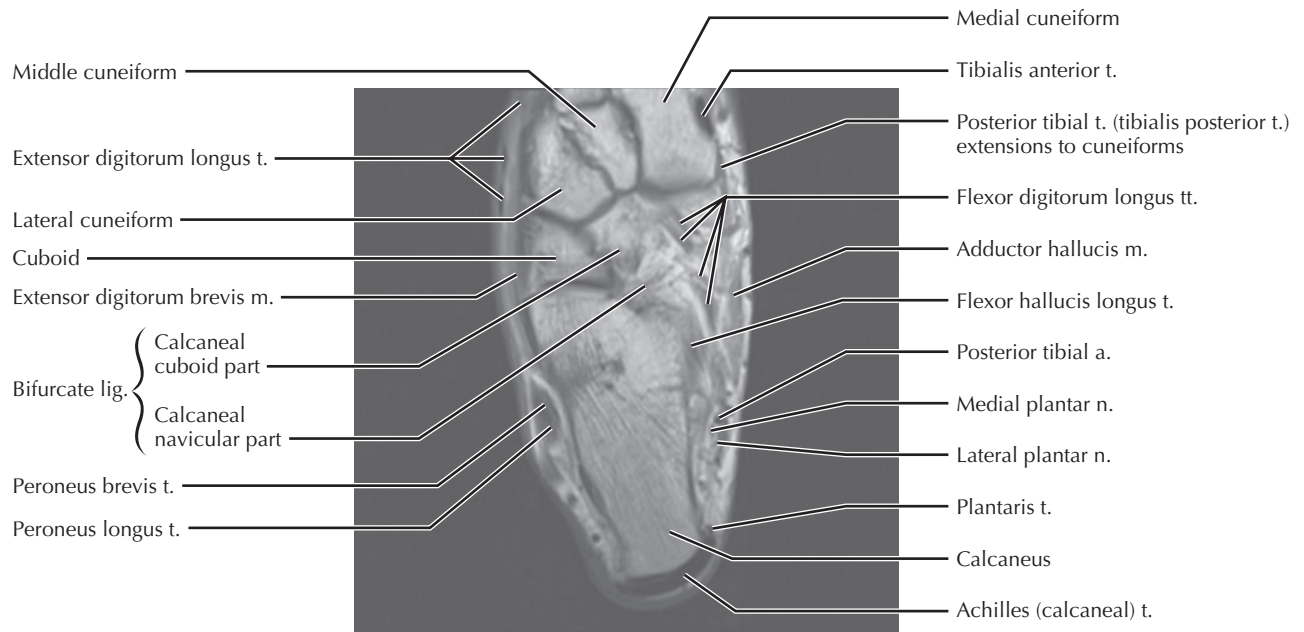
NORMAL VARIANT

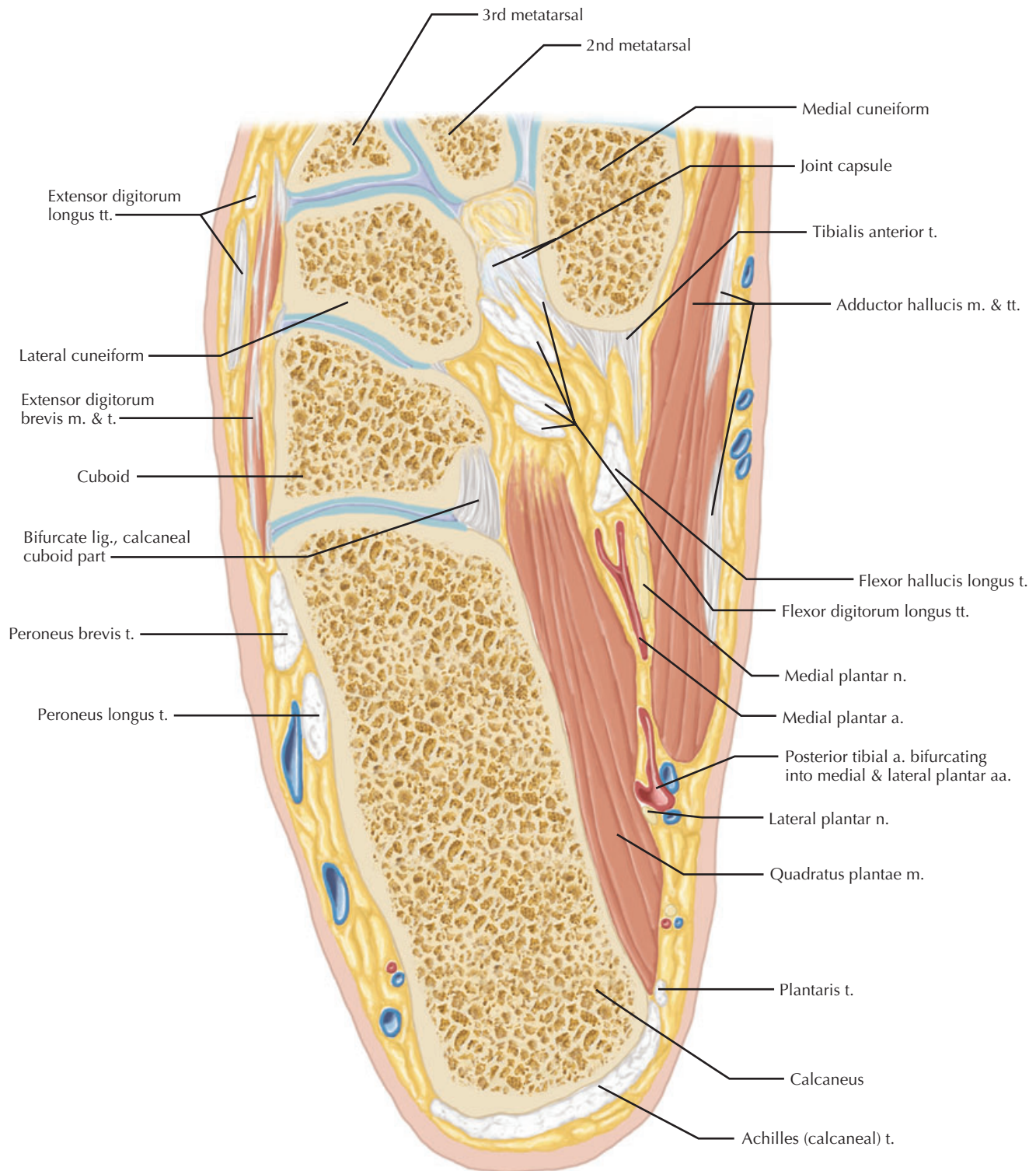
The plantaris tendon may insert onto the Achilles (calcaneal) tendon, the posterior calcaneus, or the flexor retinaculum.

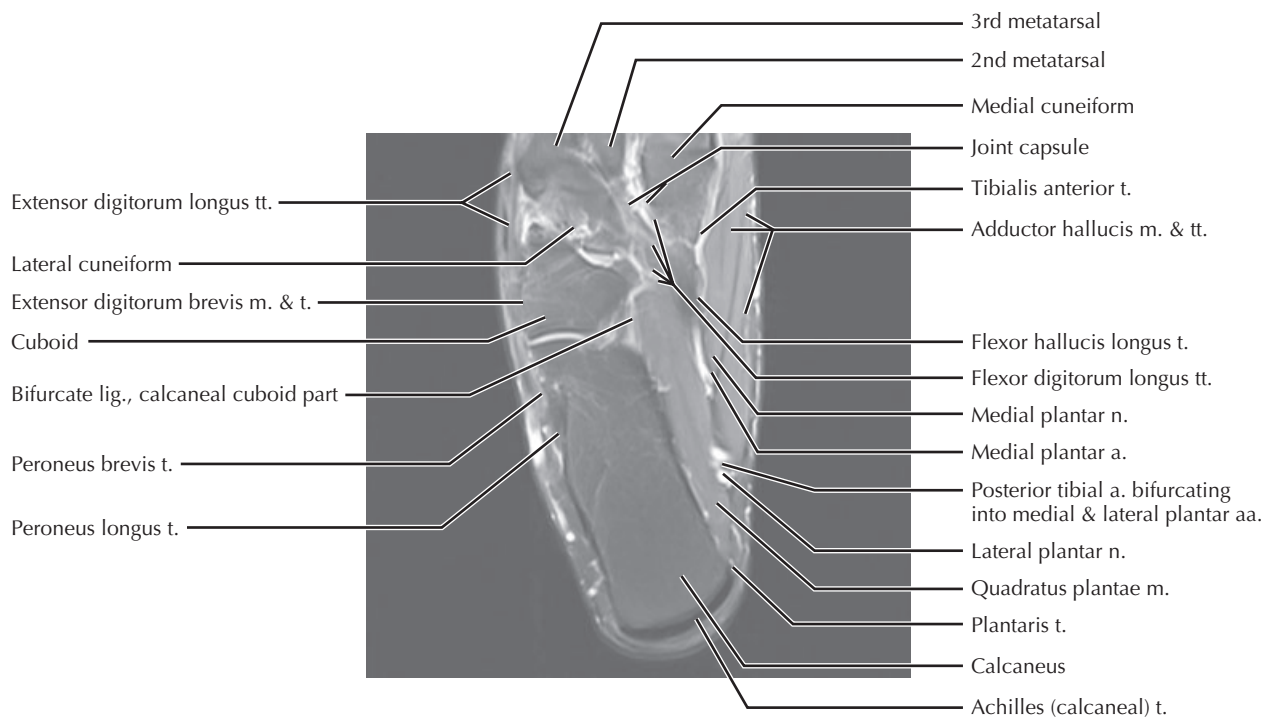
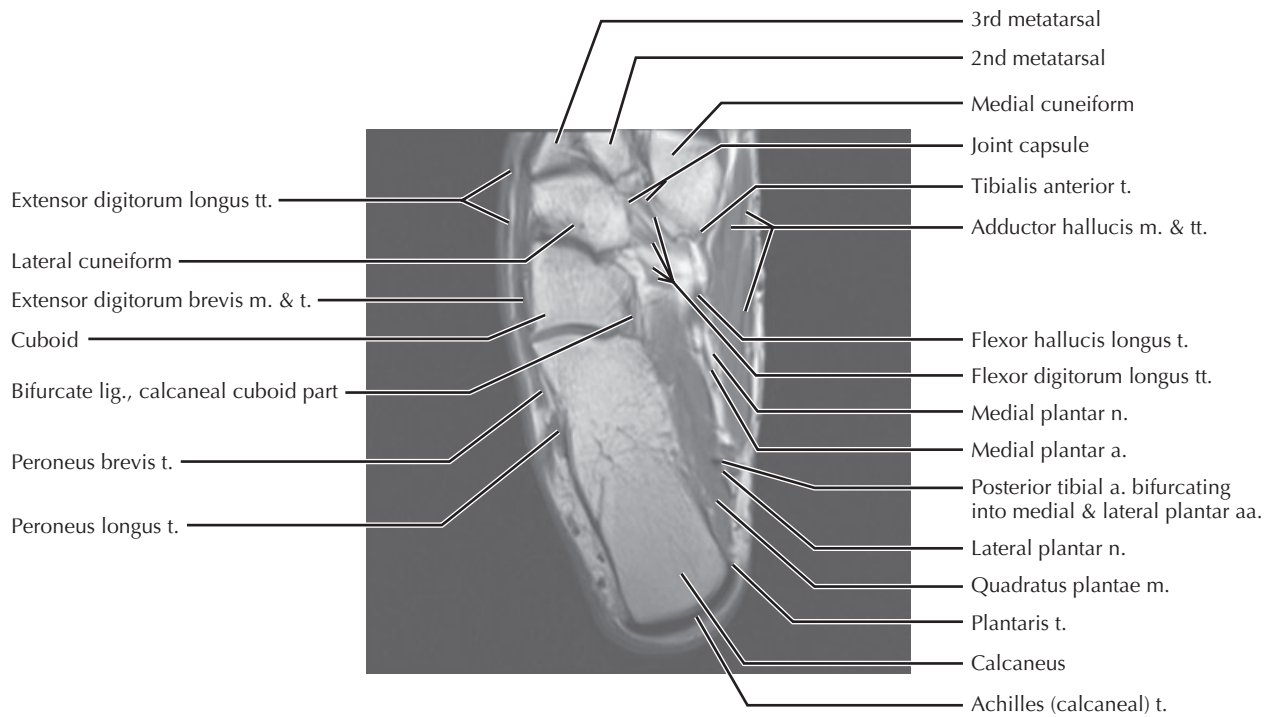
Two frequently recognized types of accessory navicular bones exist. Type 1 is a small, sesamoid bone within the posterior tibial tendon near its insertion onto the navicular. Type 2 is a large, secondary ossification center that is present in about 10% of the population and has a fibrous attachment to the navicular. This can separate and become painful with repetitive trauma or overt trauma.

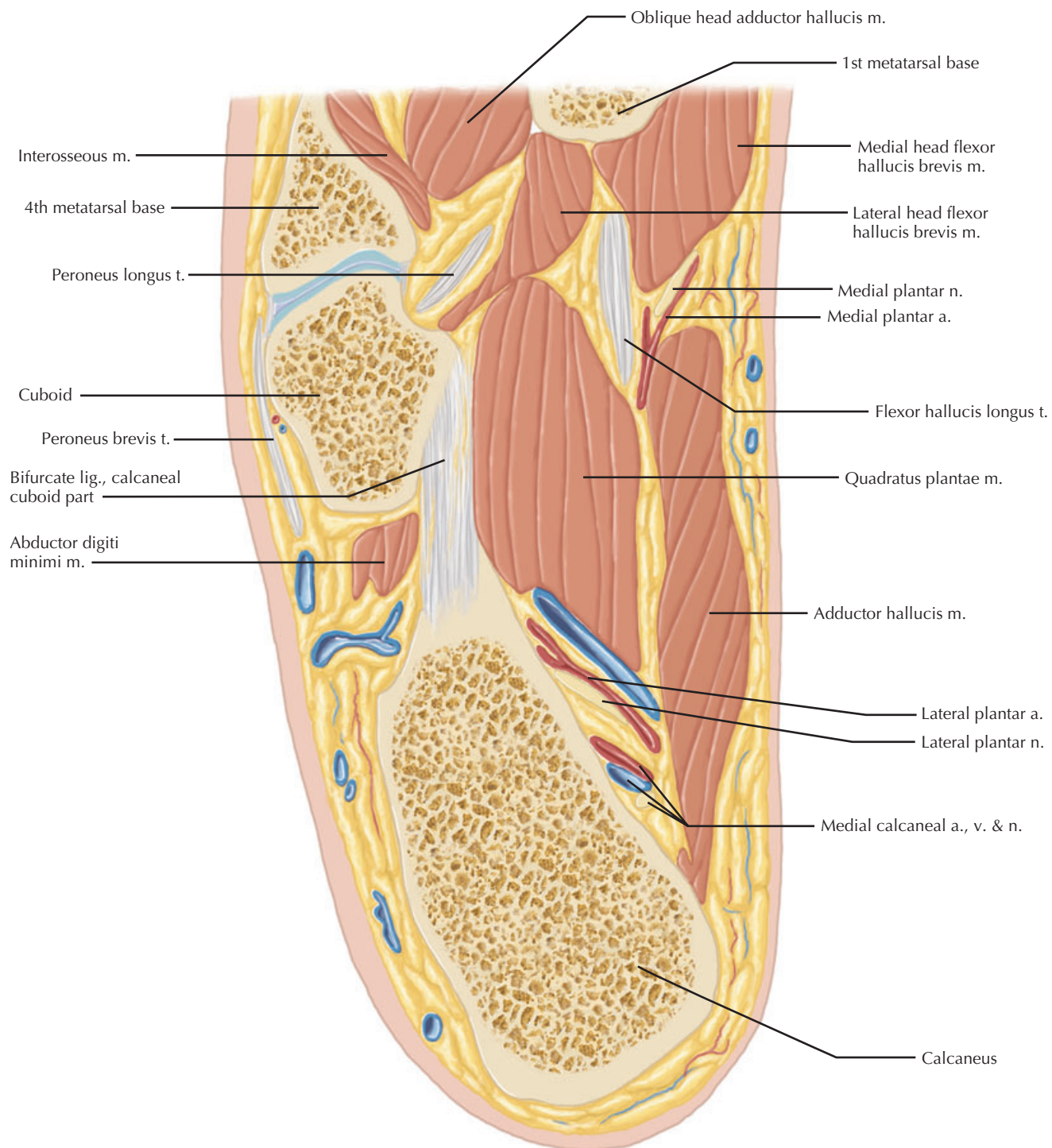
PATHOLOGIC PROCESS

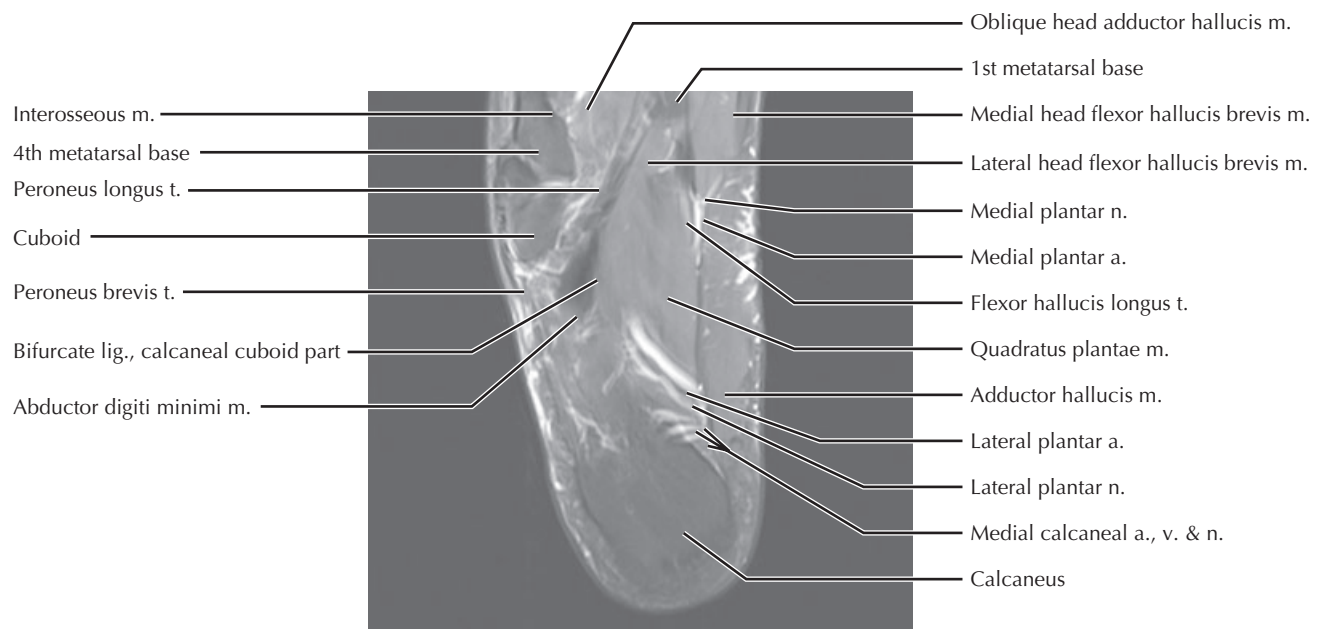
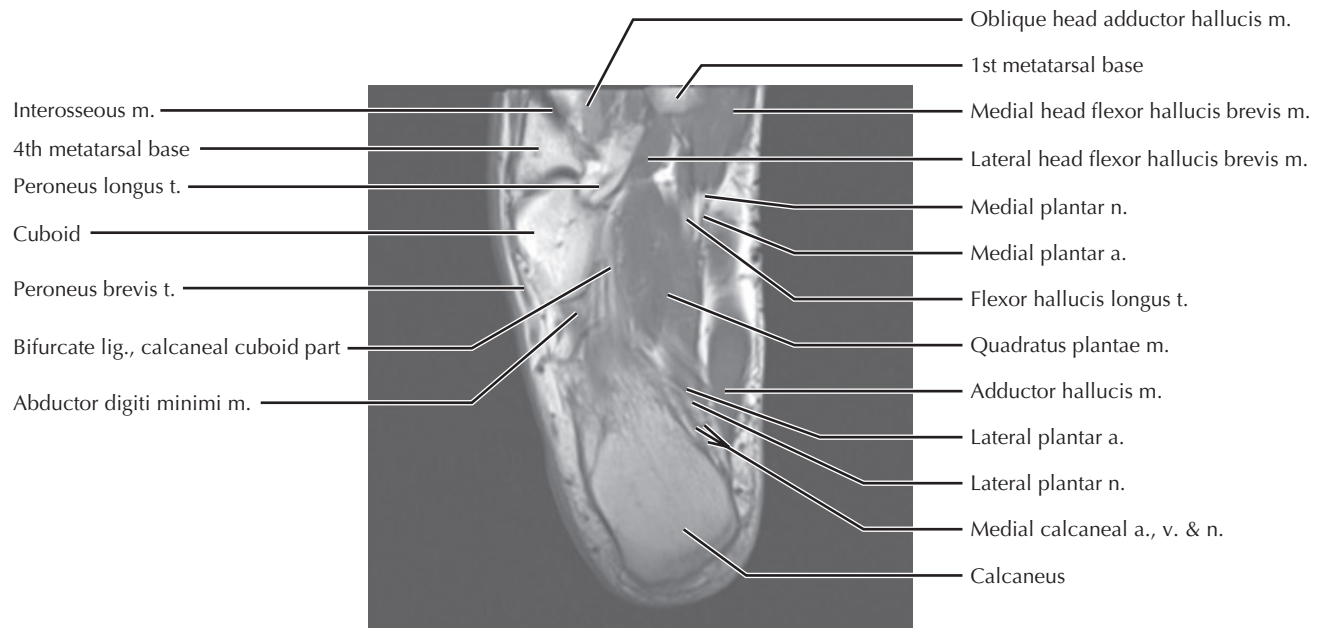
Longitudinal split tears of the peroneus brevis can be distinguished from two muscle variants, which are termed the *accessory peroneus quartus* and the *low-lying peroneus brevis*. A split tear will have one muscle belly and two tendons arising from it, whereas the low-lying peroneus brevis and the peroneus quartus will each have one tendon and one muscle belly.

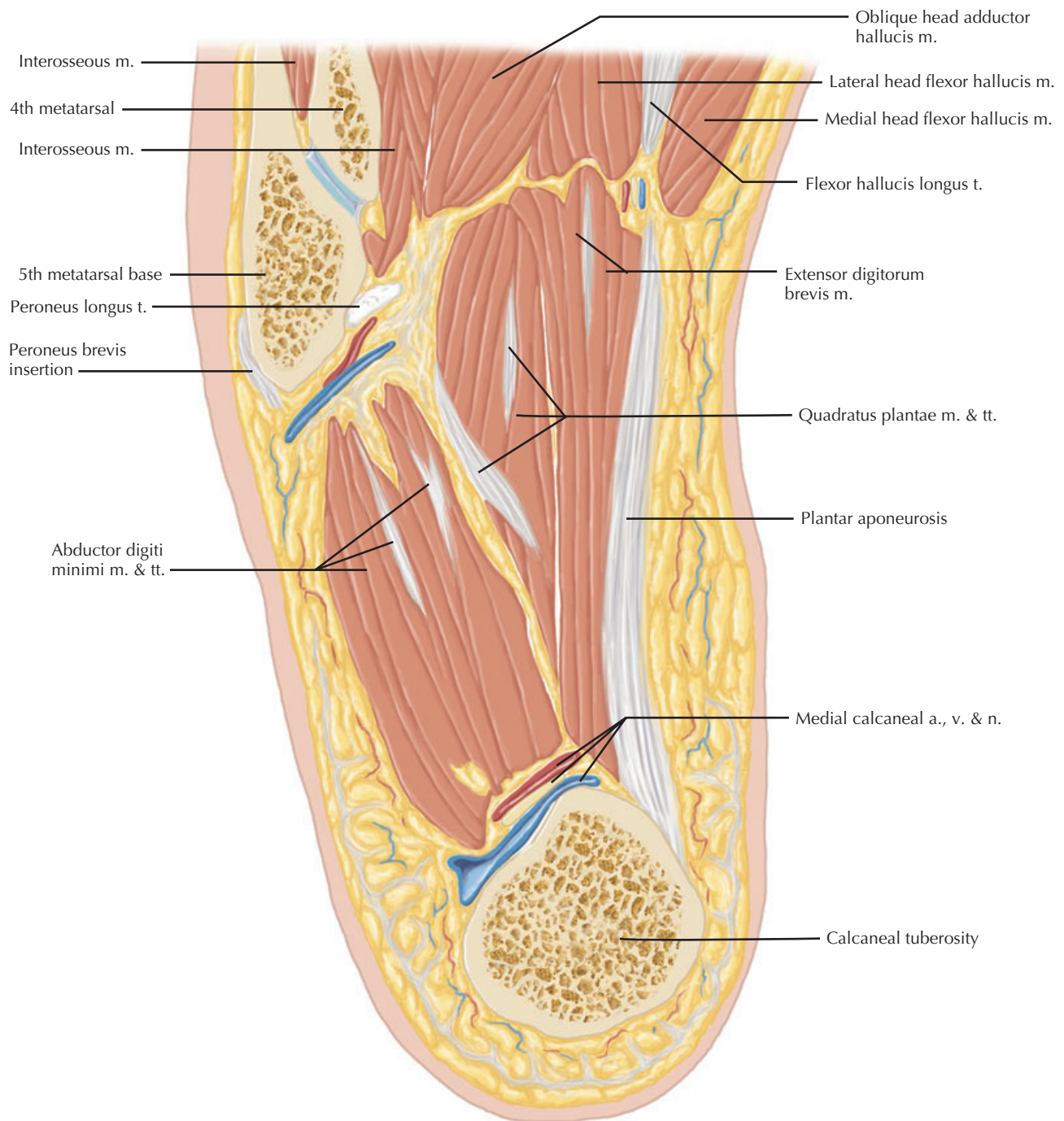


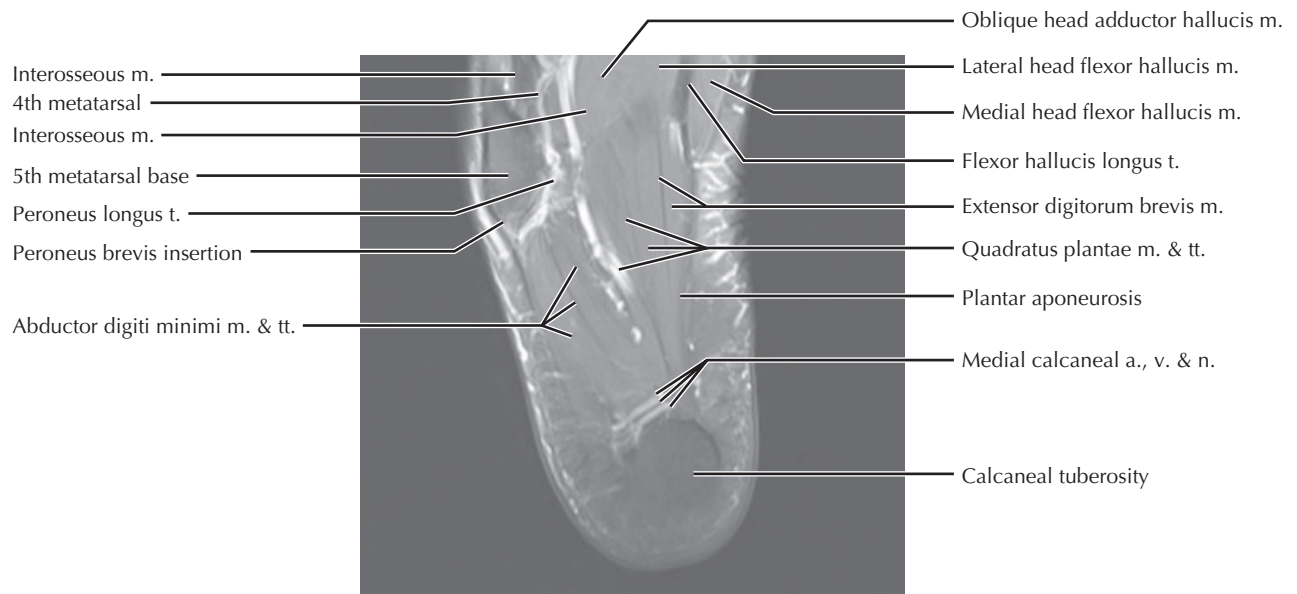
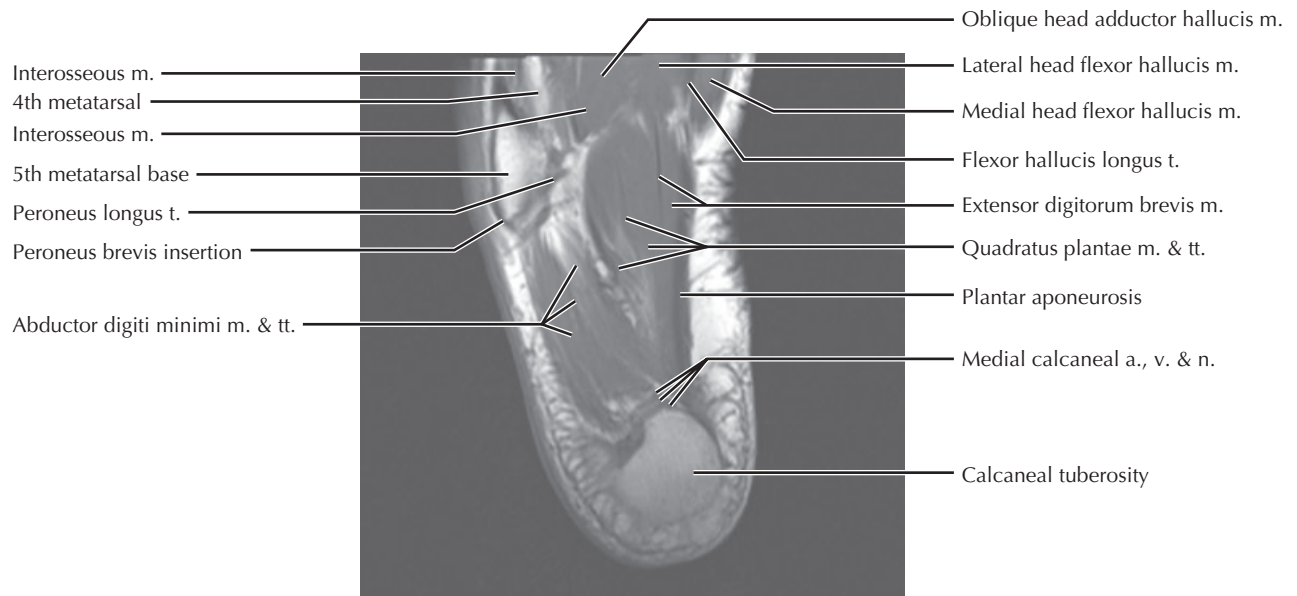


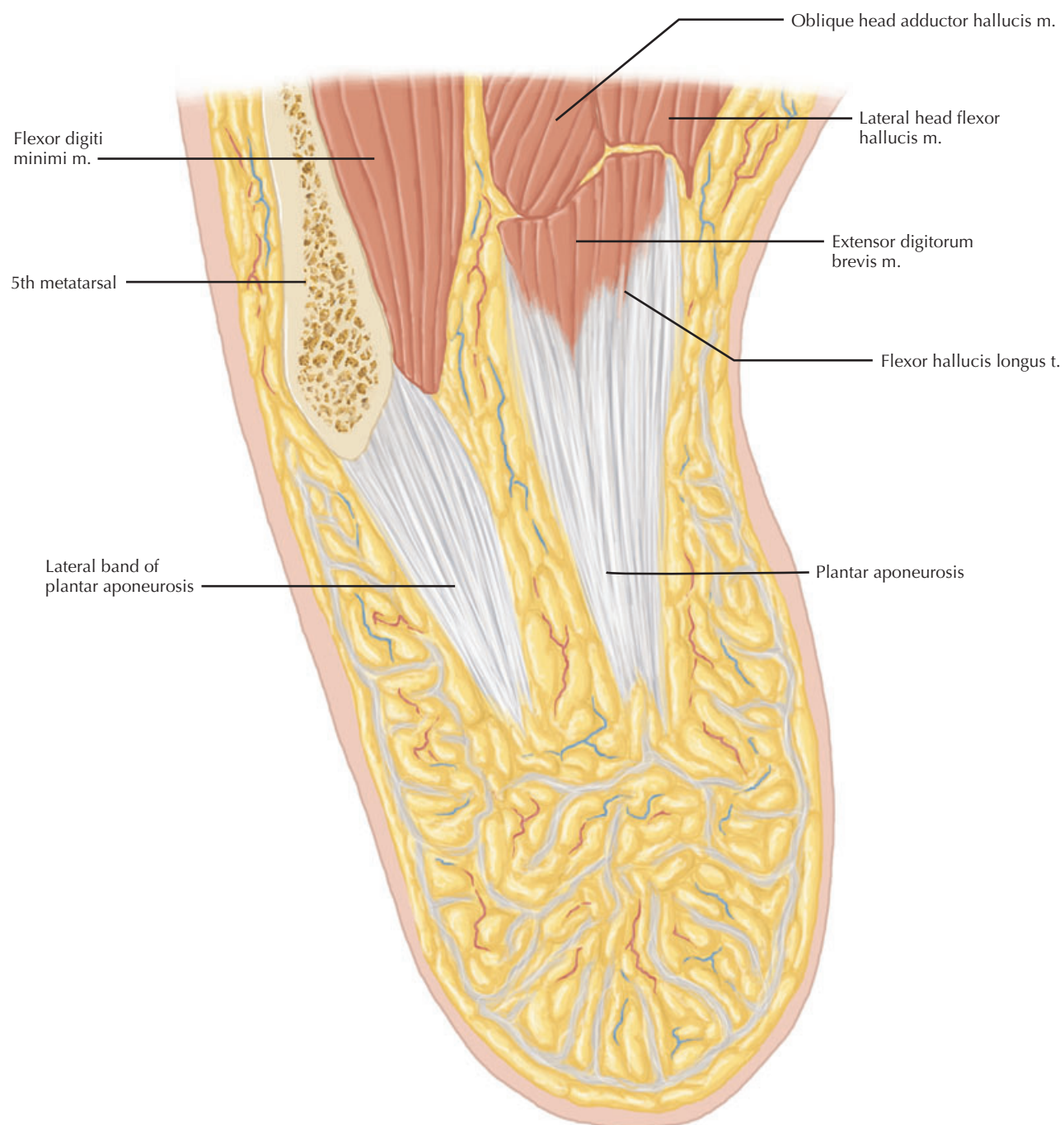


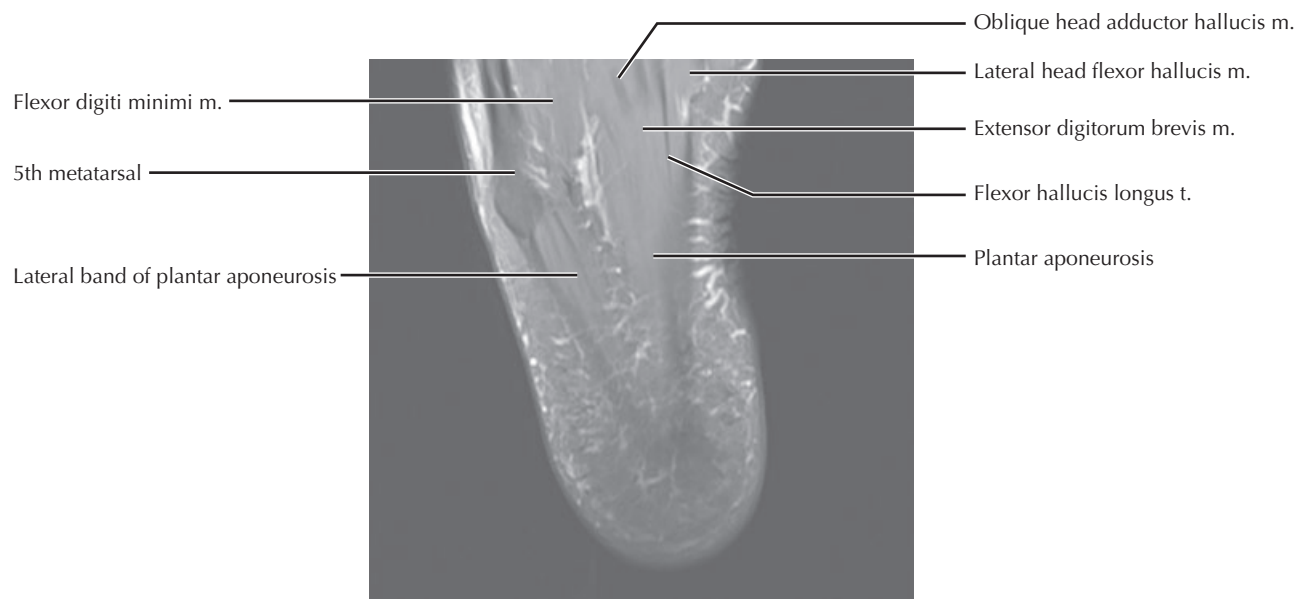
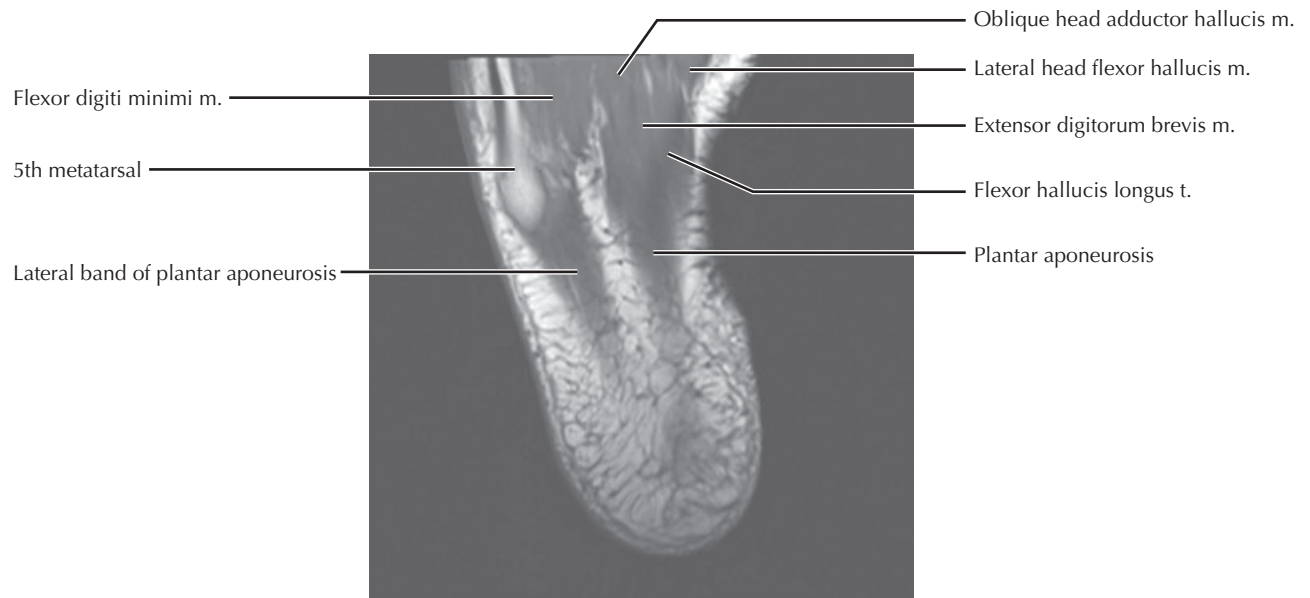


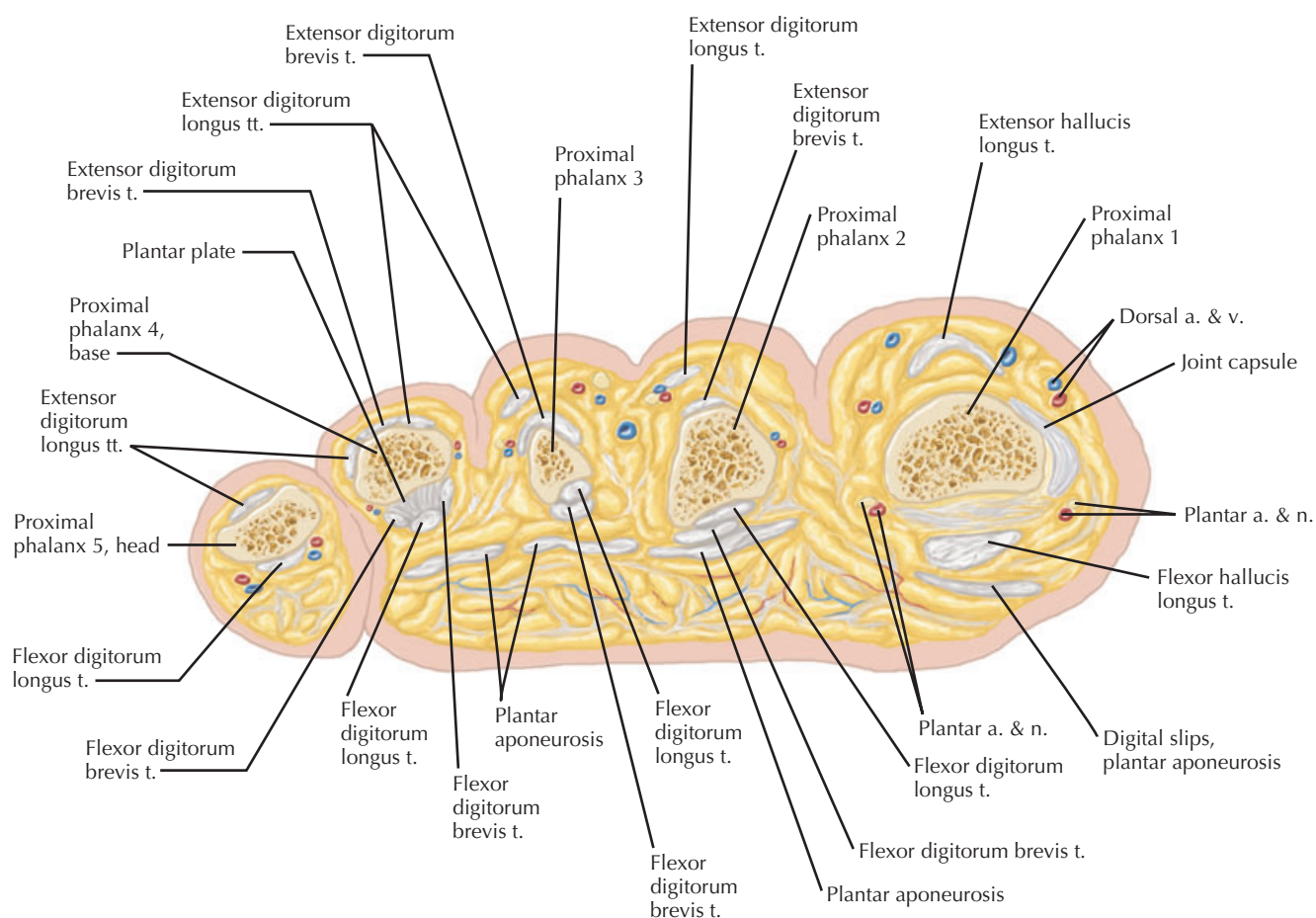






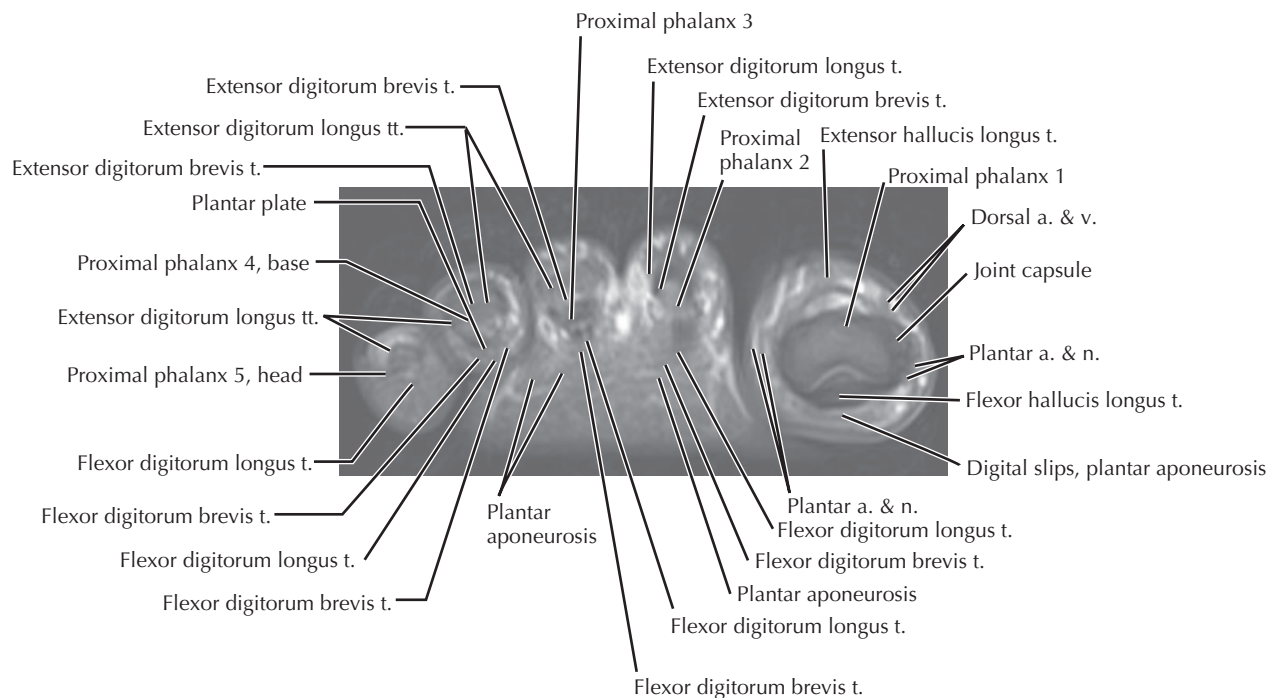
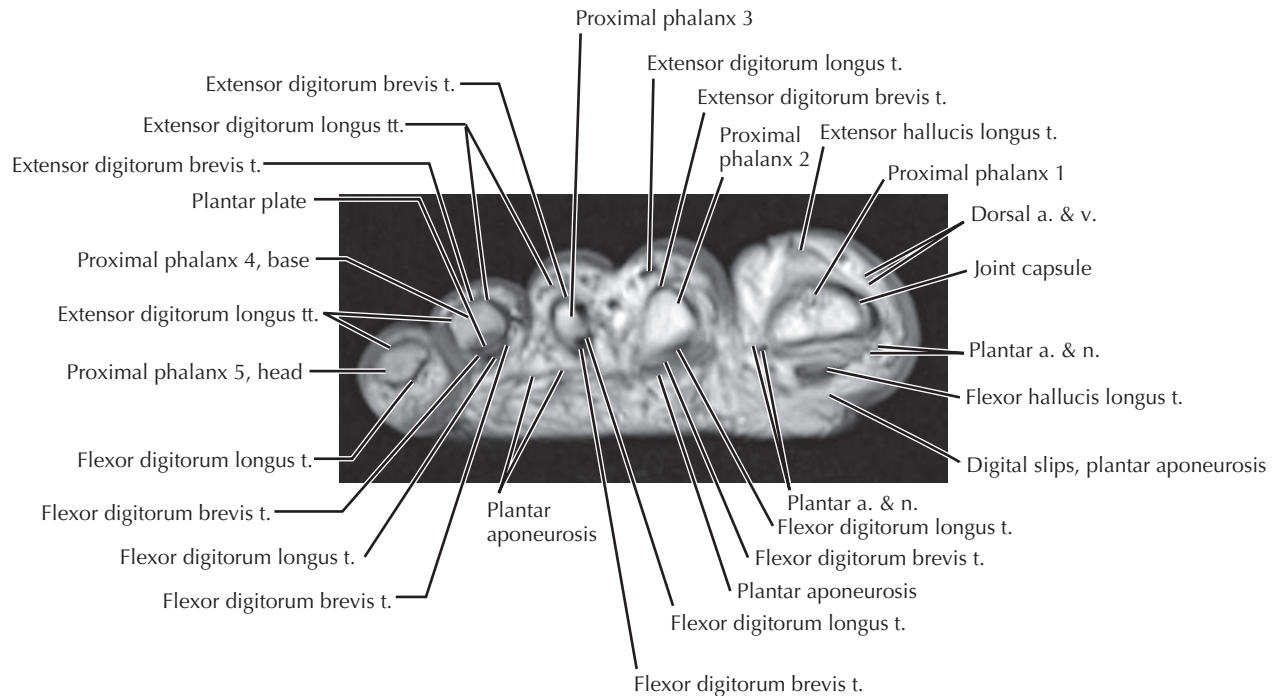
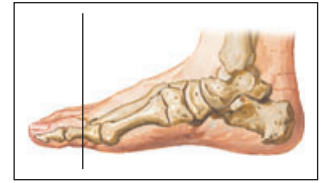


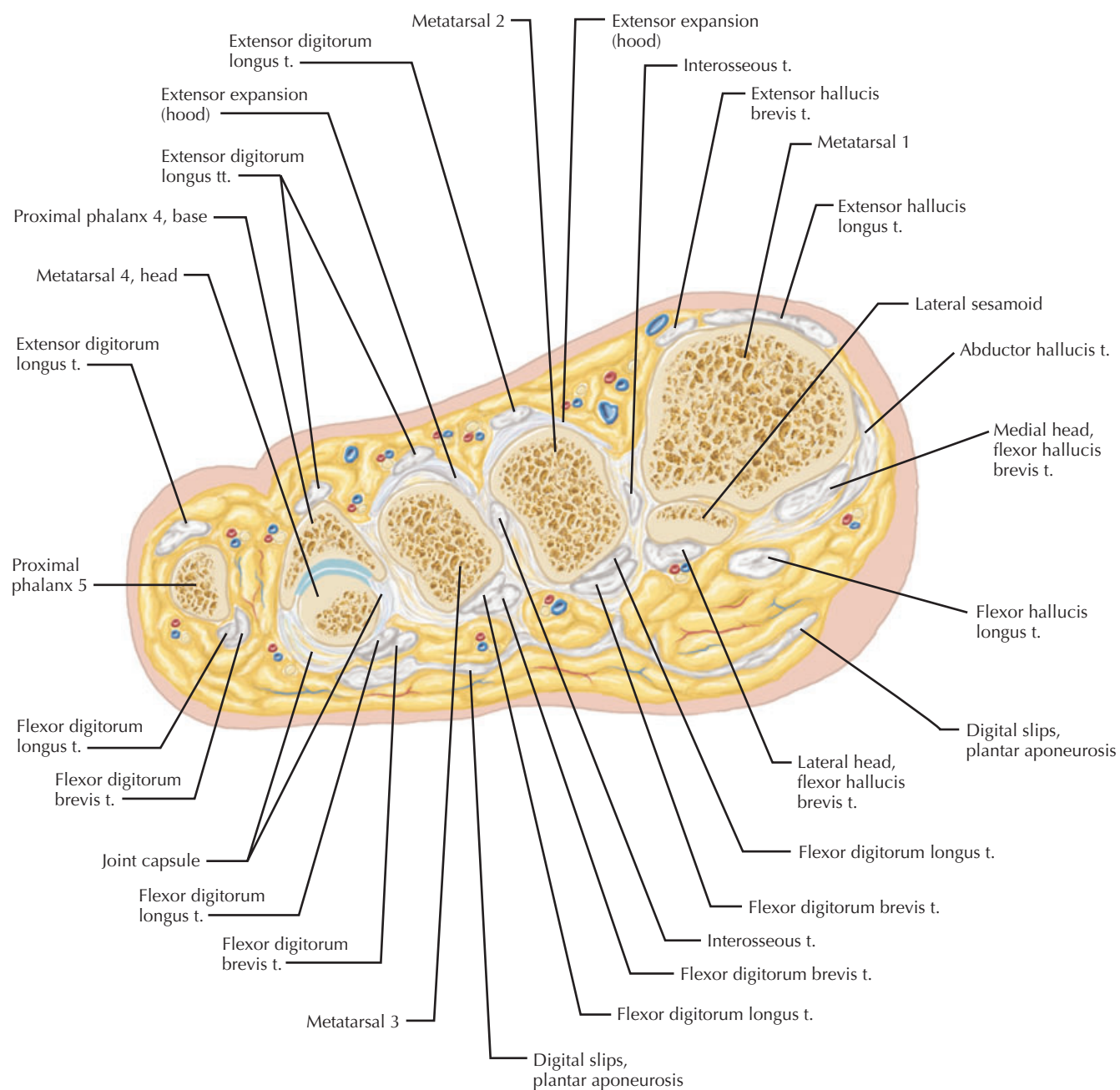


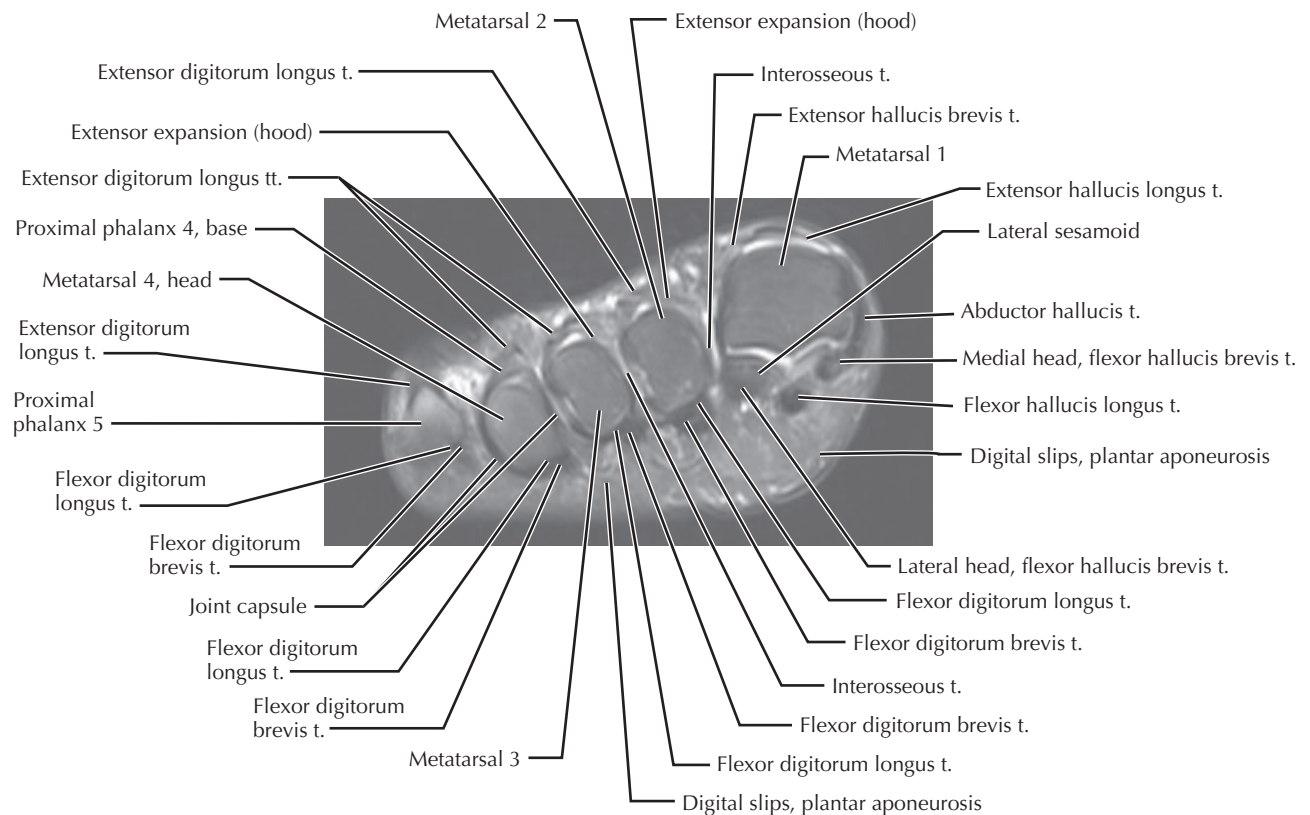
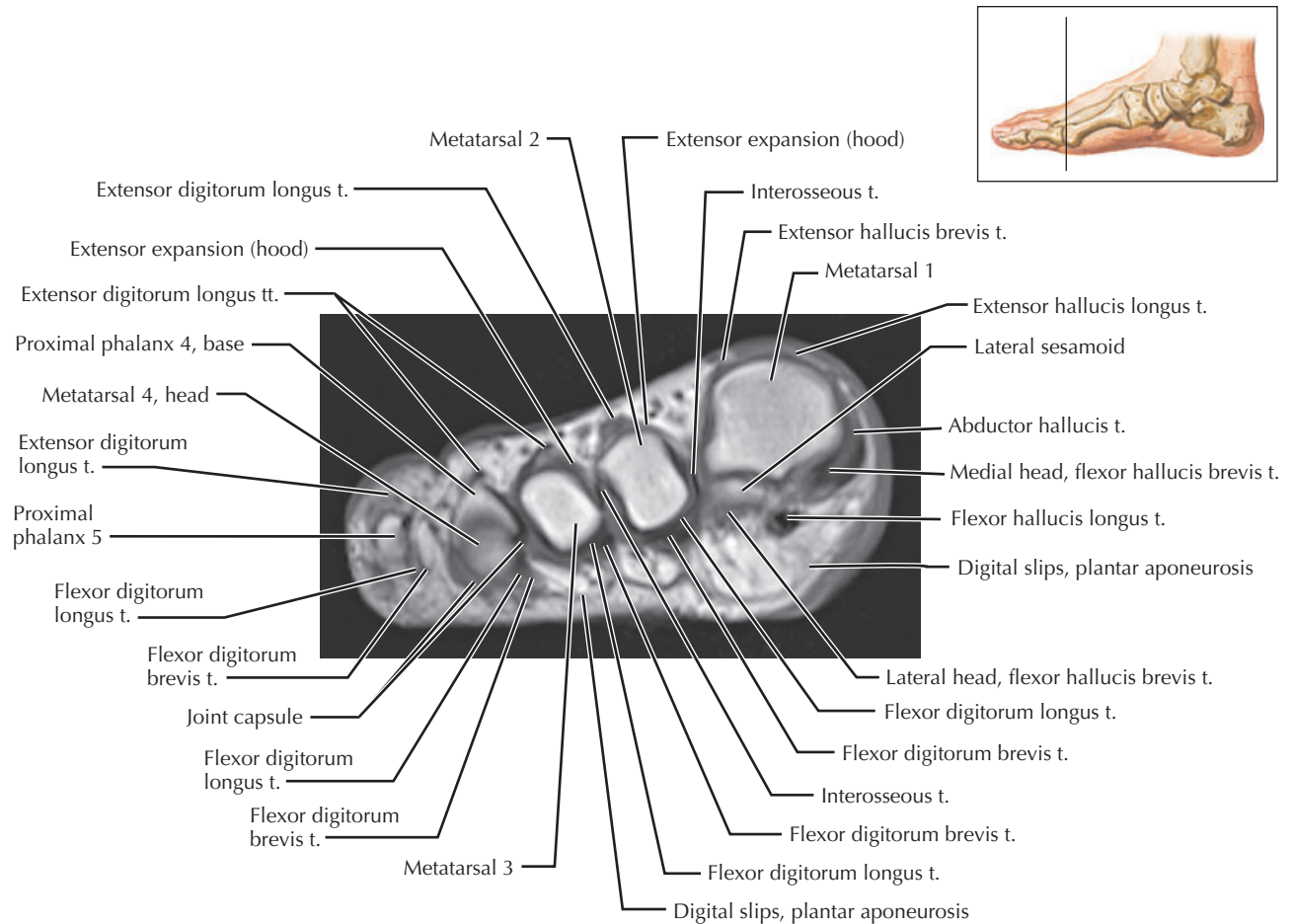


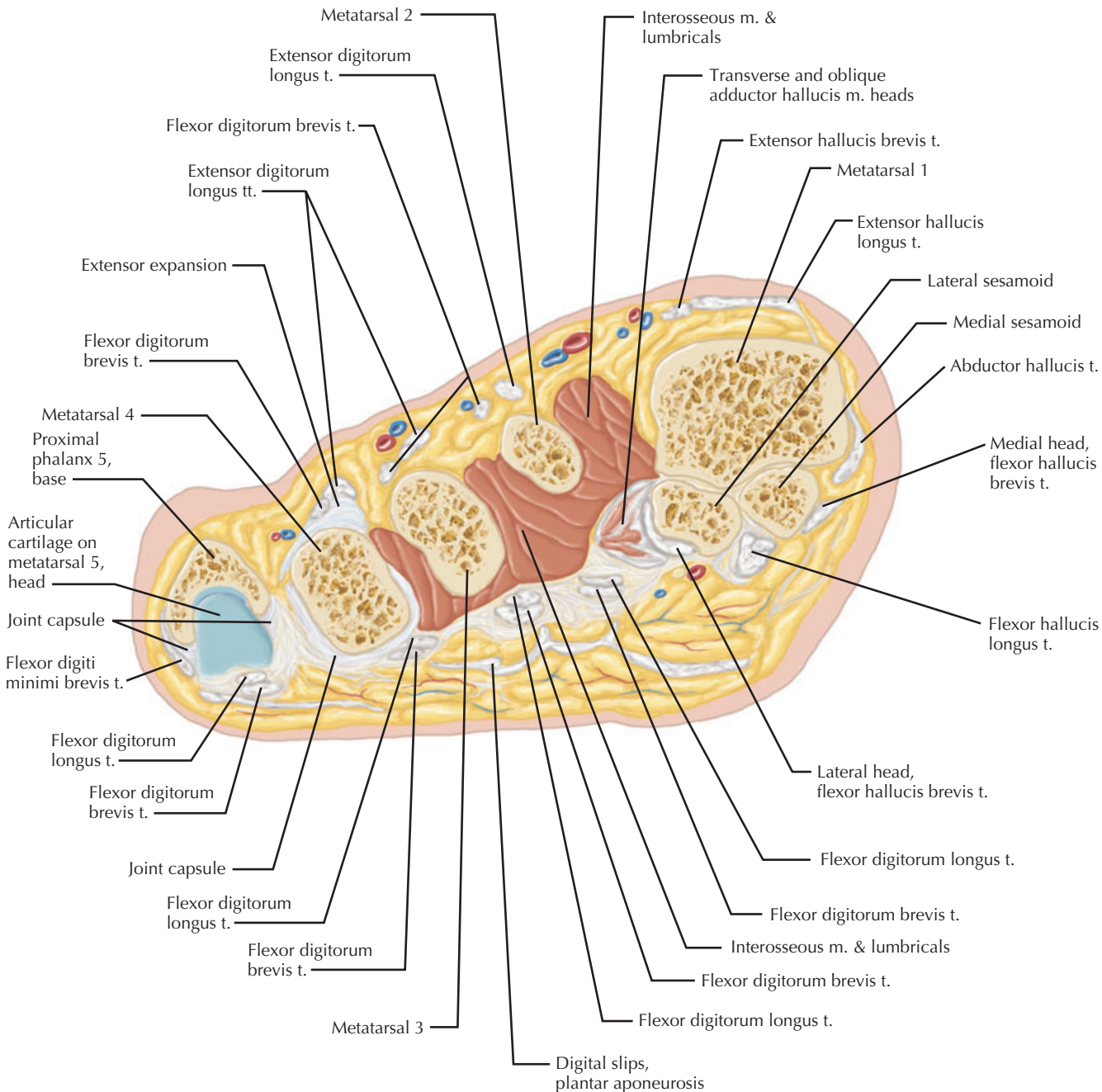
DIAGNOSTIC CONSIDERATION

The terms "axial" and "coronal" can be confusing when describing planes of imaging in the foot. The ankle has coronal and axial planes, but sections through the foot are more easily described as *long axis* (parallel to long axis of metatarsals) and *short axis* (perpendicular to long axis of metatarsals).



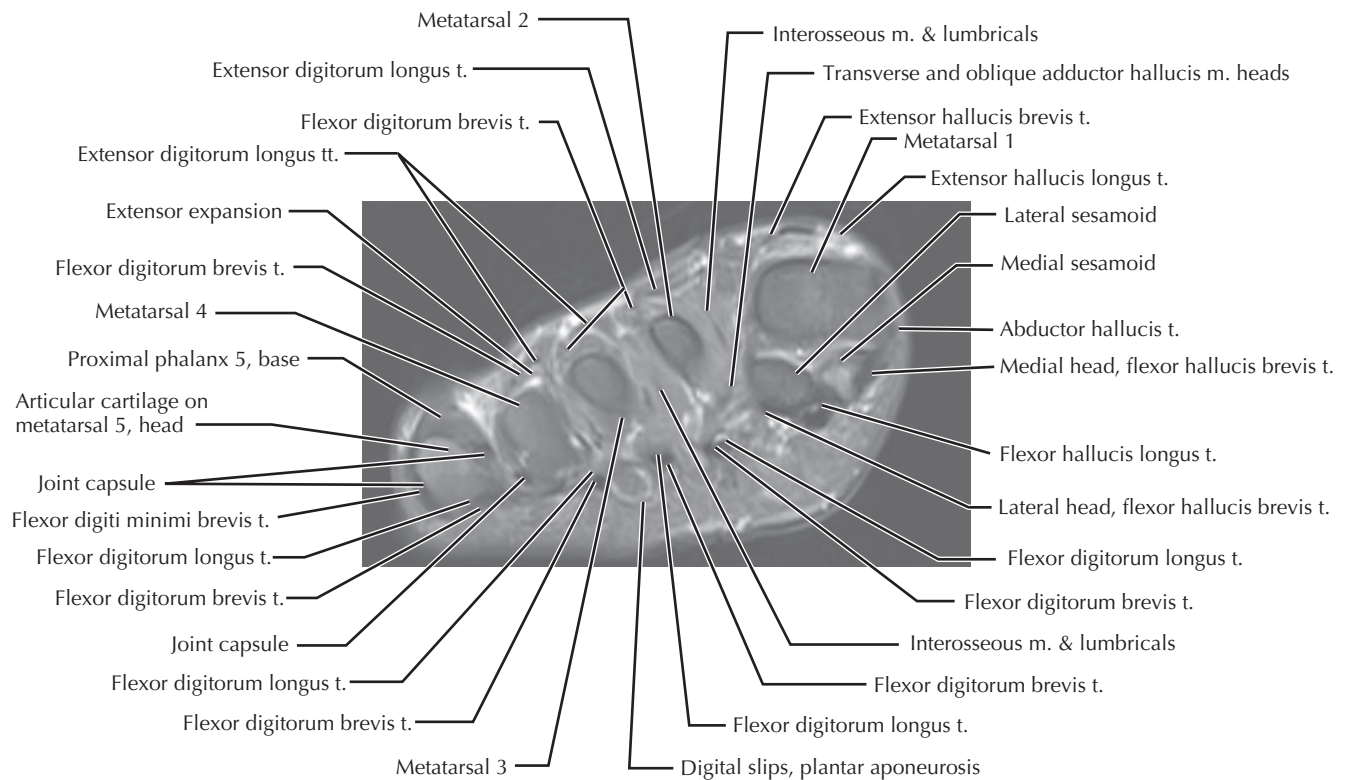
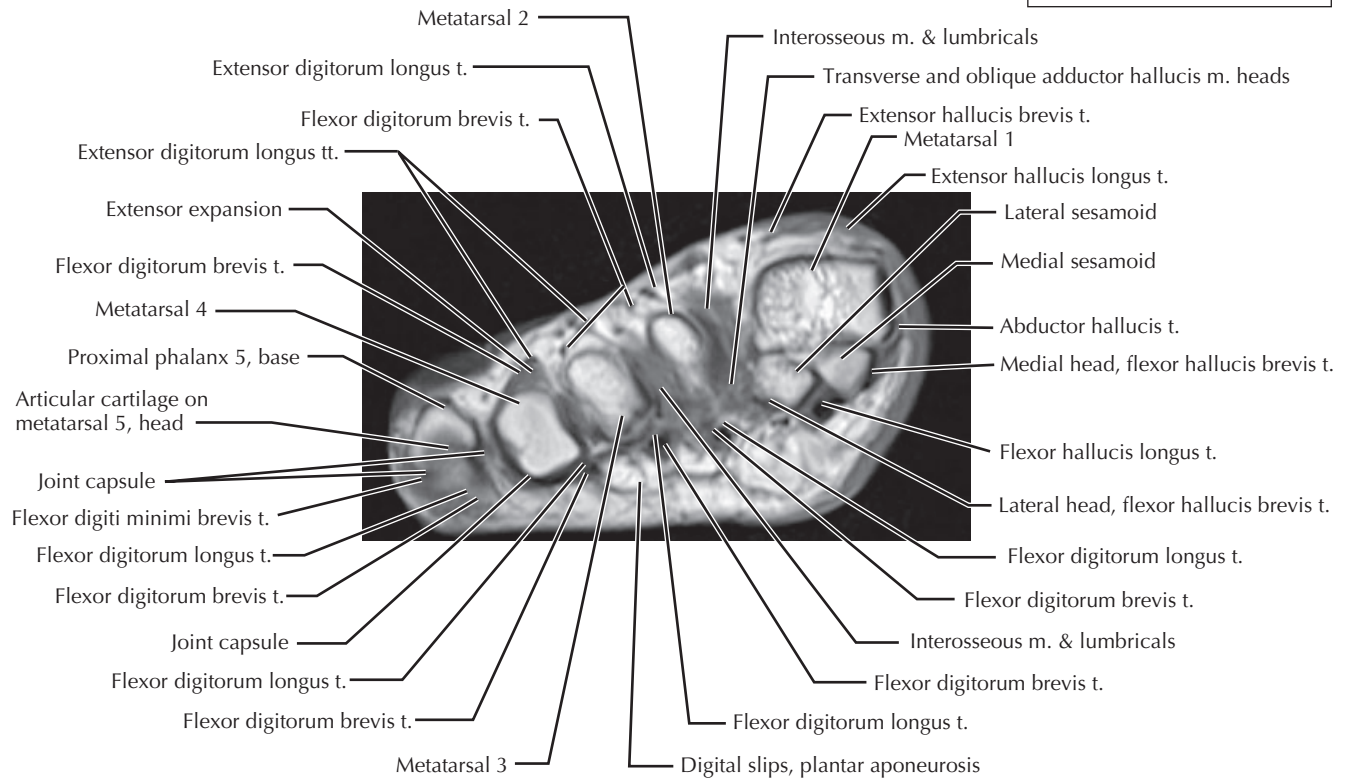


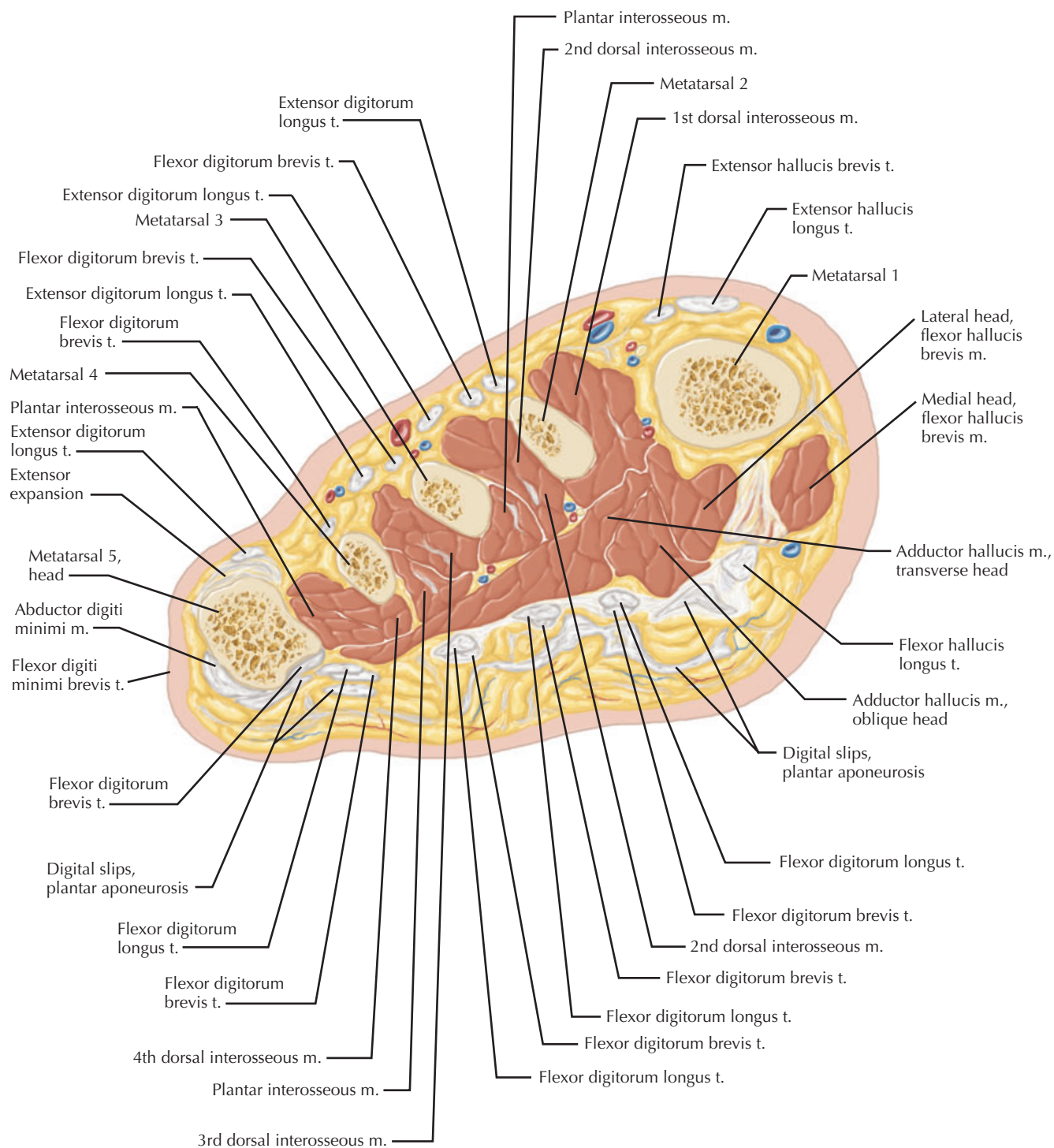


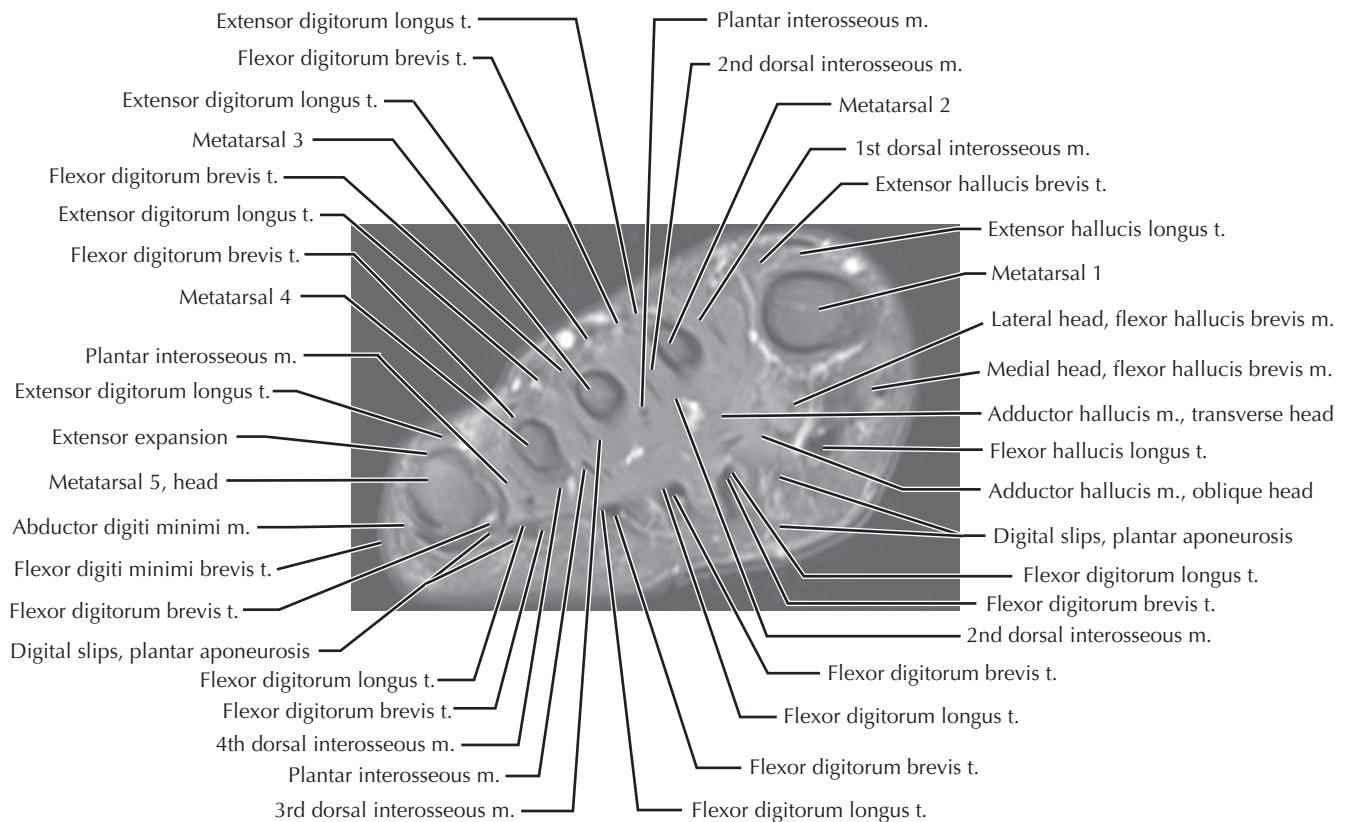
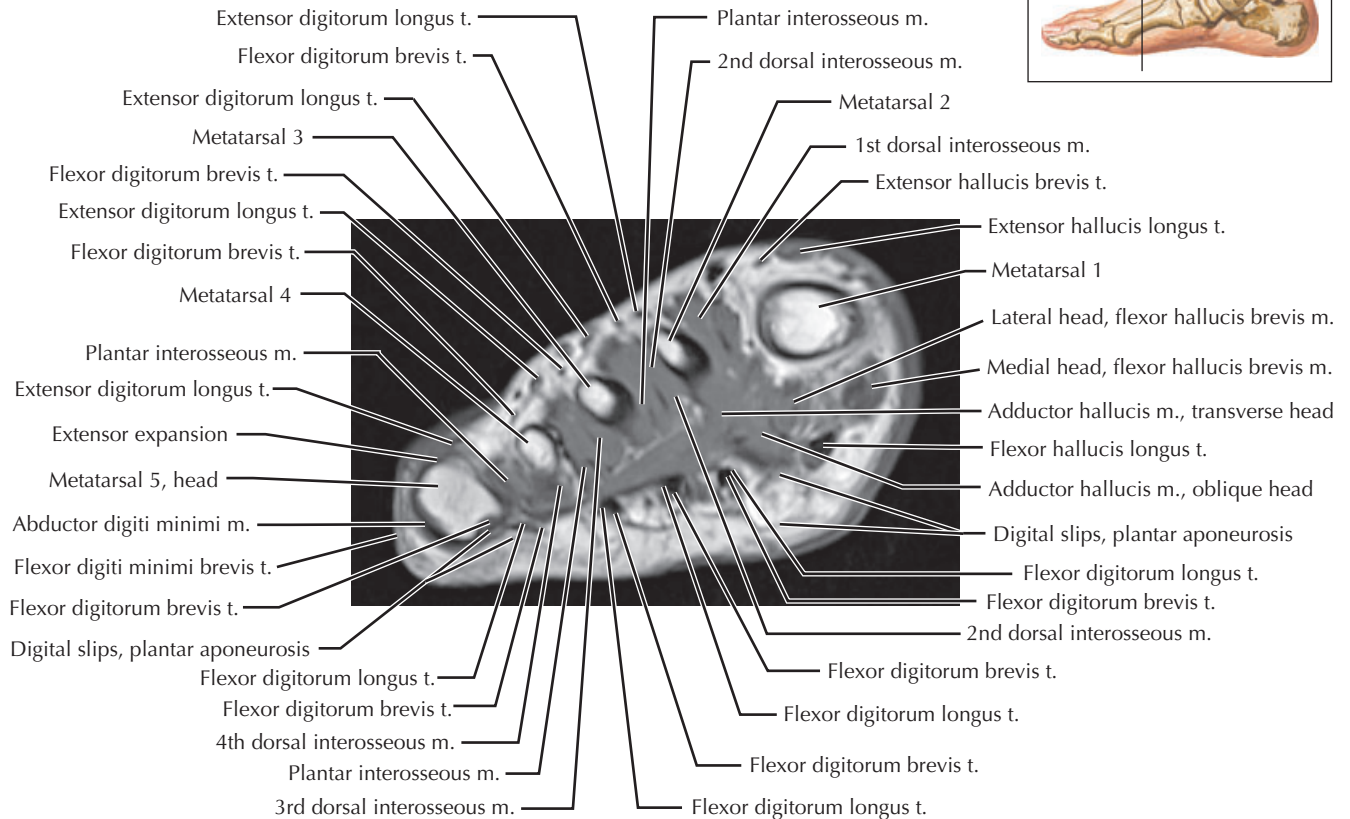


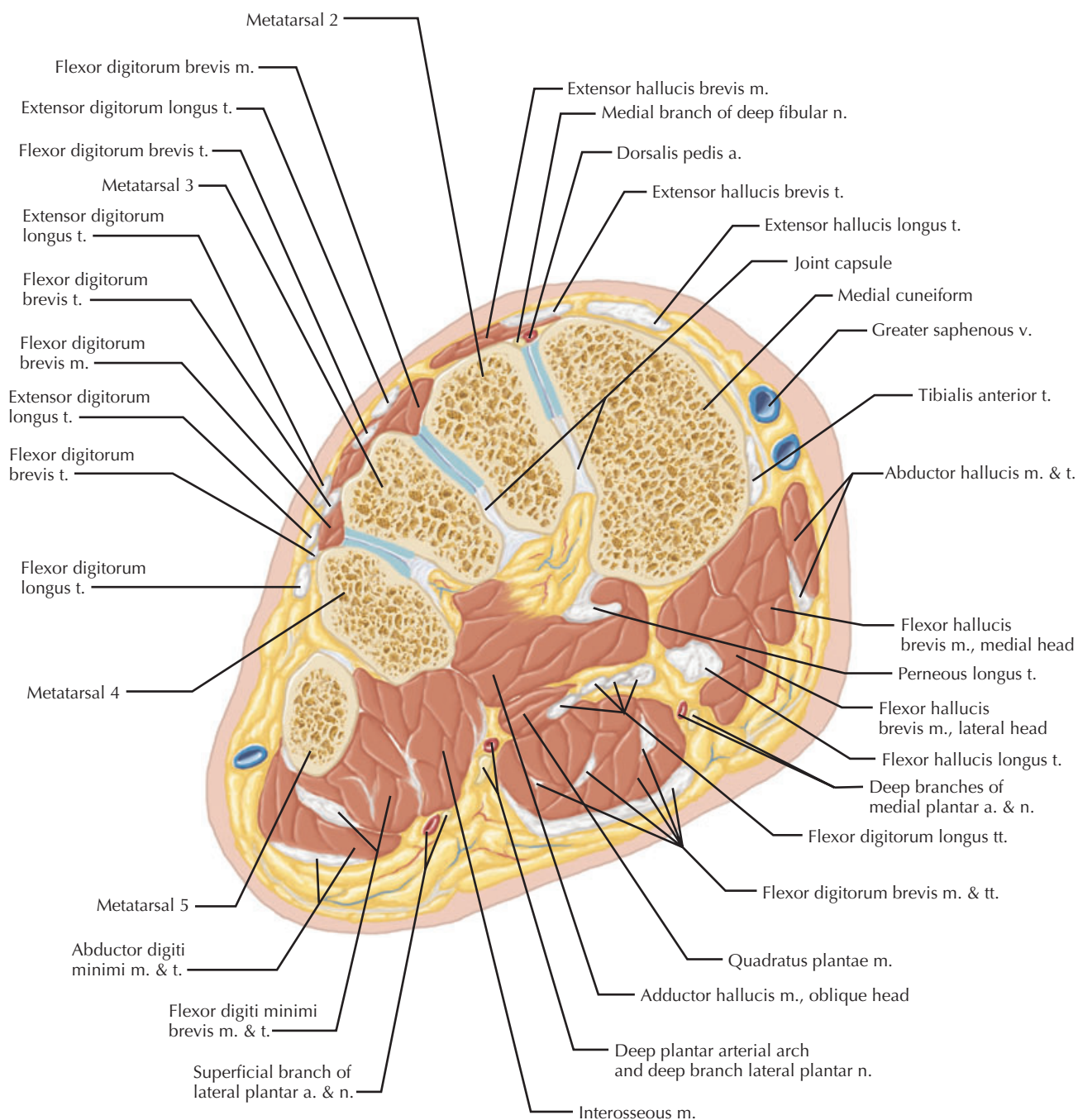
PATHOLOGIC PROCESS

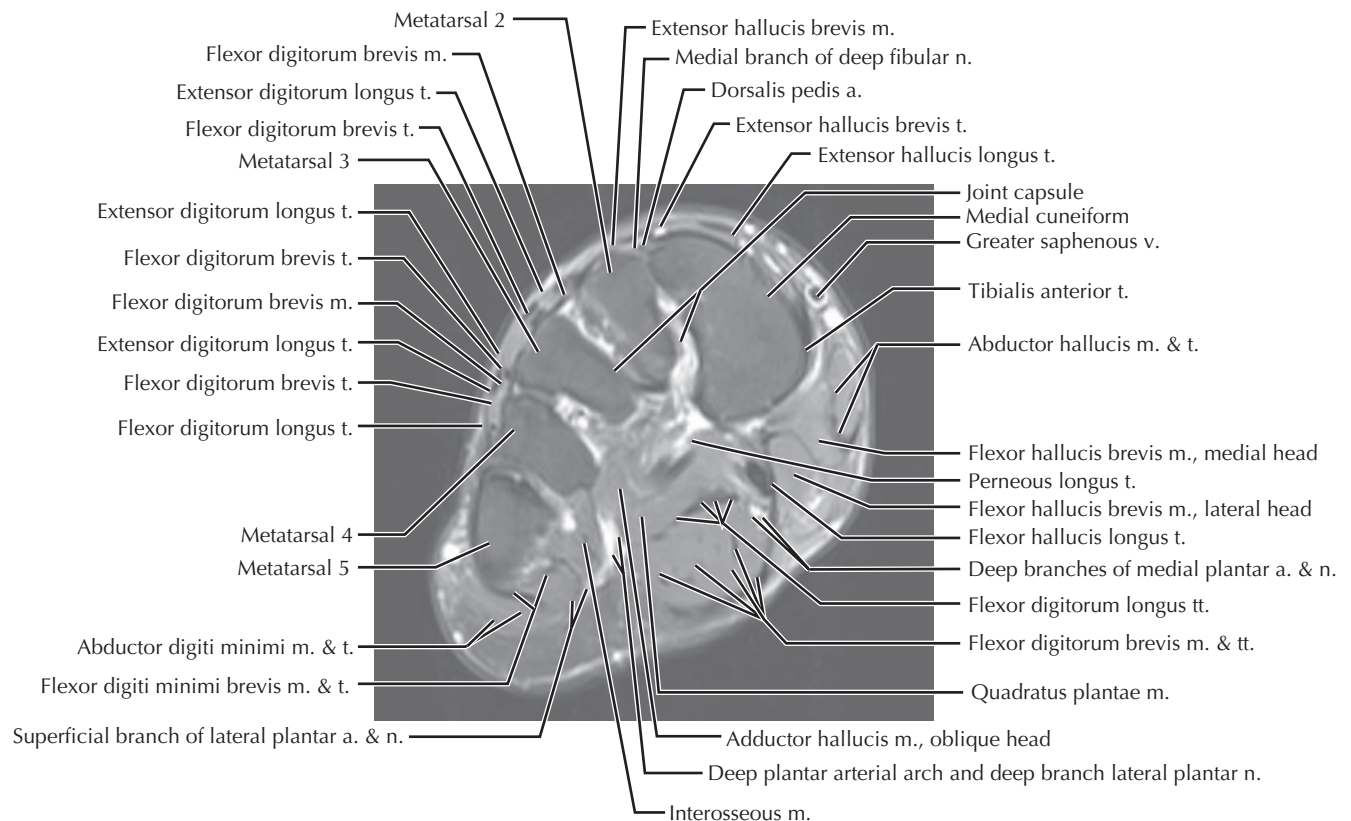
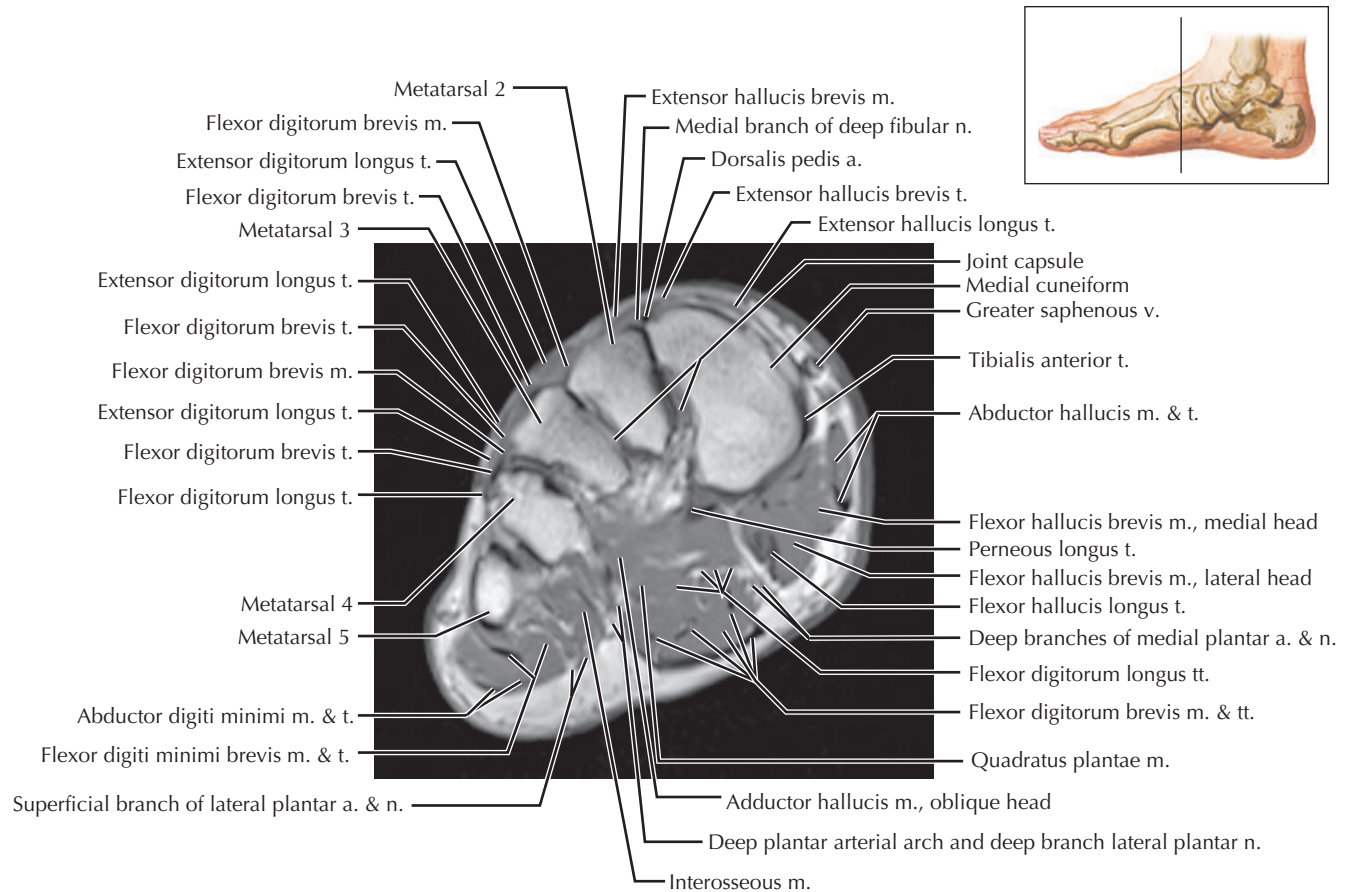
The medial and lateral hallux sesamoids are located in the flexor hallucis brevis tendon at the level of the first metatarsal head. Generally, the medial sesamoid is more likely to be involved with traumatic abnormalities, whereas the lateral sesamoid is more often affected by ischemic changes with osteonecrosis.

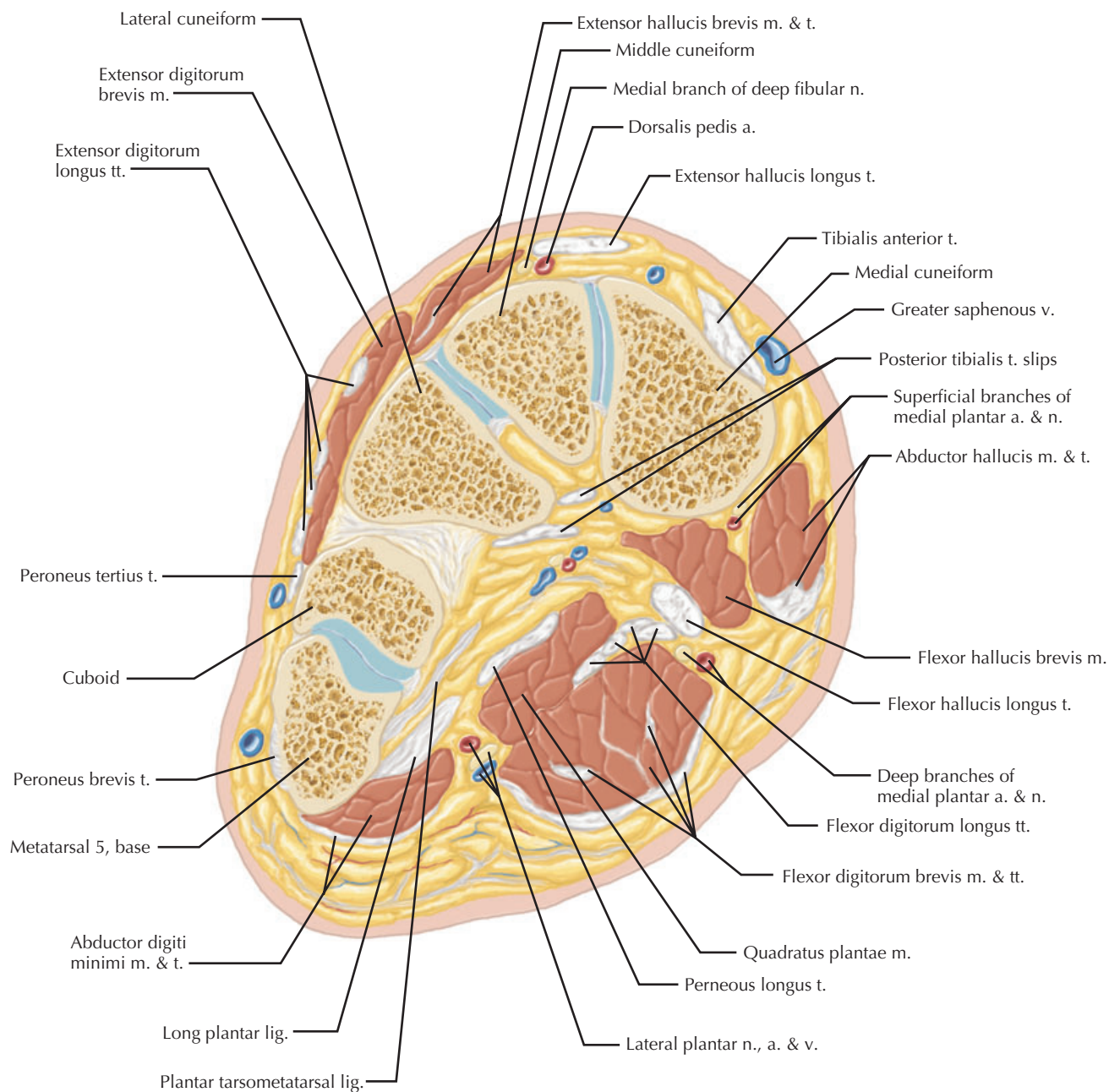


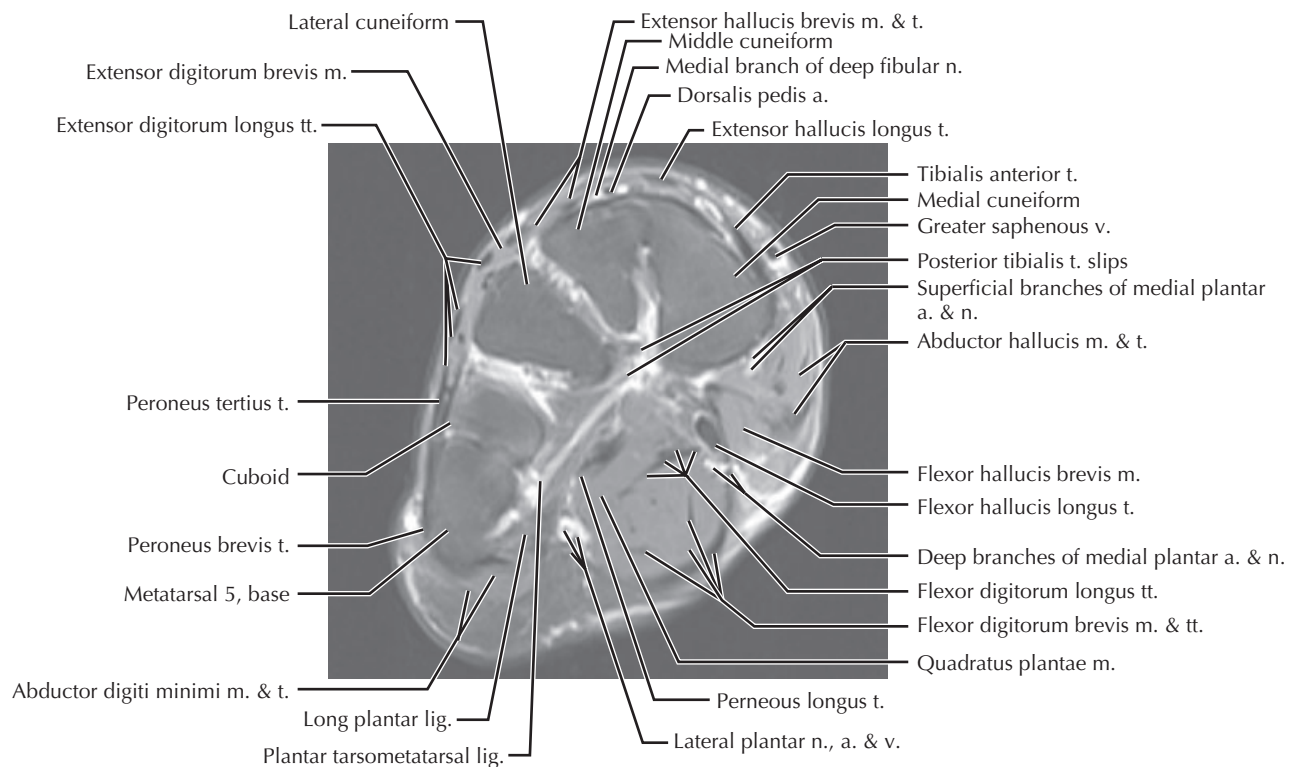
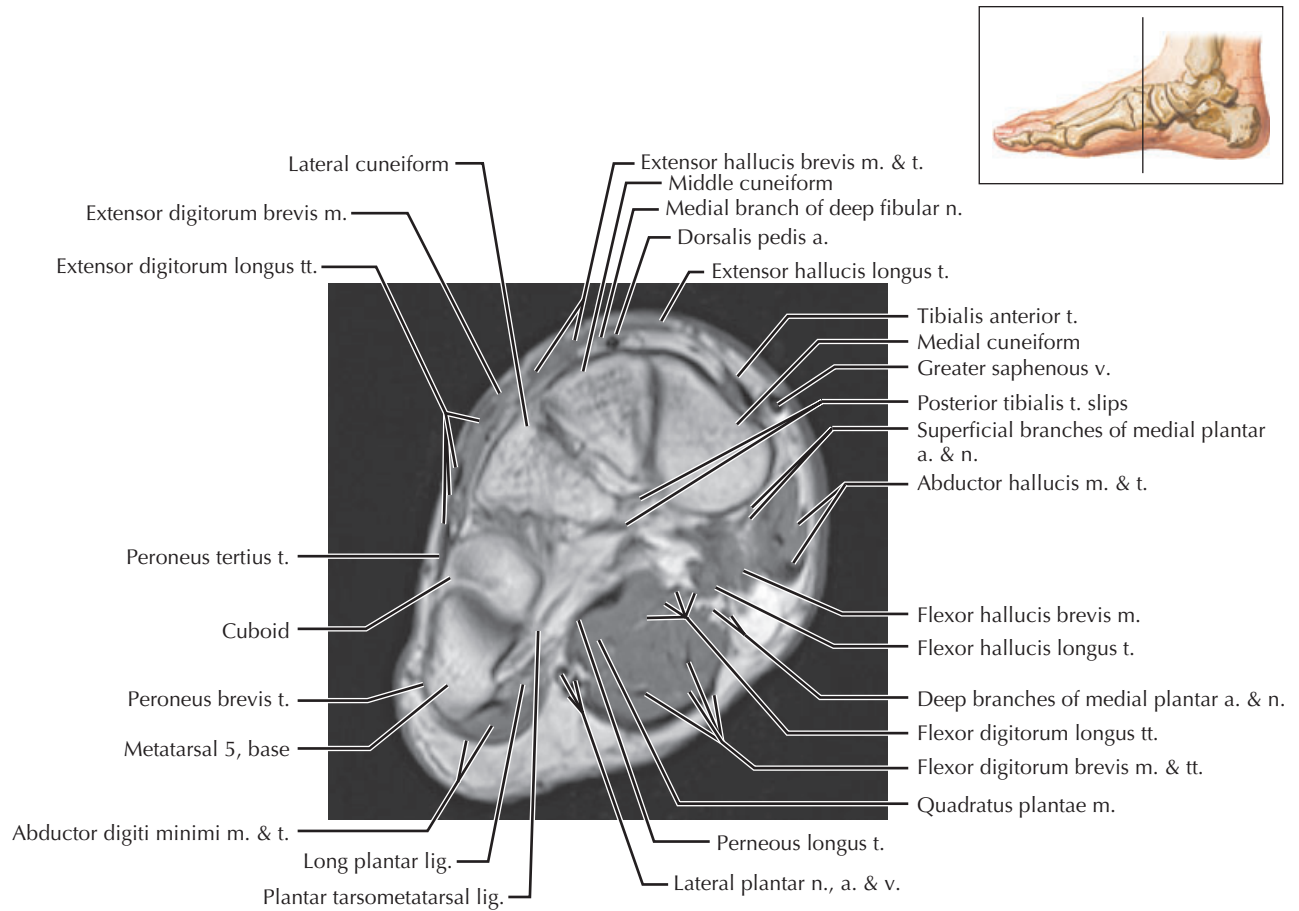


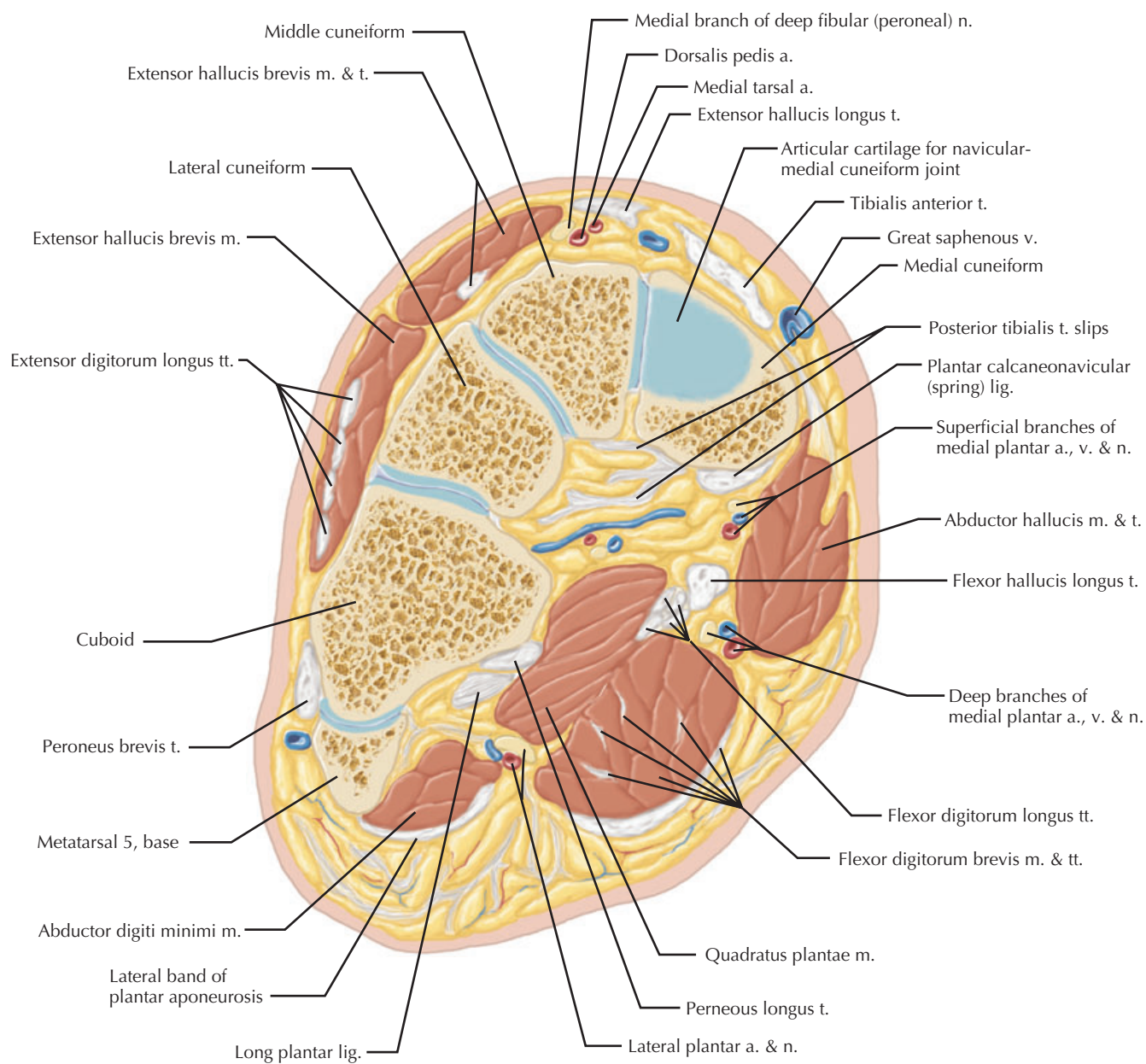


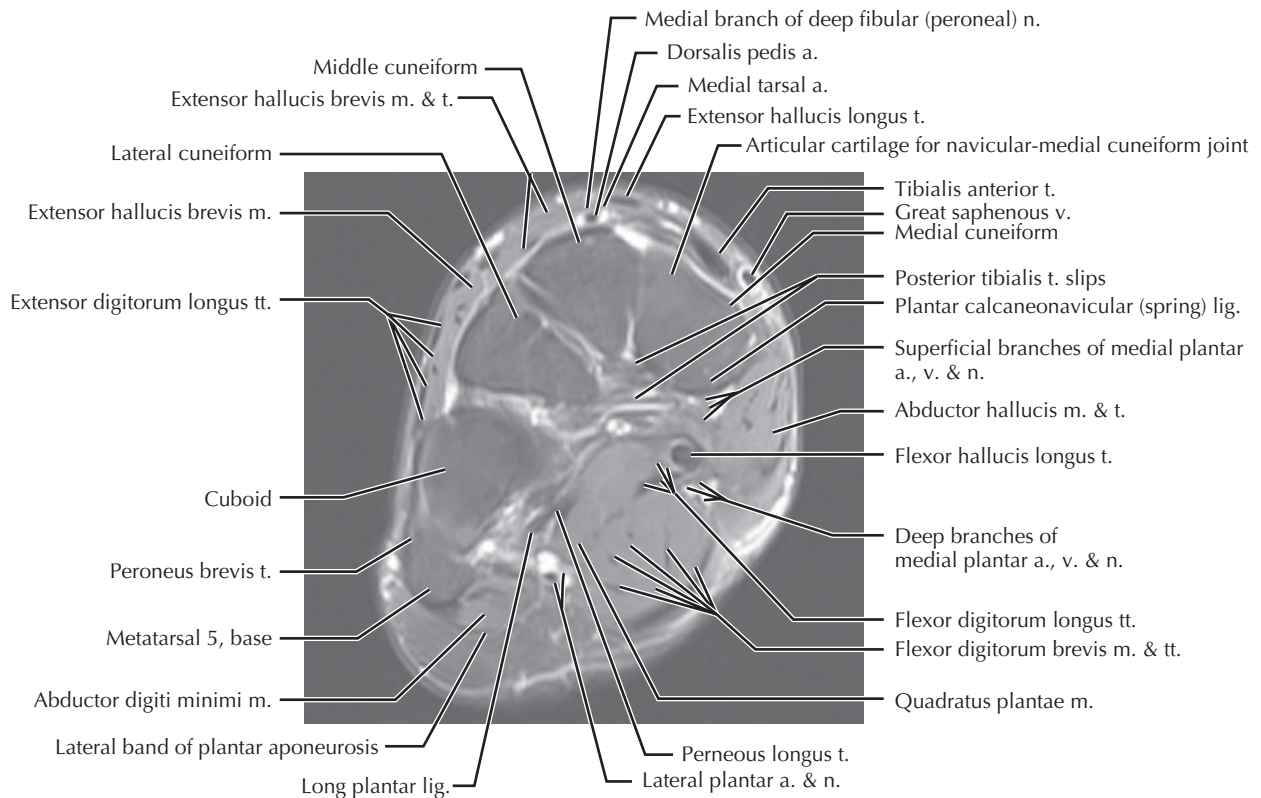
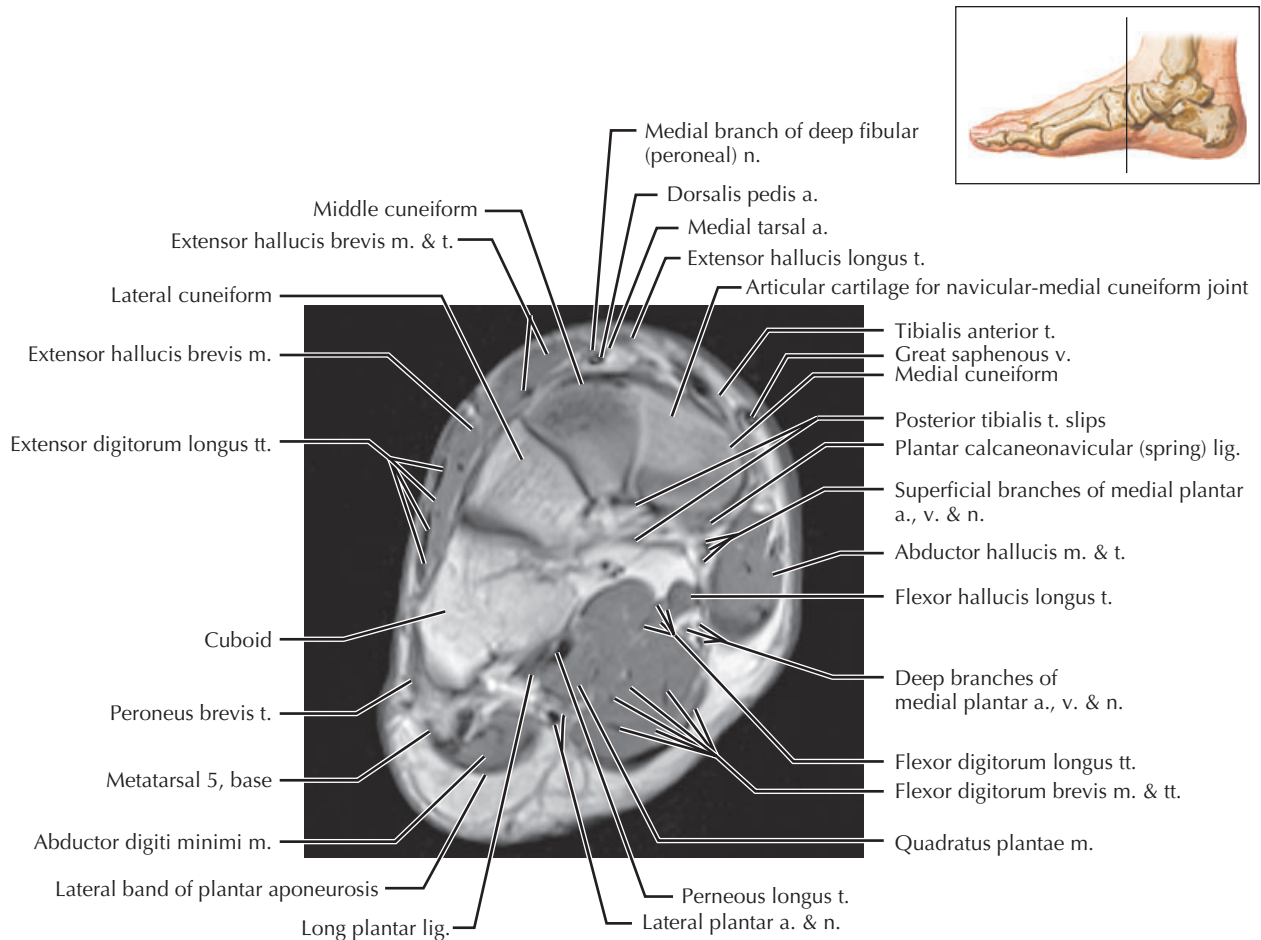


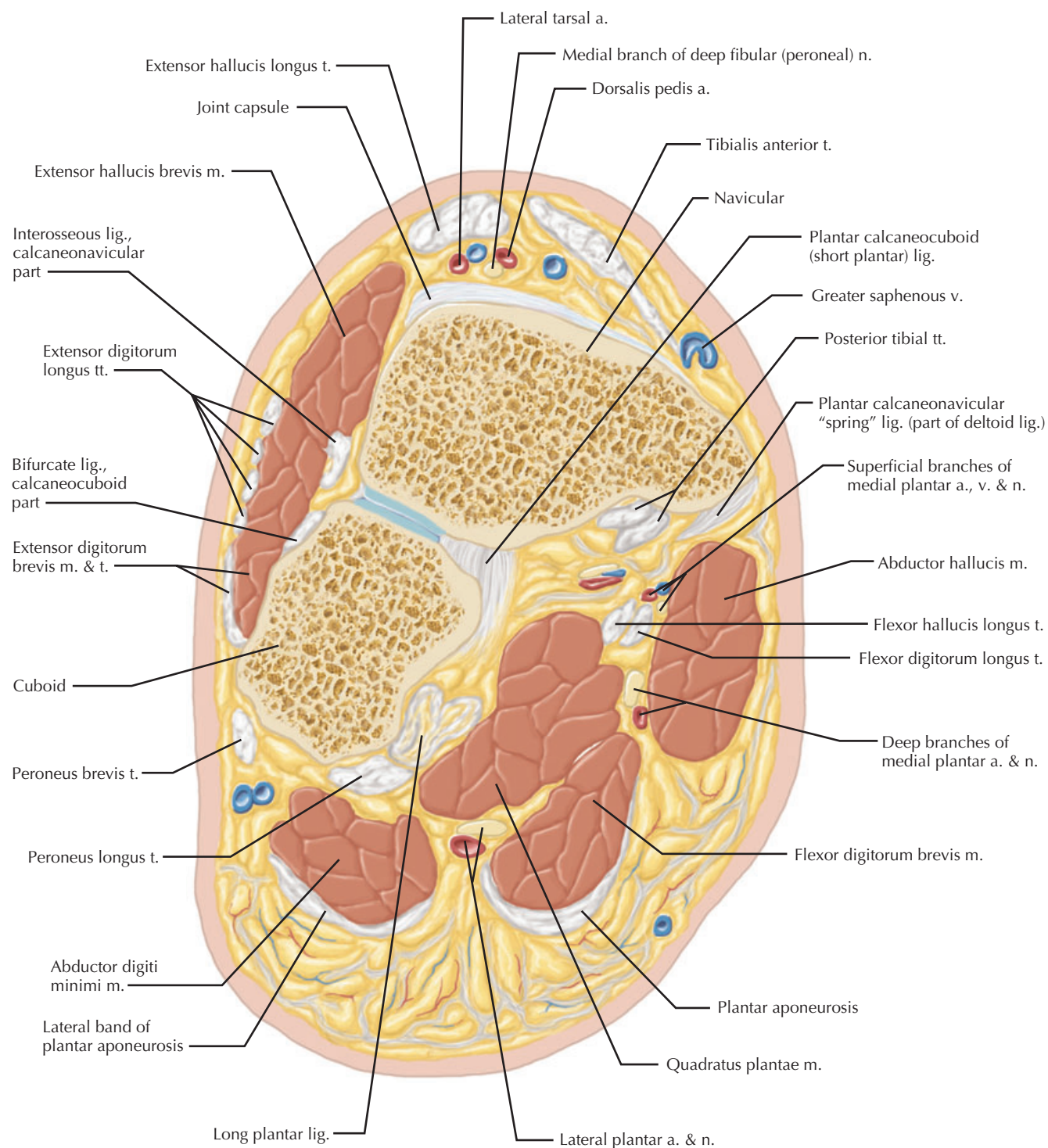


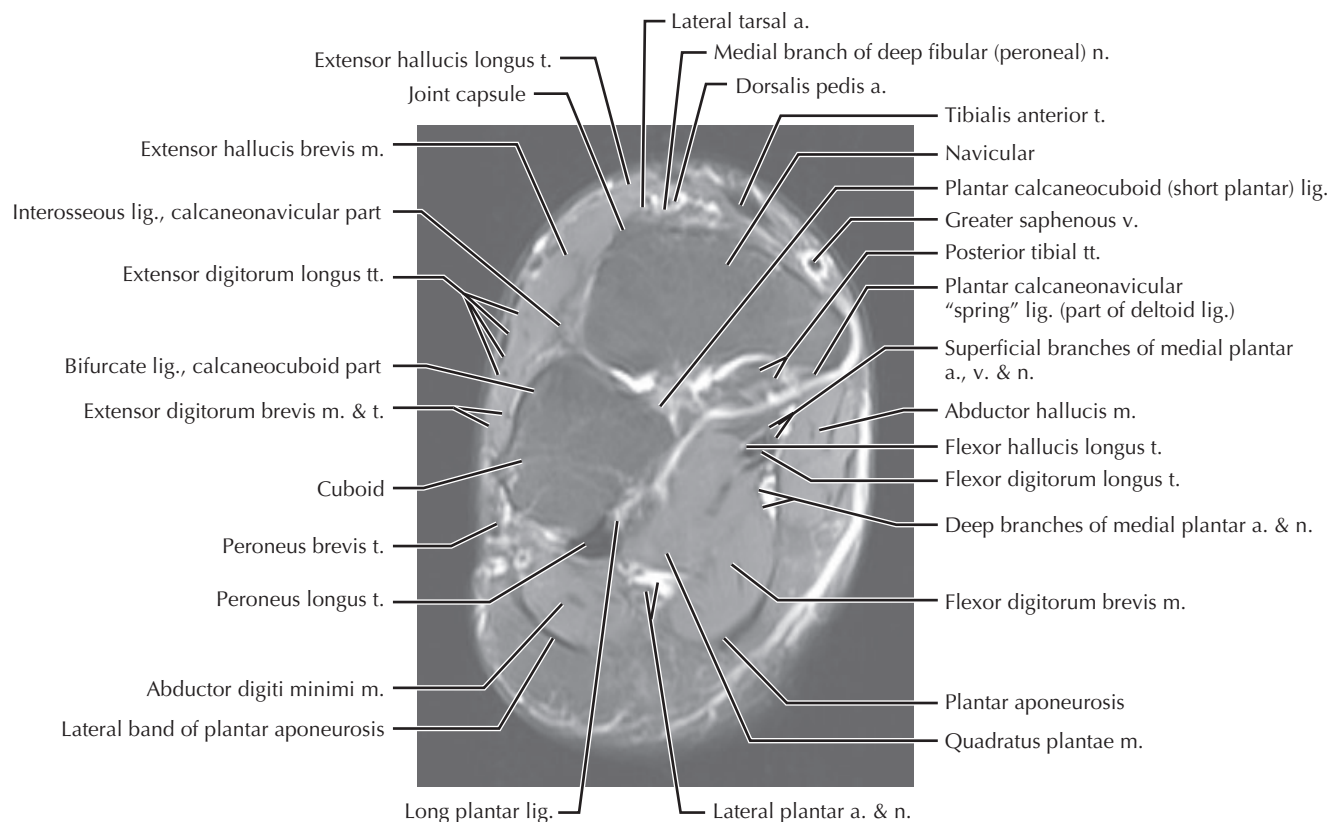
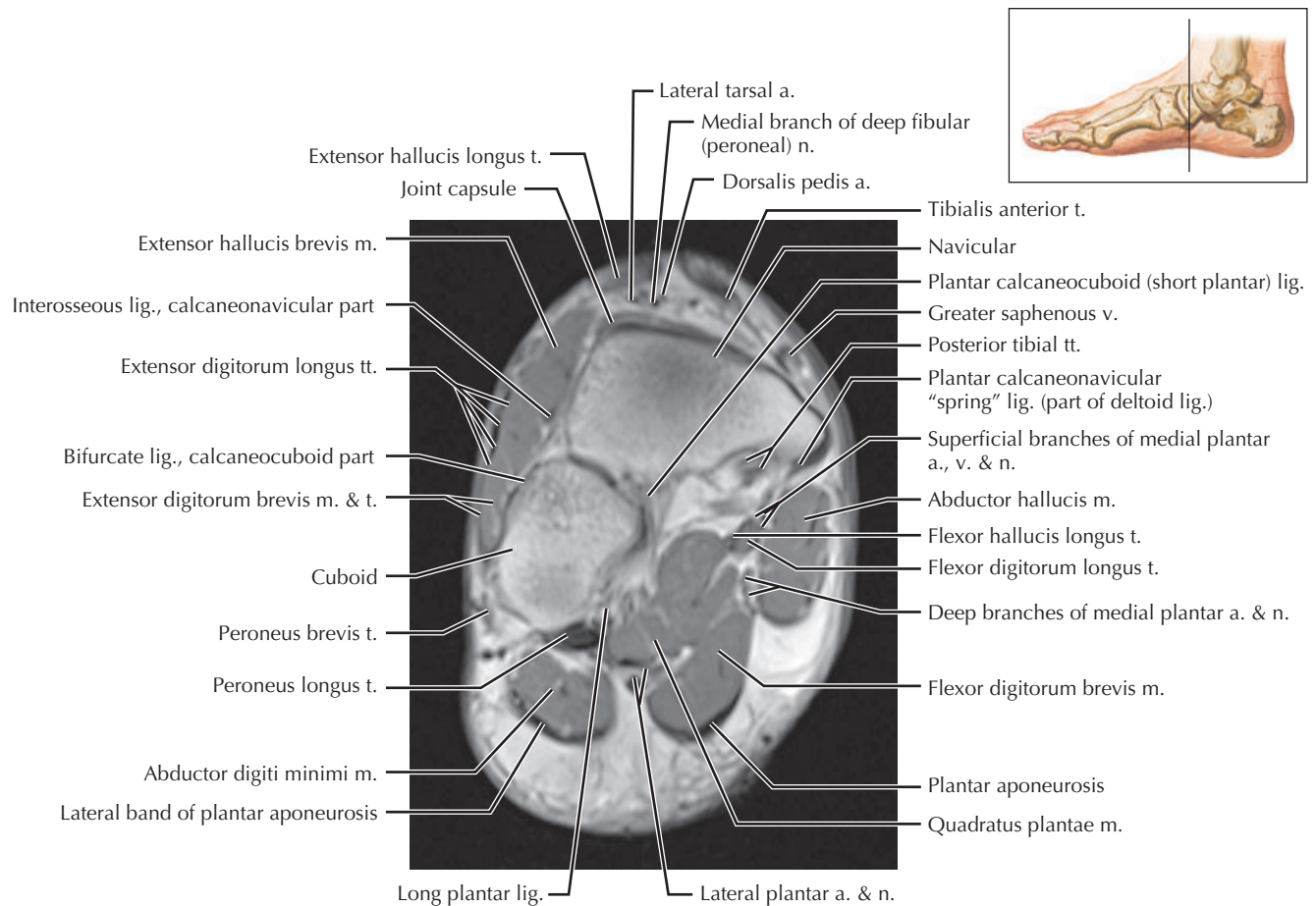


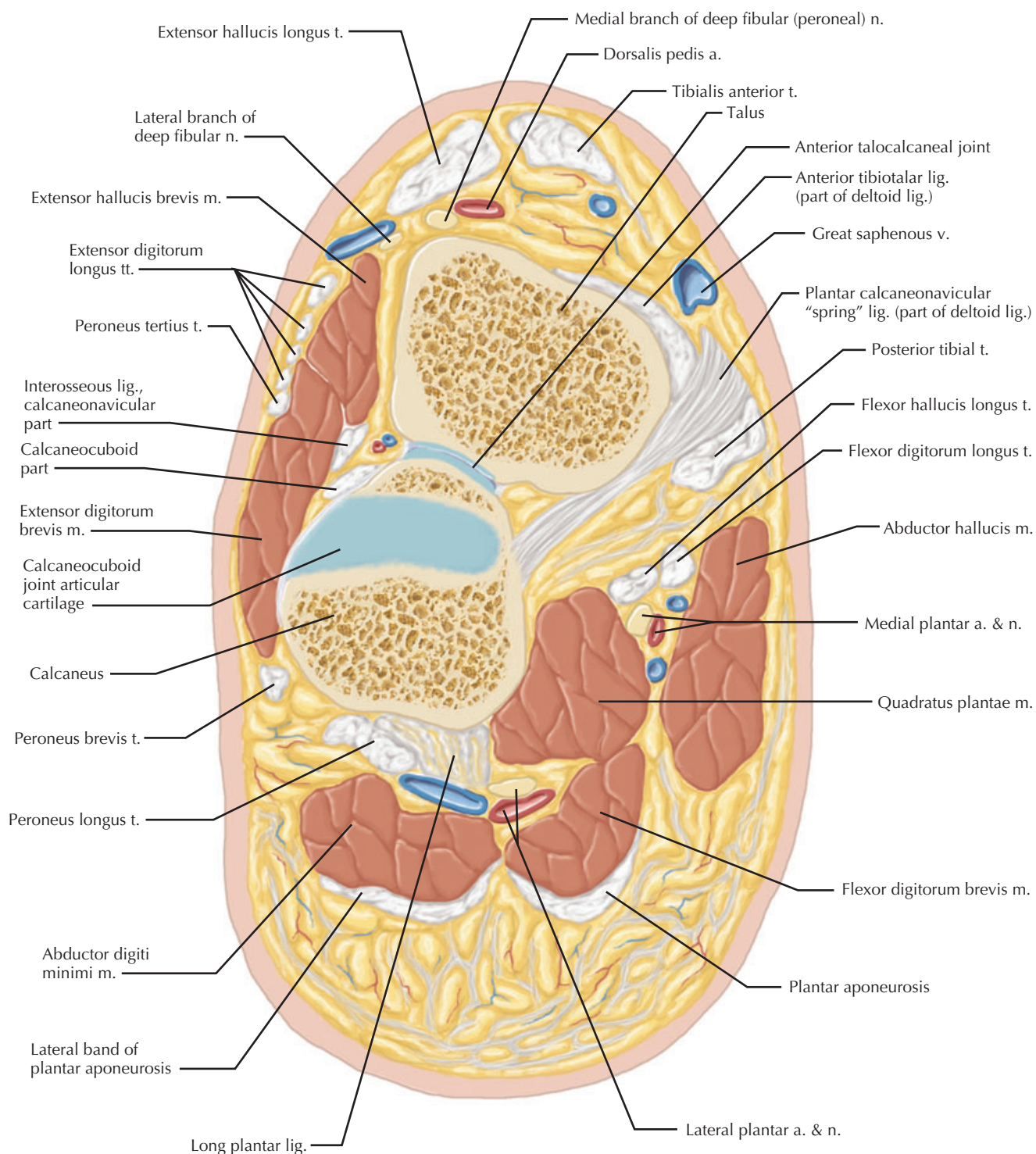


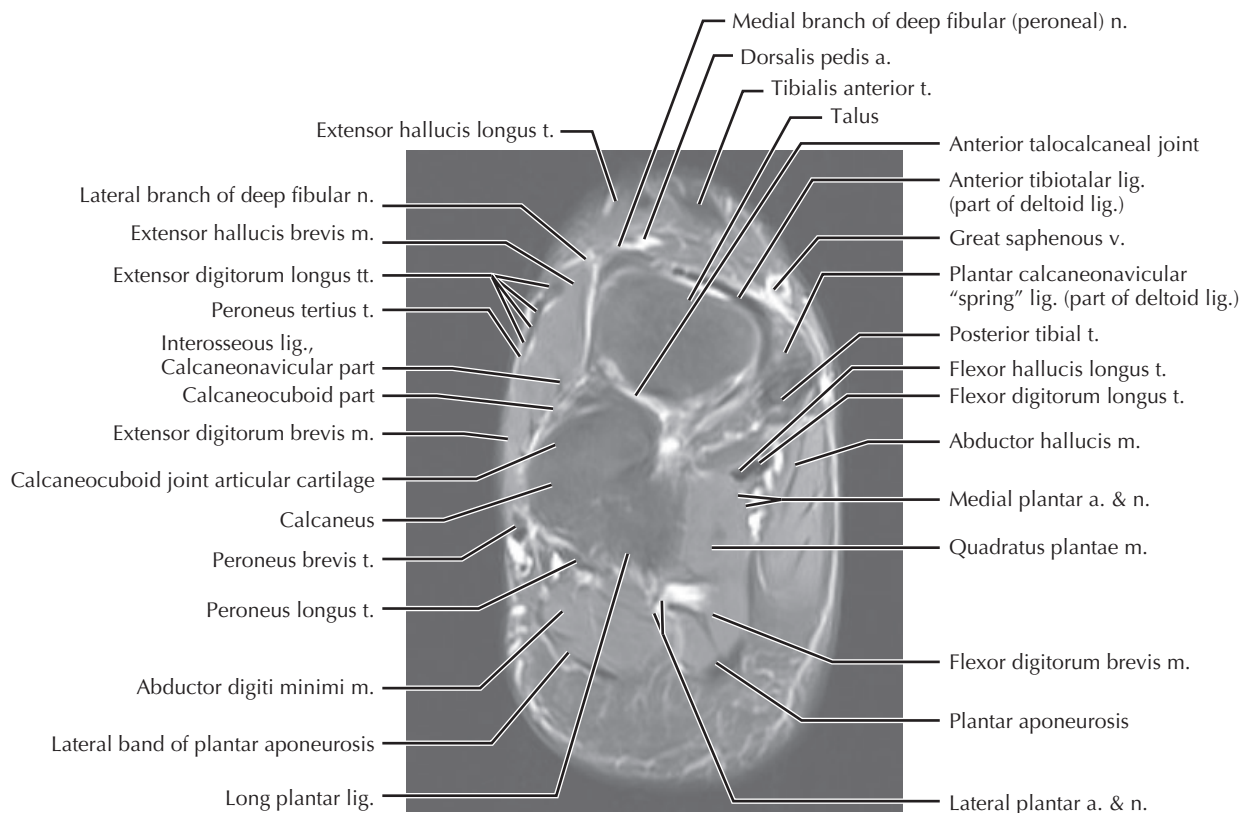
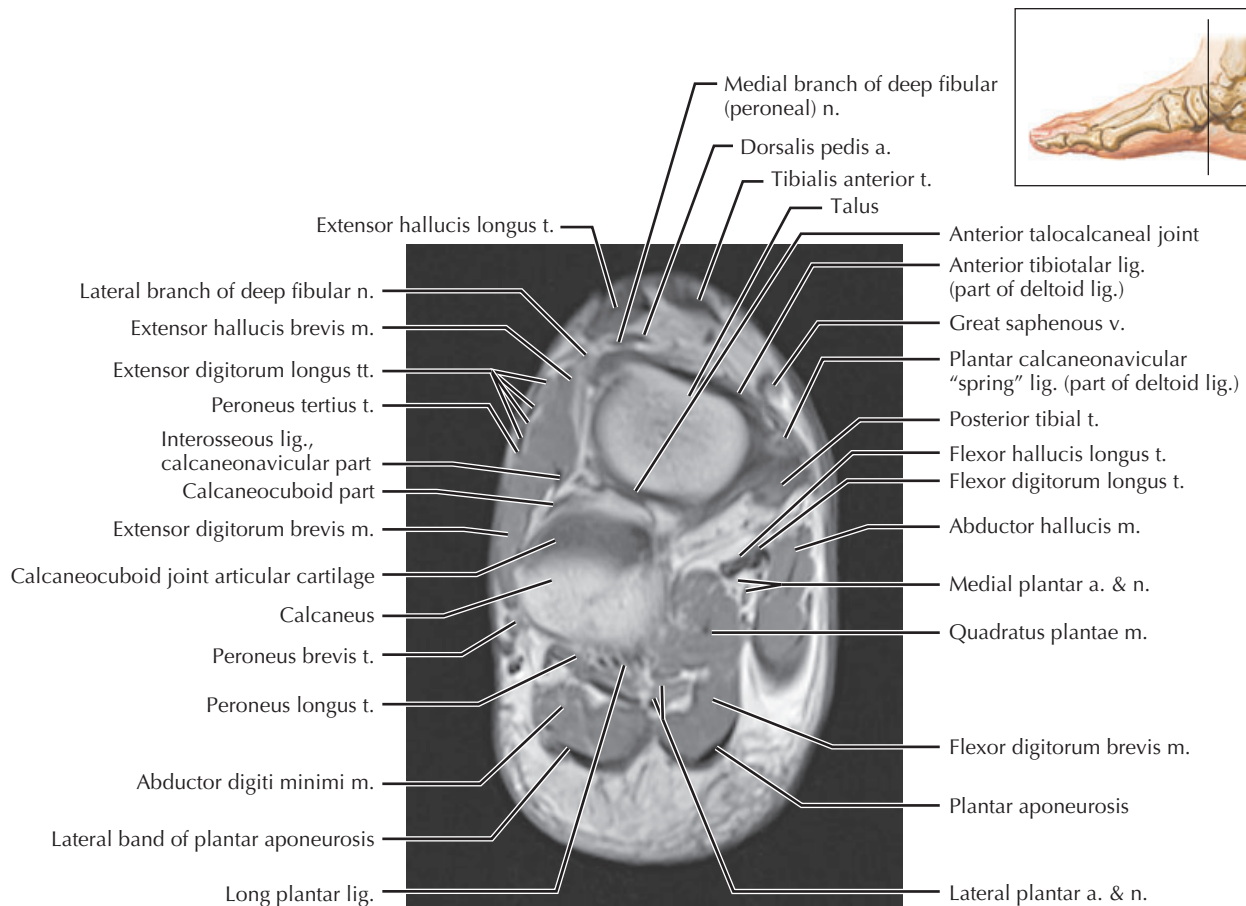


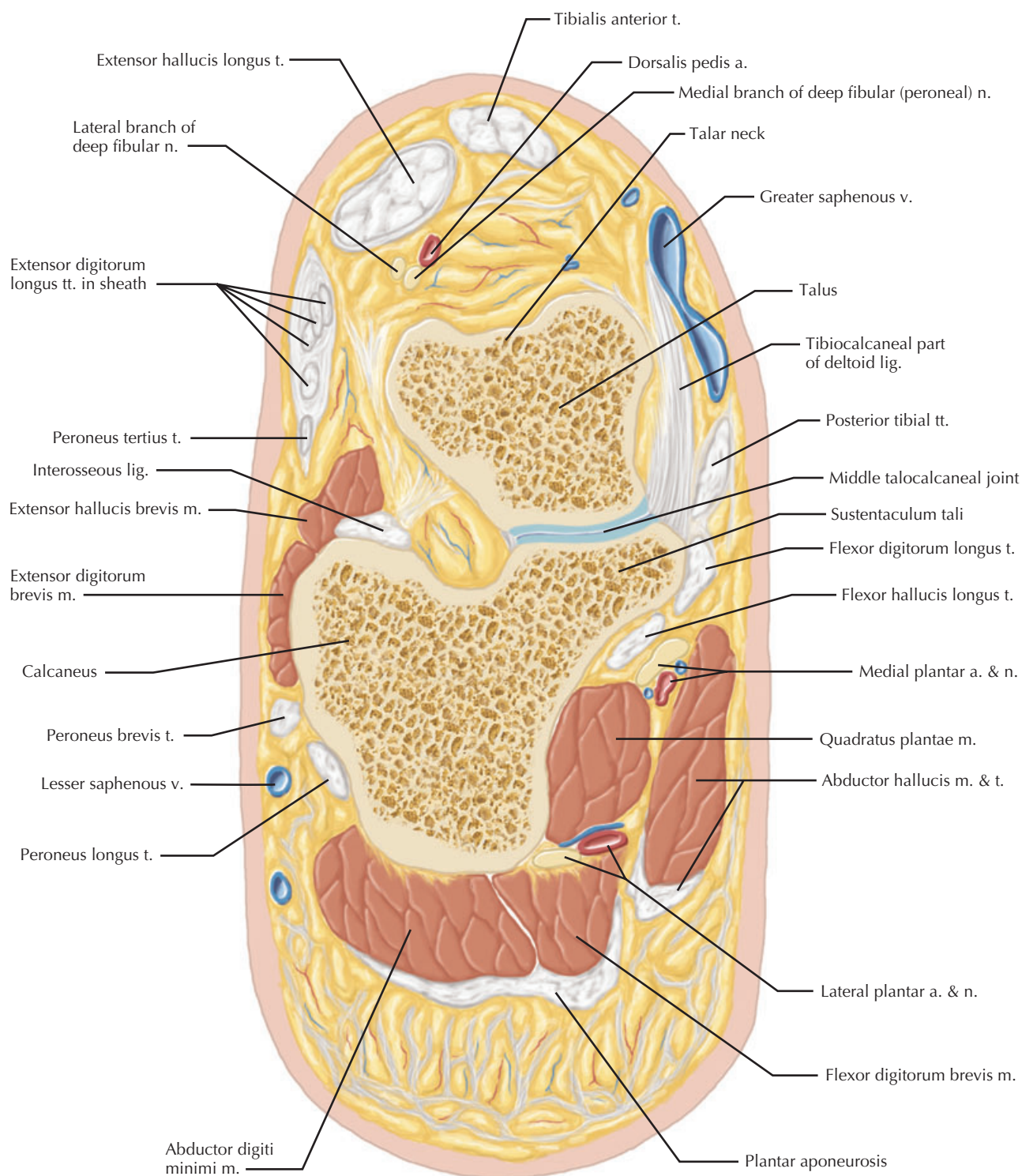










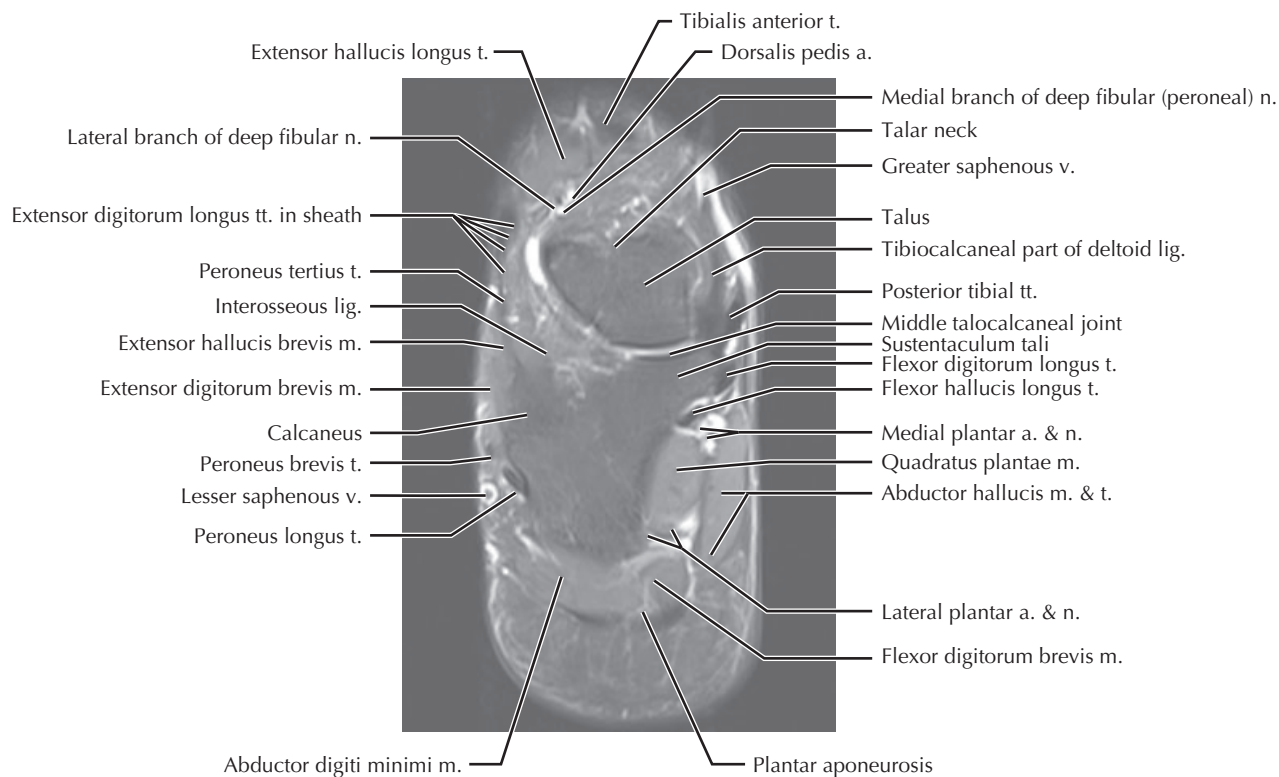
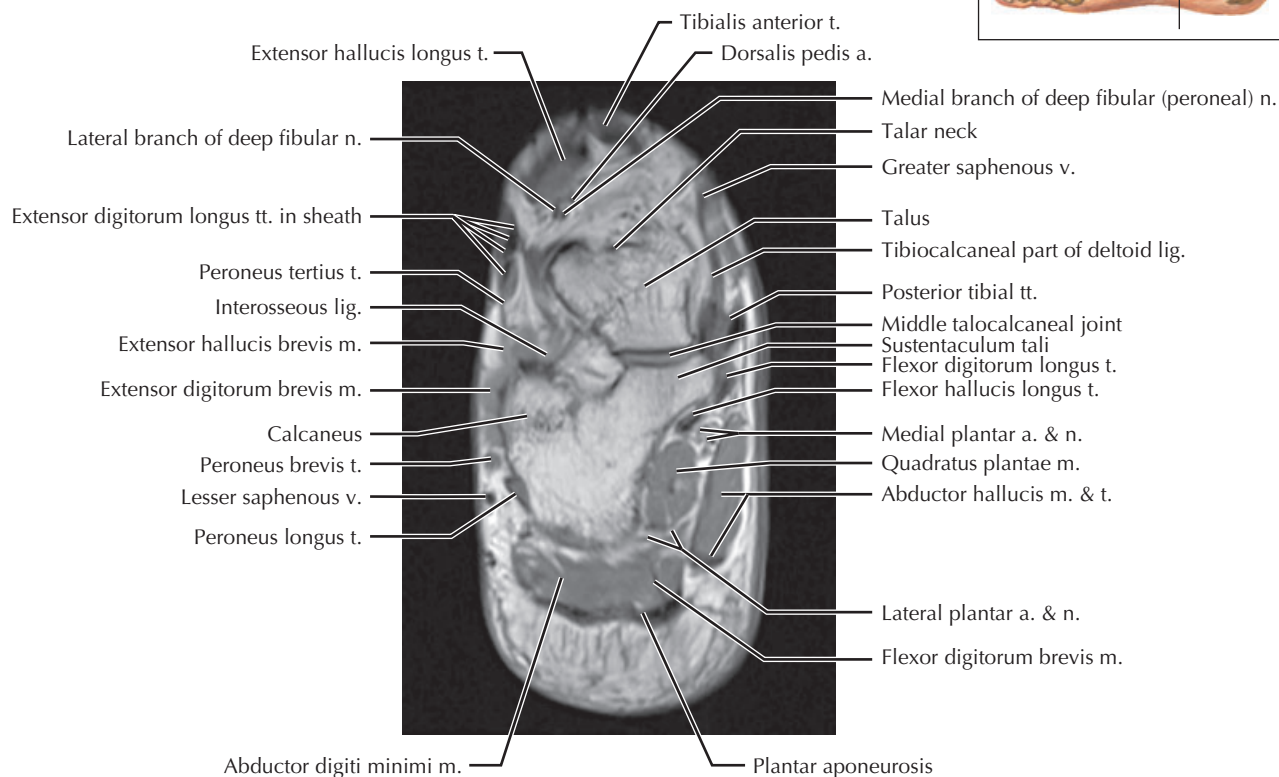


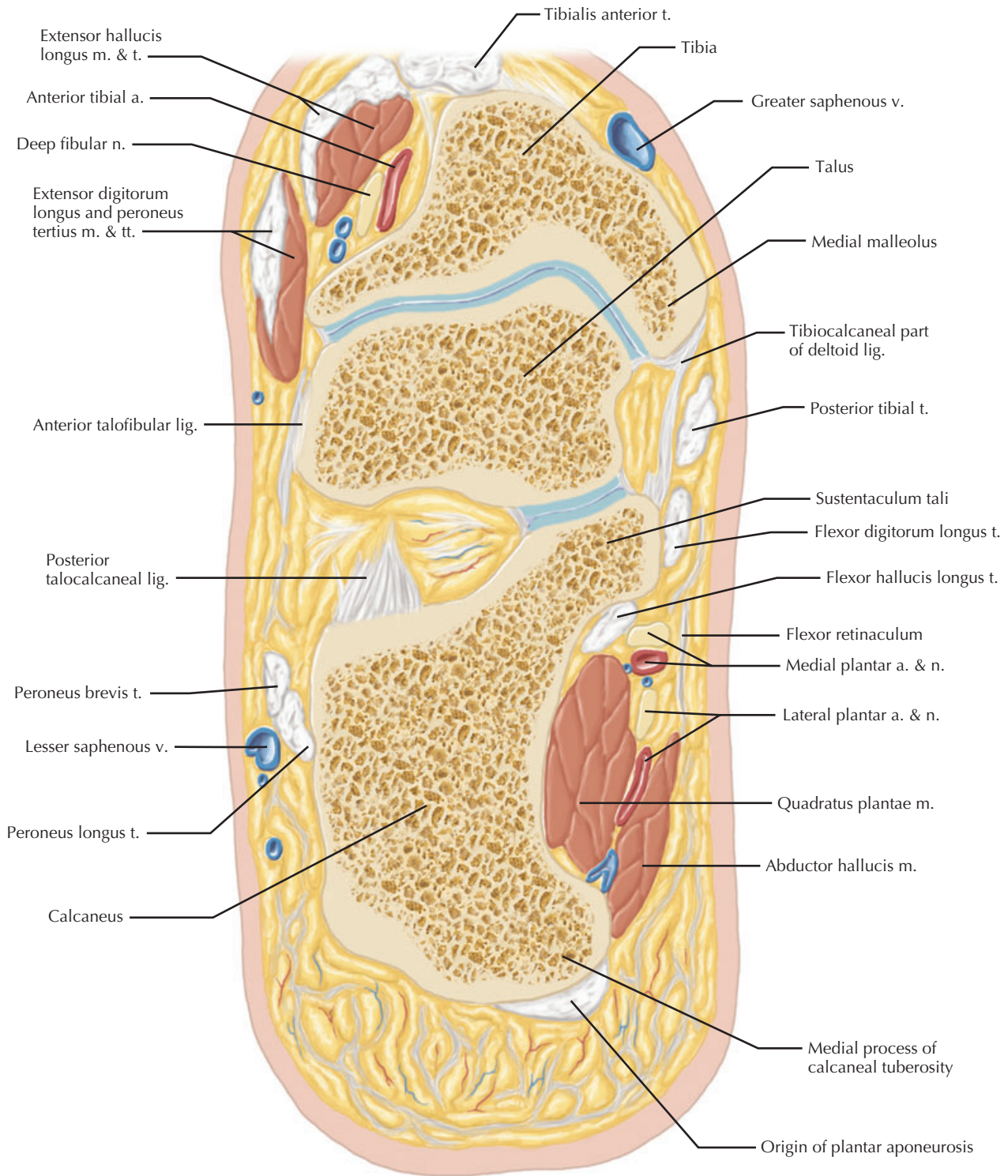
PATHOLOGIC PROCESS

A high percentage of patients with disruption of the posterior tibial tendon also have disruption of the spring ligament.

NORMAL ANATOMY

The spring ligament is also called the "tibio-spring" ligament and is the most medial portion of the deltoid supporting the head of the talus.

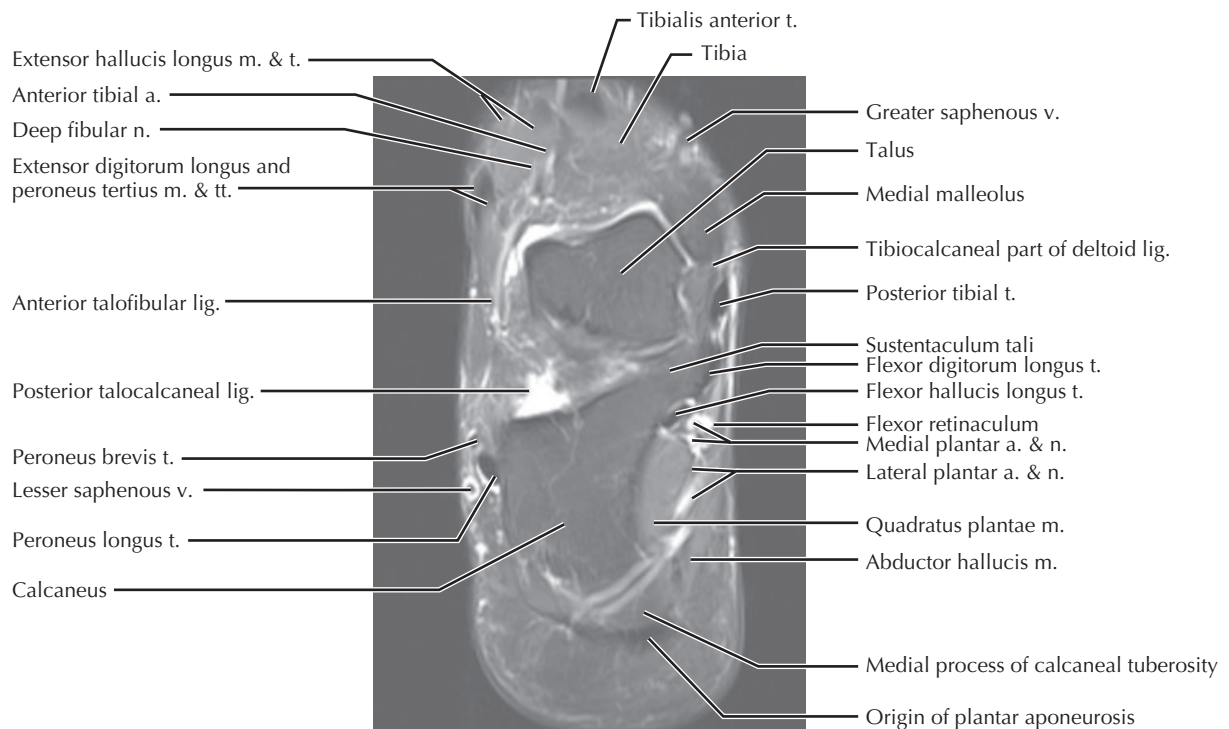
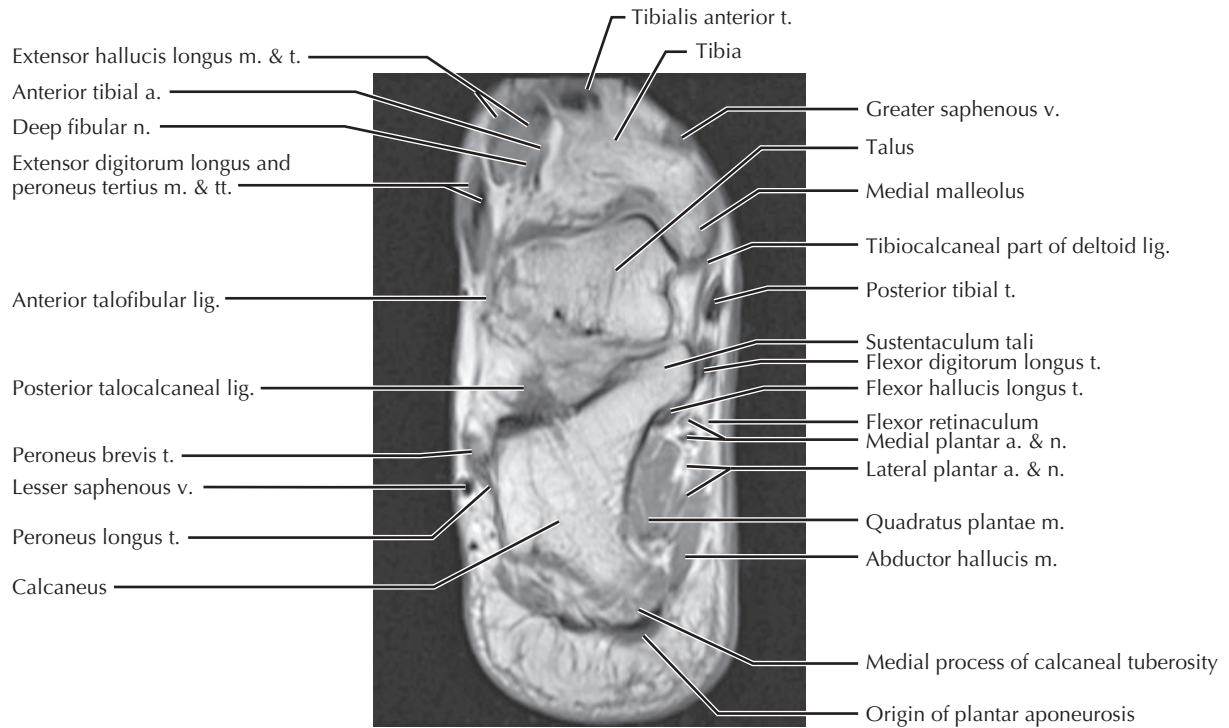


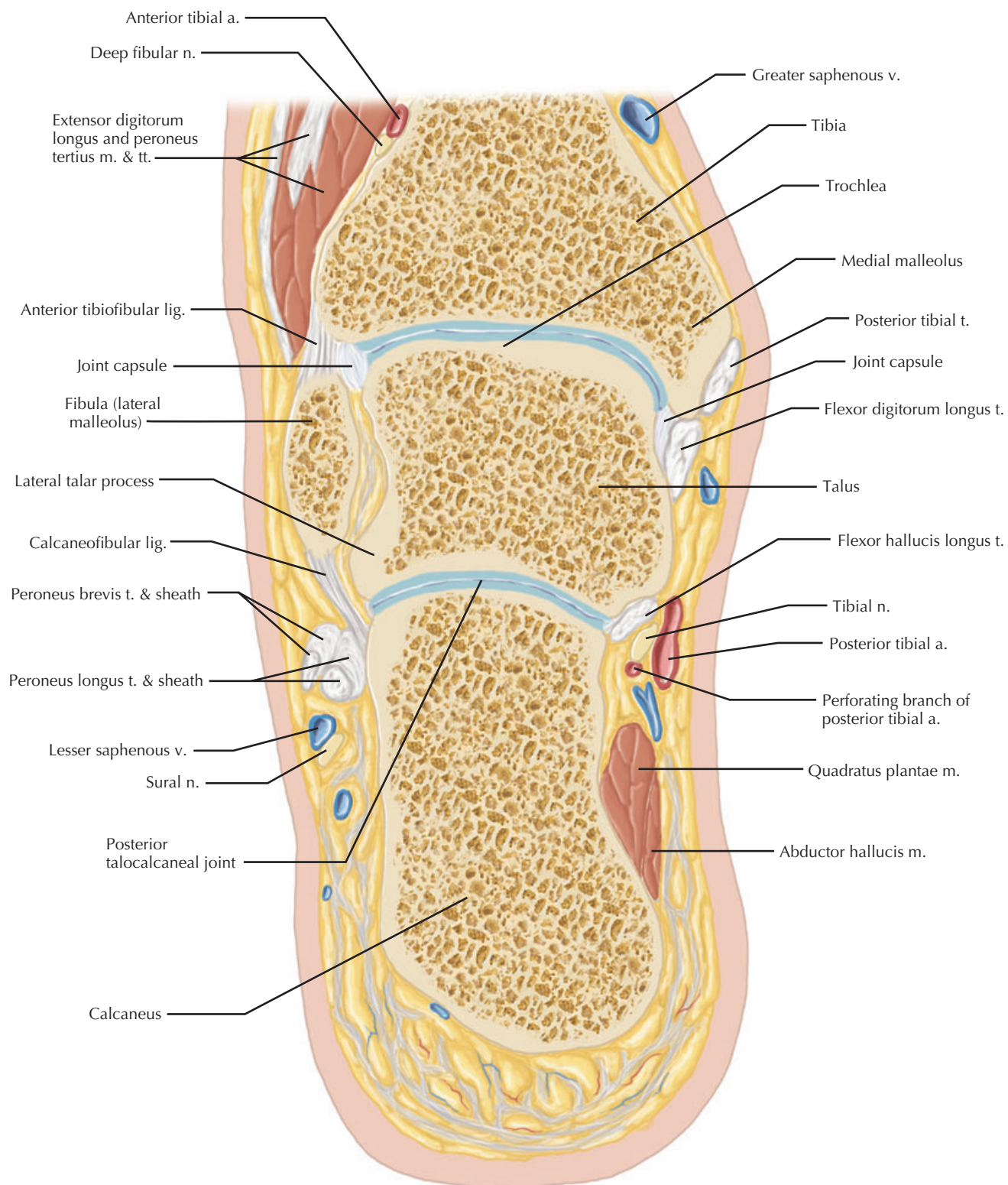


PATHOLOGIC PROCESS

Plantar fasciitis can have mass effect on Baxter's nerve, which is the first branch of the lateral plantar nerve (branch from posterior tibial nerve). Plantar fasciitis presents as pain in the medial aspect of the heel. Associated compression of Baxter's nerve can cause numbness in the fourth and fifth toes and can be seen on T2-weighted MR images as neurogenic edema involving the muscle bellies of abductor hallucis, flexor digitorum brevis, and quadratus plantae.

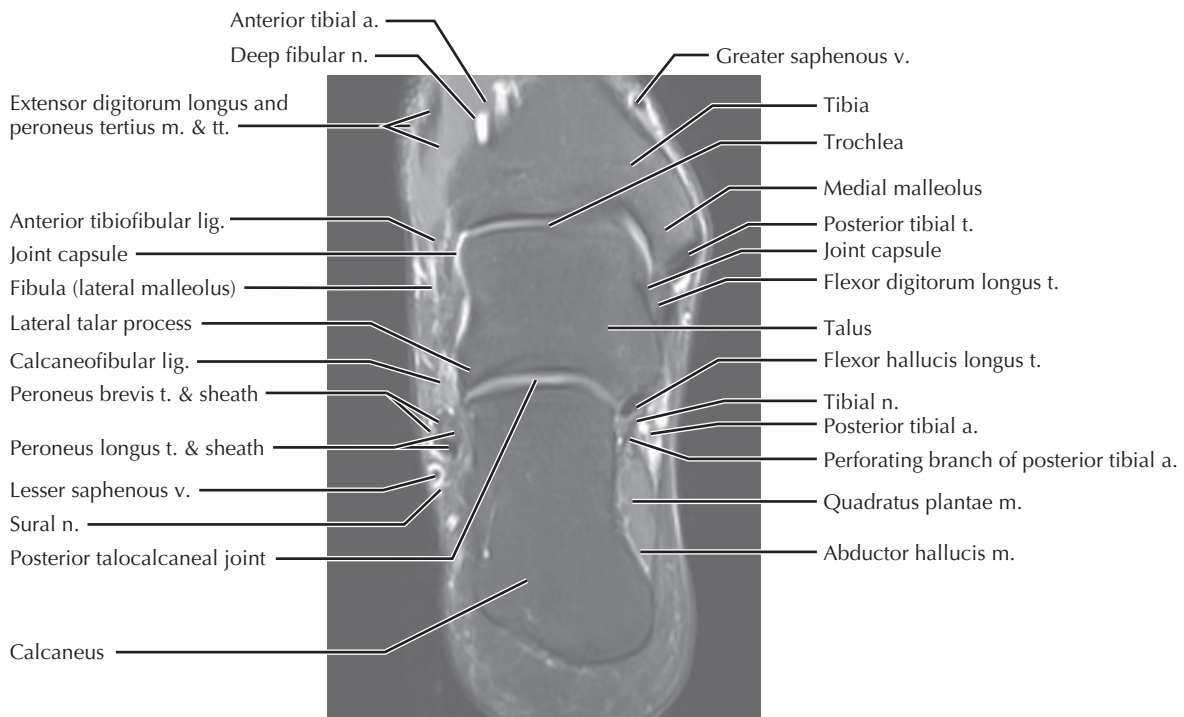
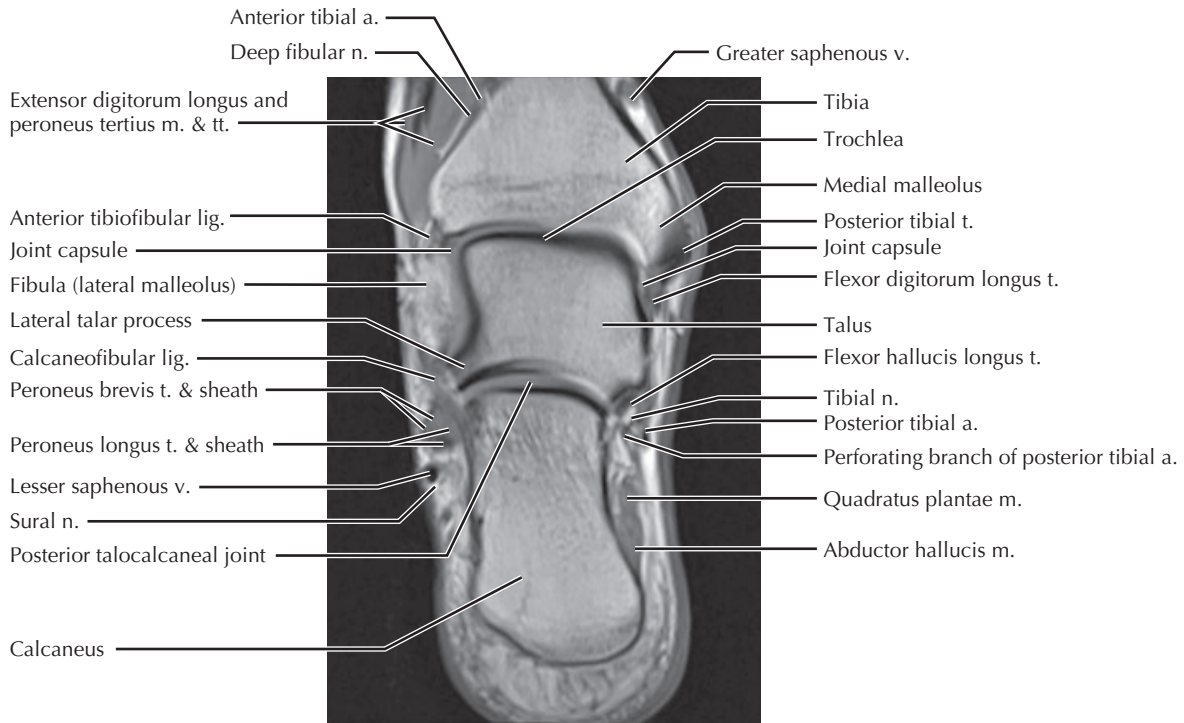
Mass effect in the tarsal tunnel can lead to impression on the posterior tibial nerve, causing numbness in its distribution.

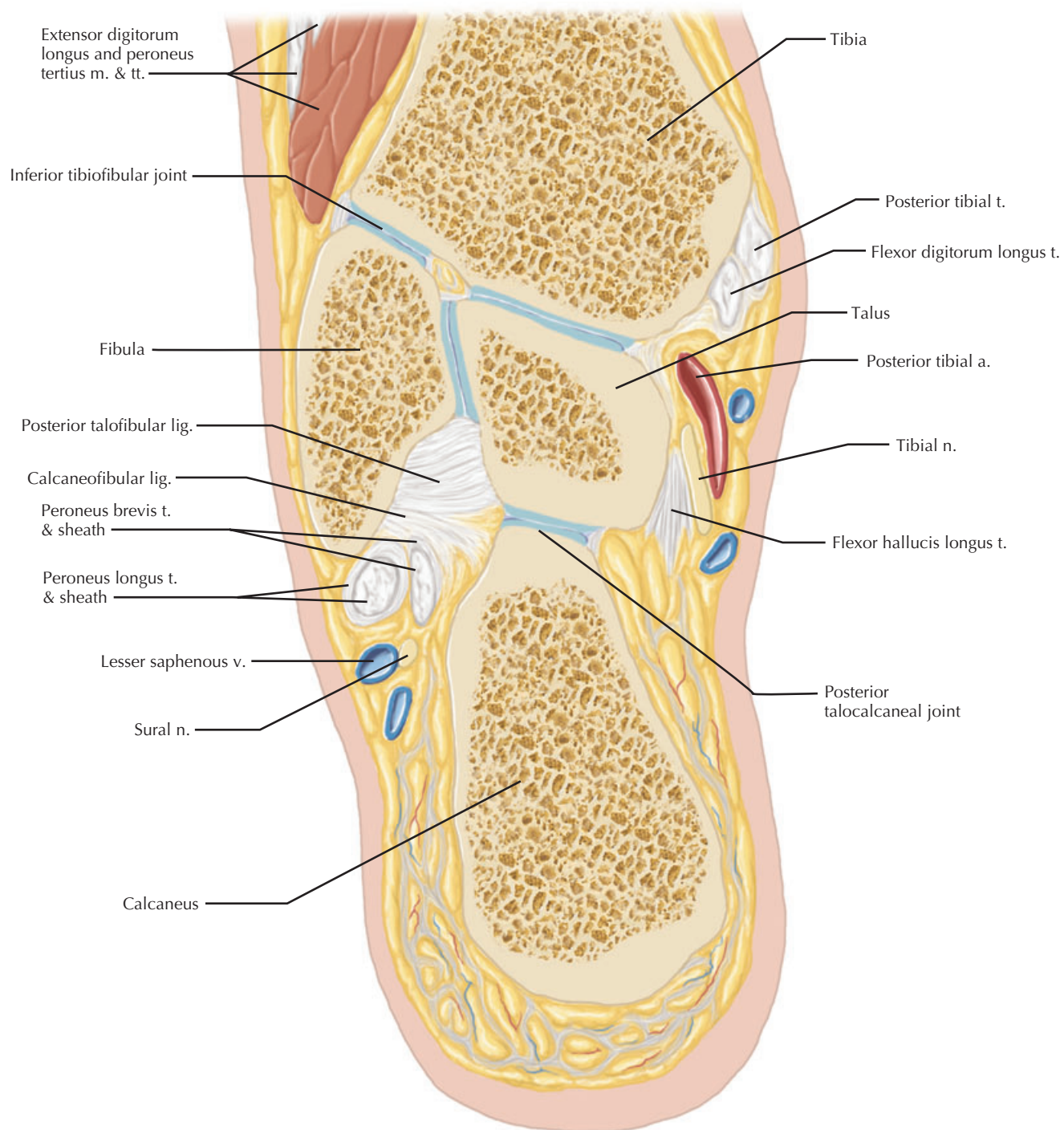


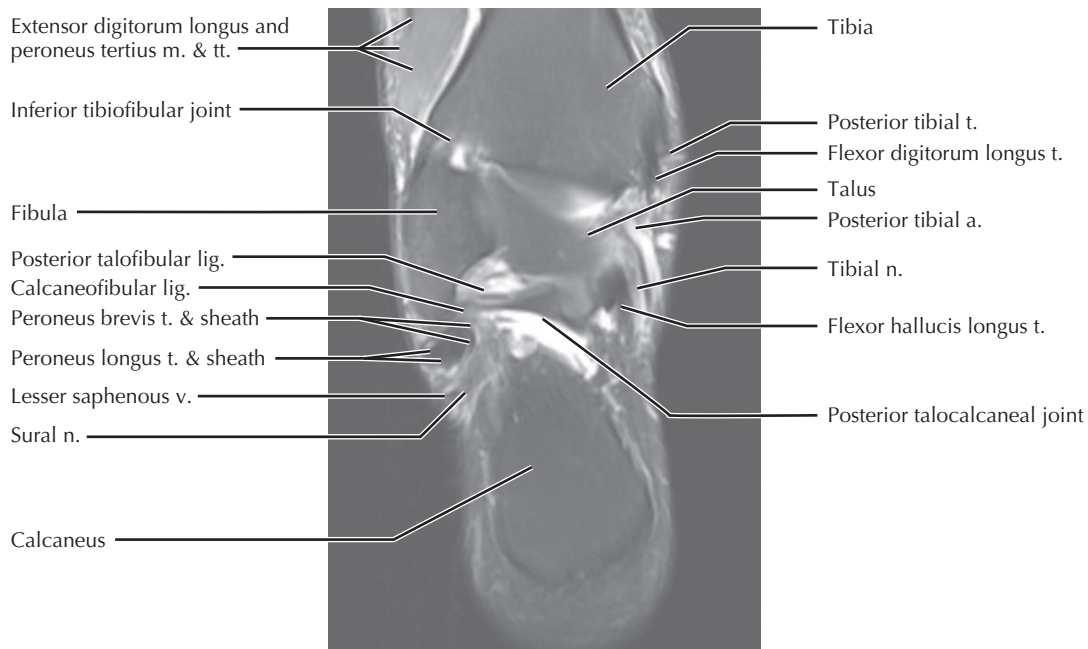
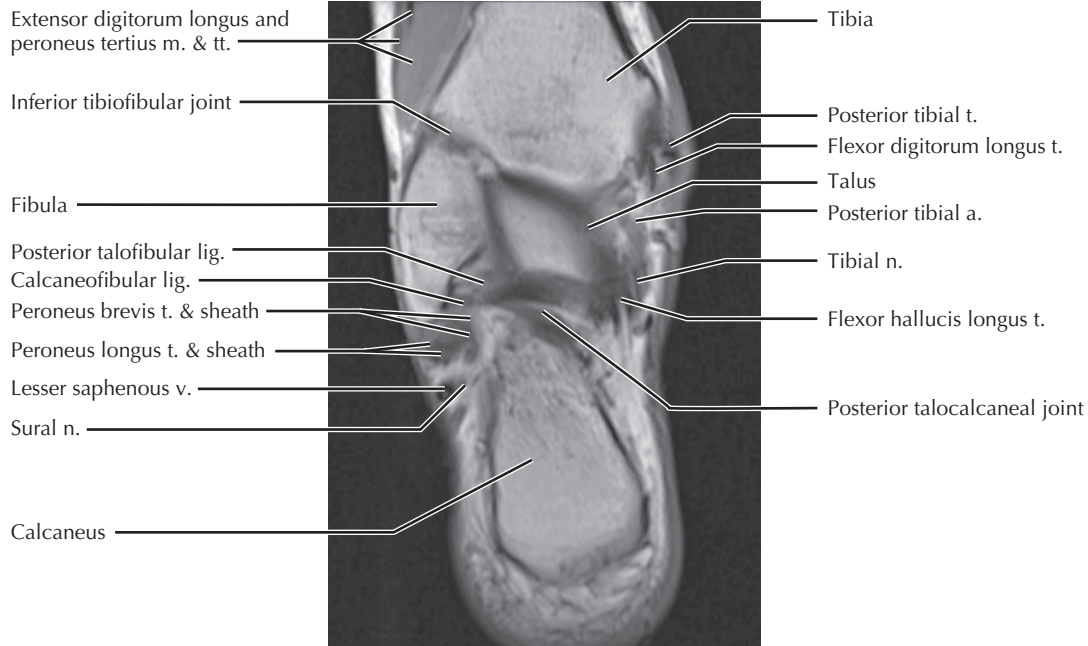


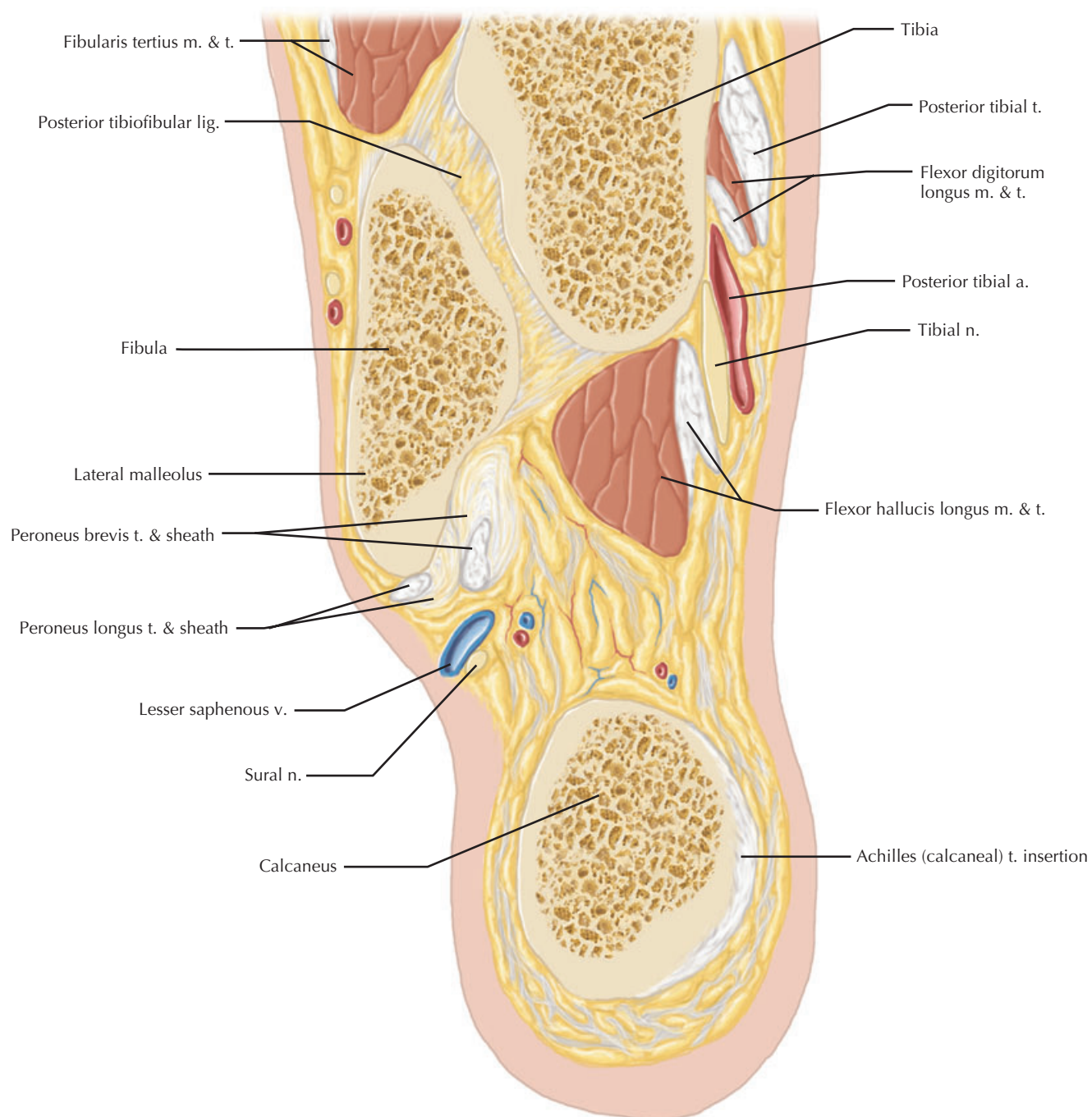
PATHOLOGIC PROCESS

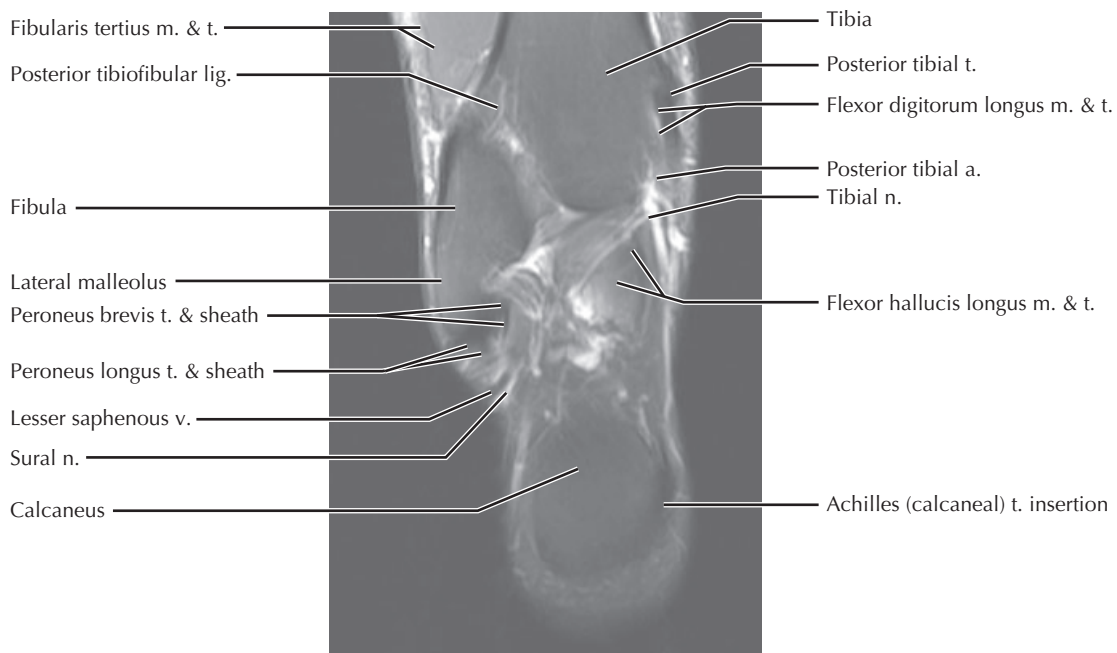
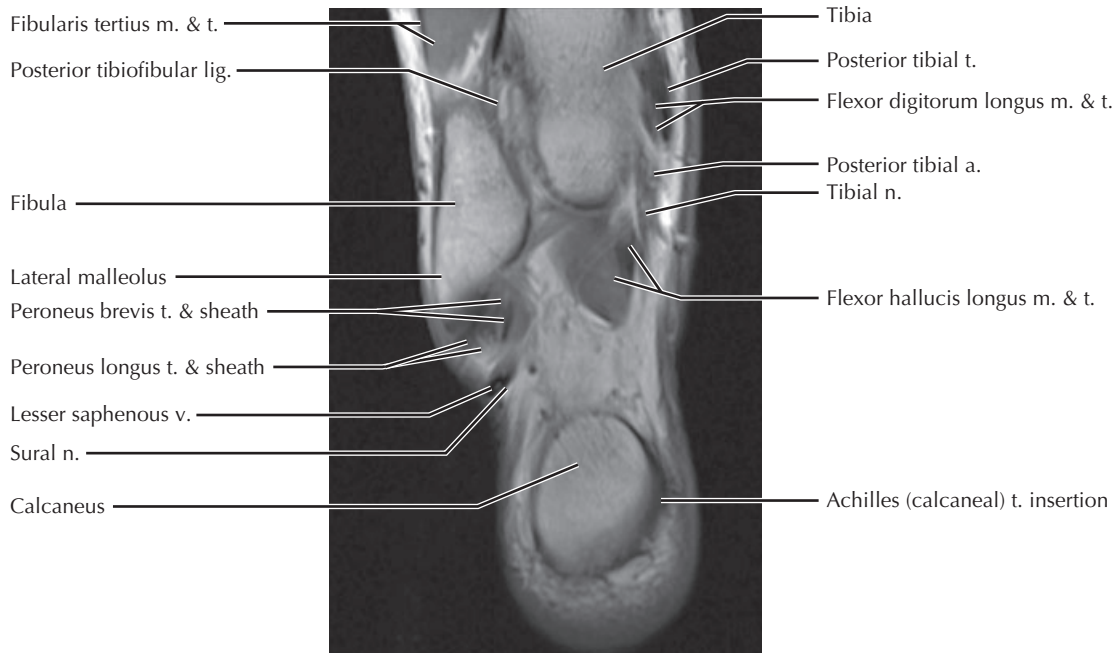
The MR features indicating a loose osteochondral fragment are high signal surrounding the fragment on T2-weighted images, large subchondral cysts deep to the fragment, defects in the overlying cartilage, and absence of the fragment, with or without an intra-articular loose body seen.

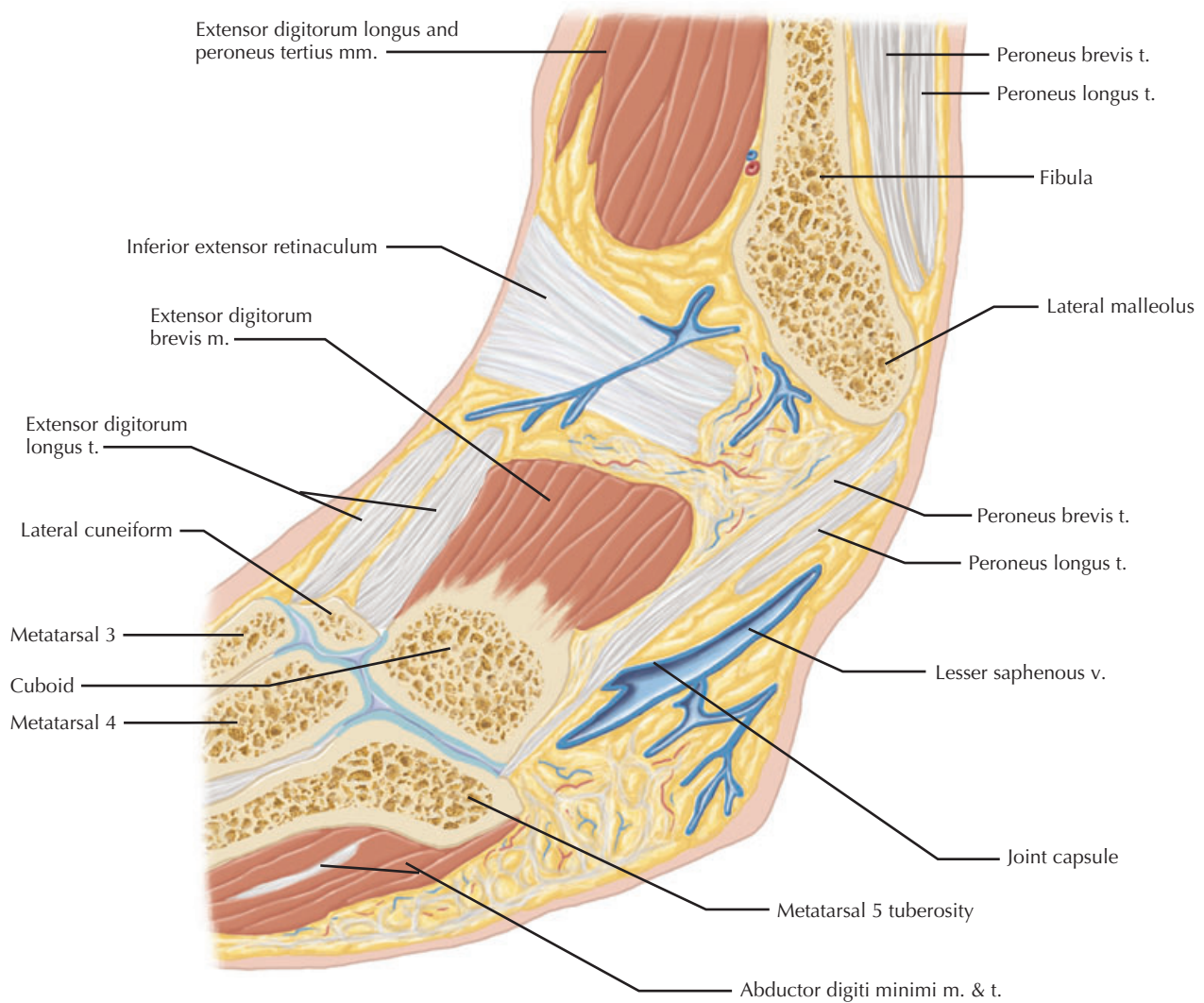


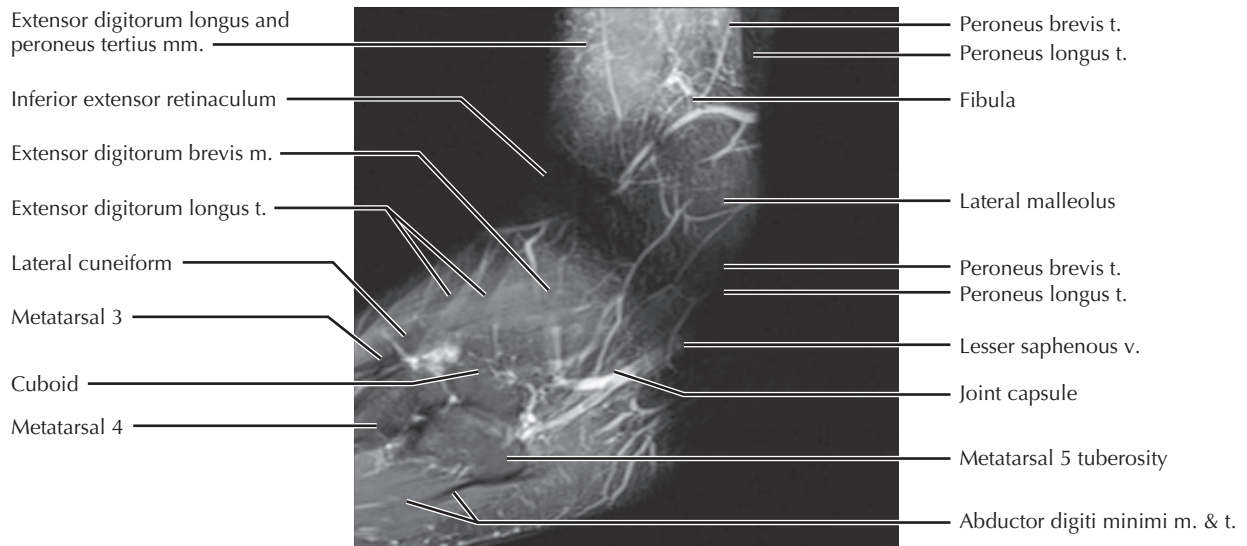
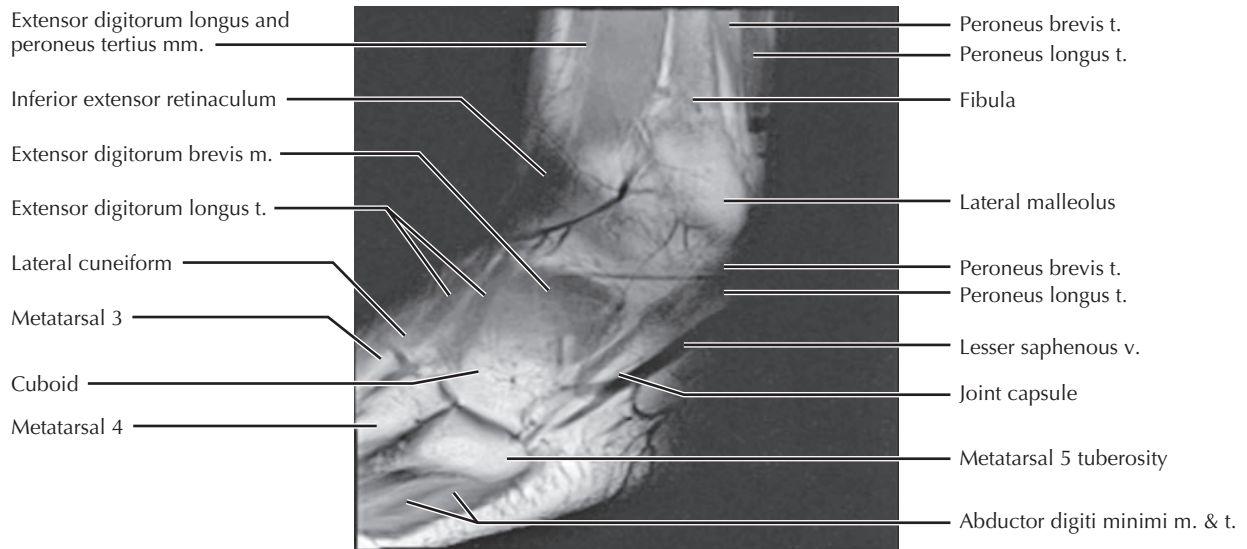
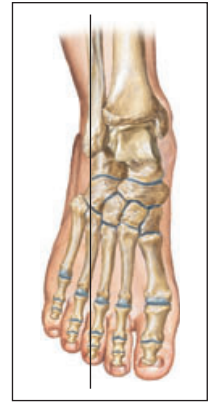


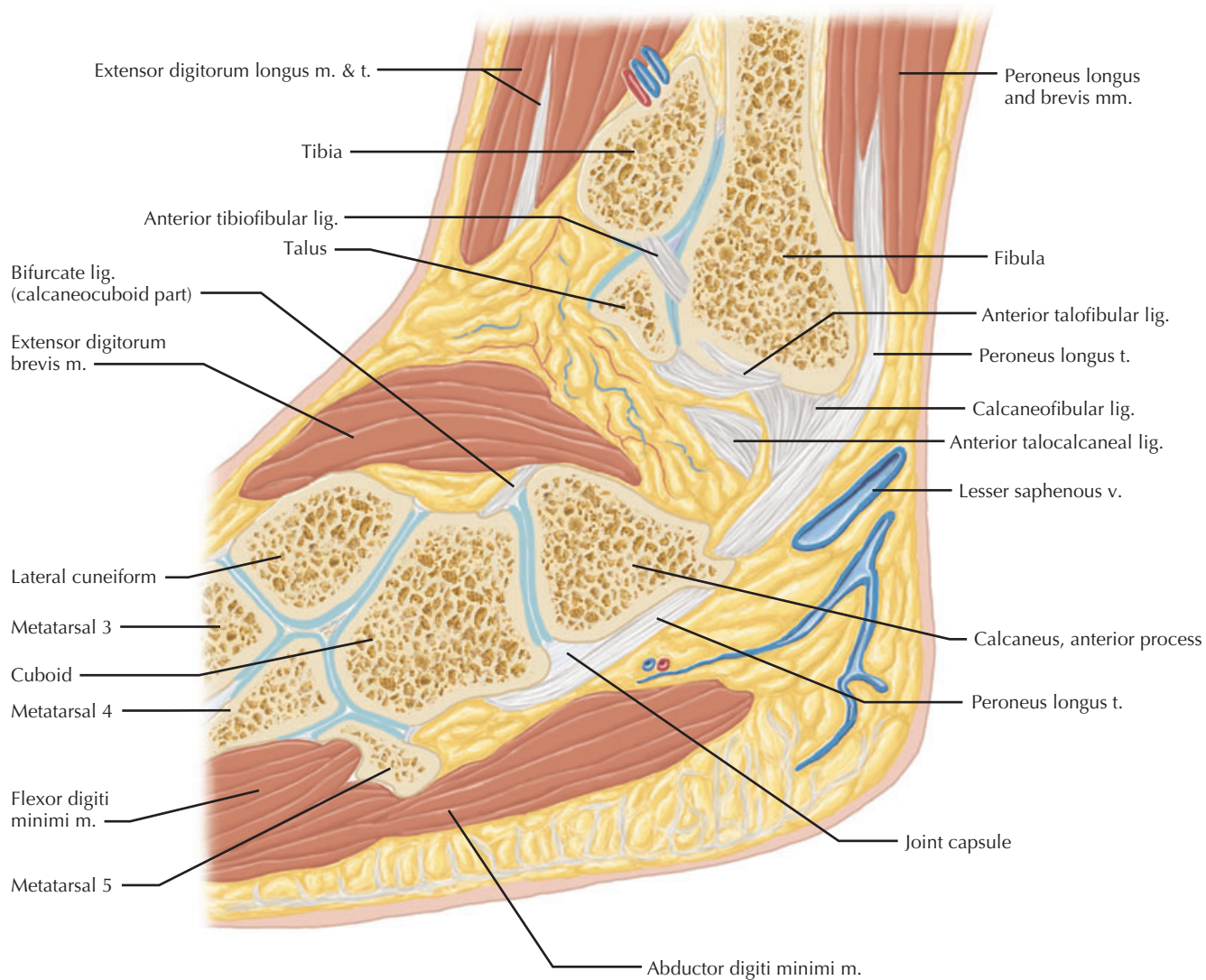


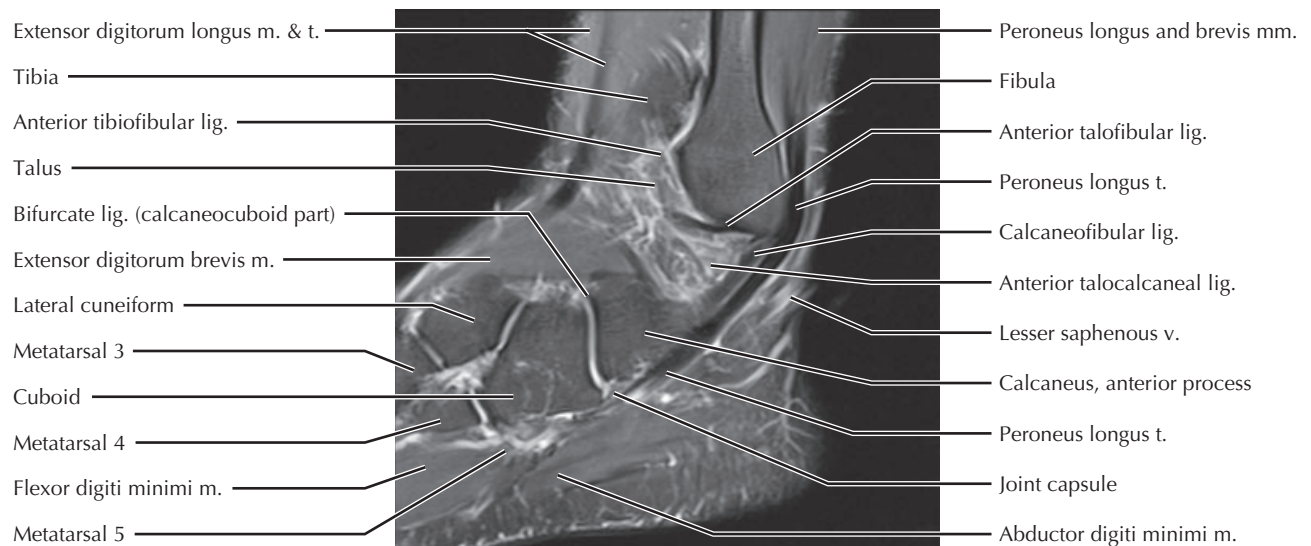
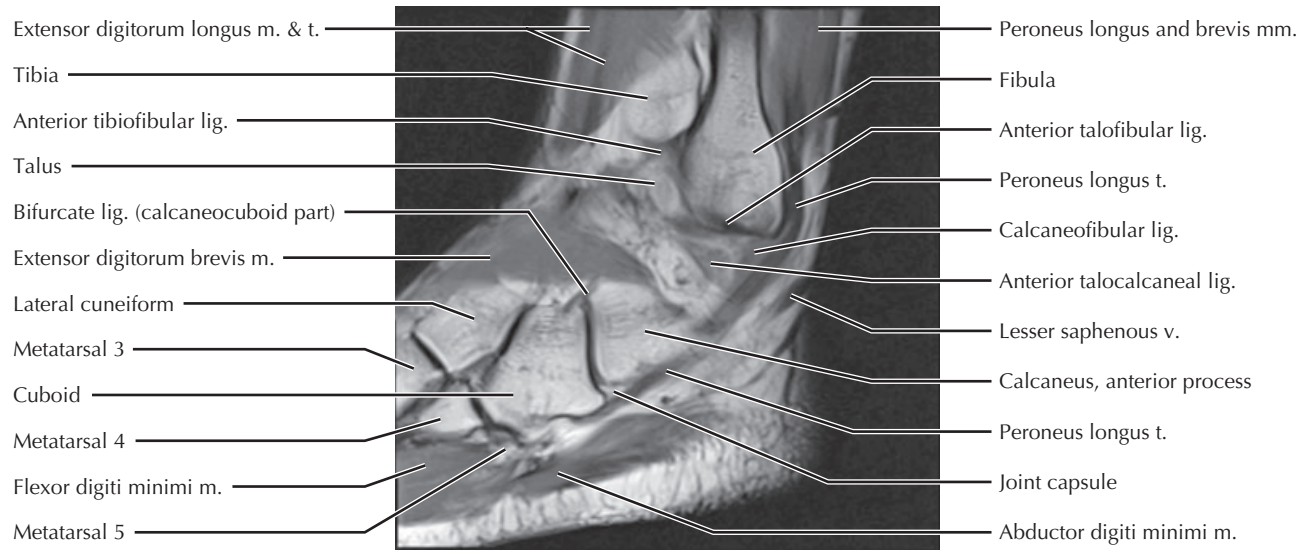
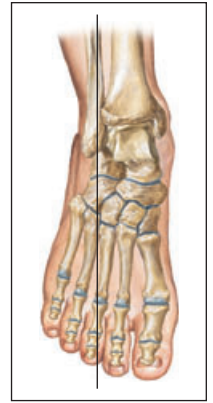


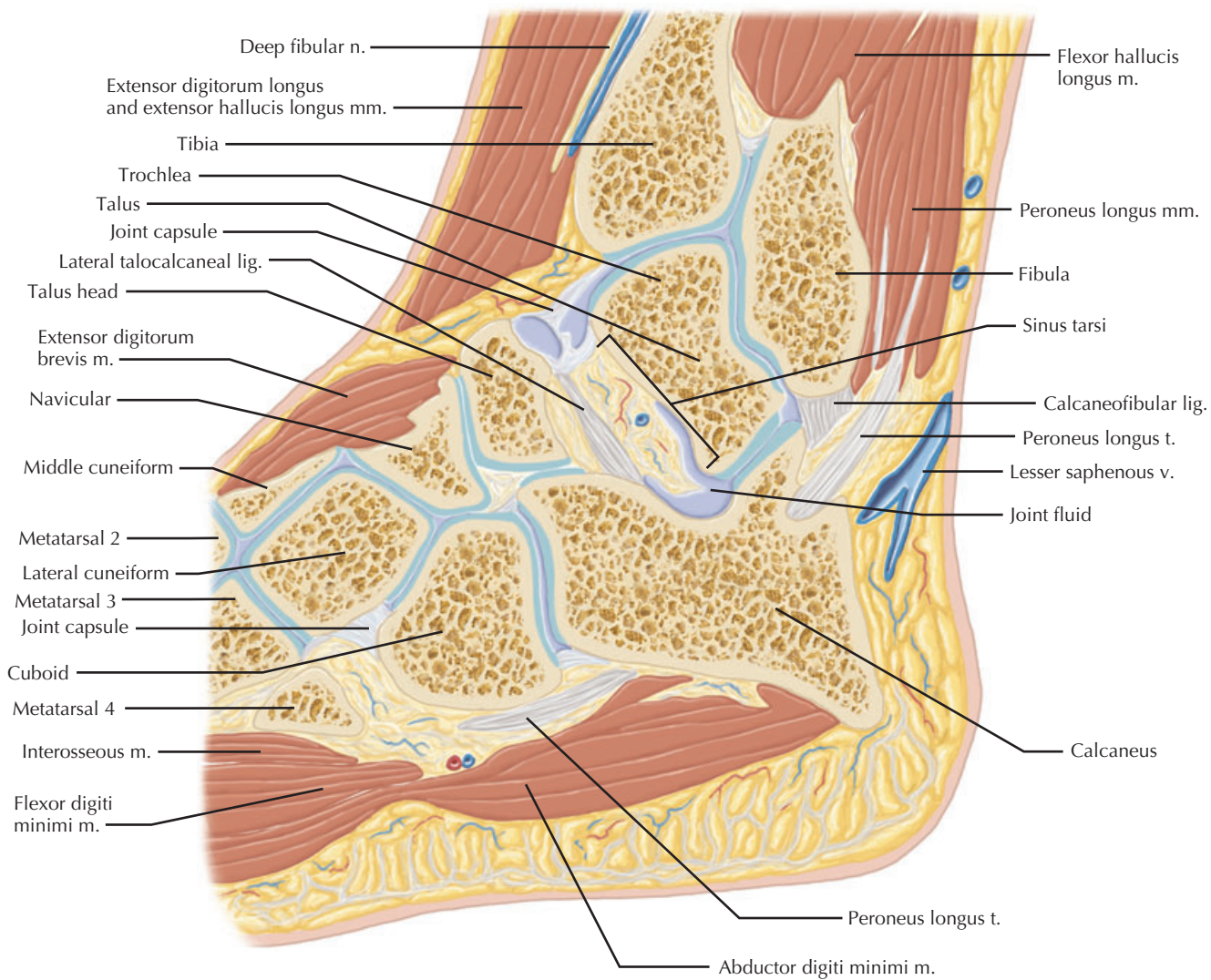


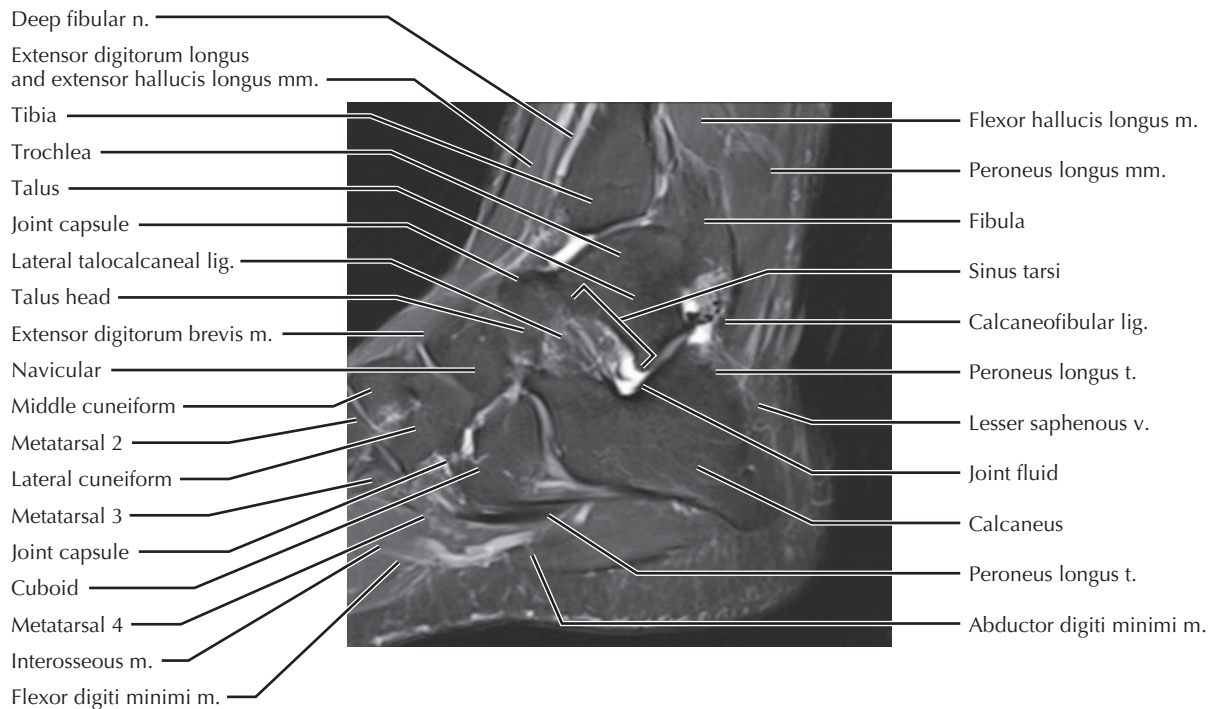
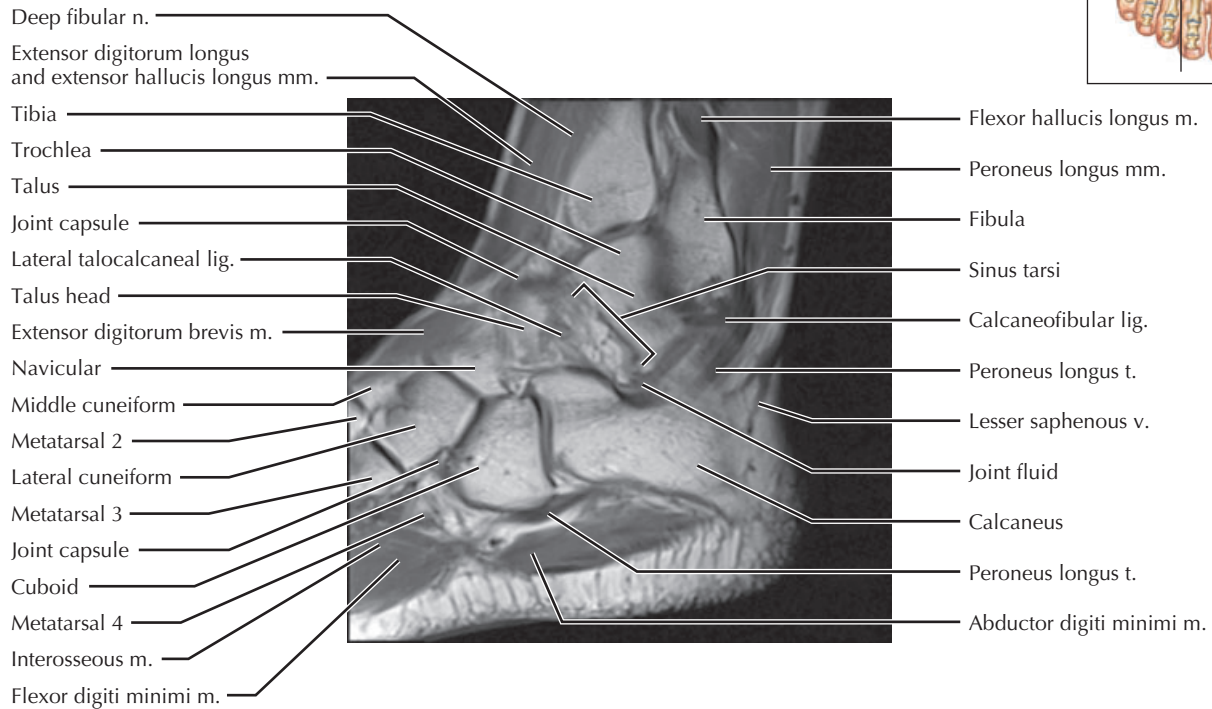
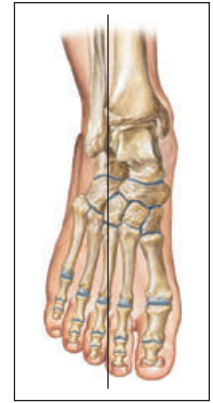


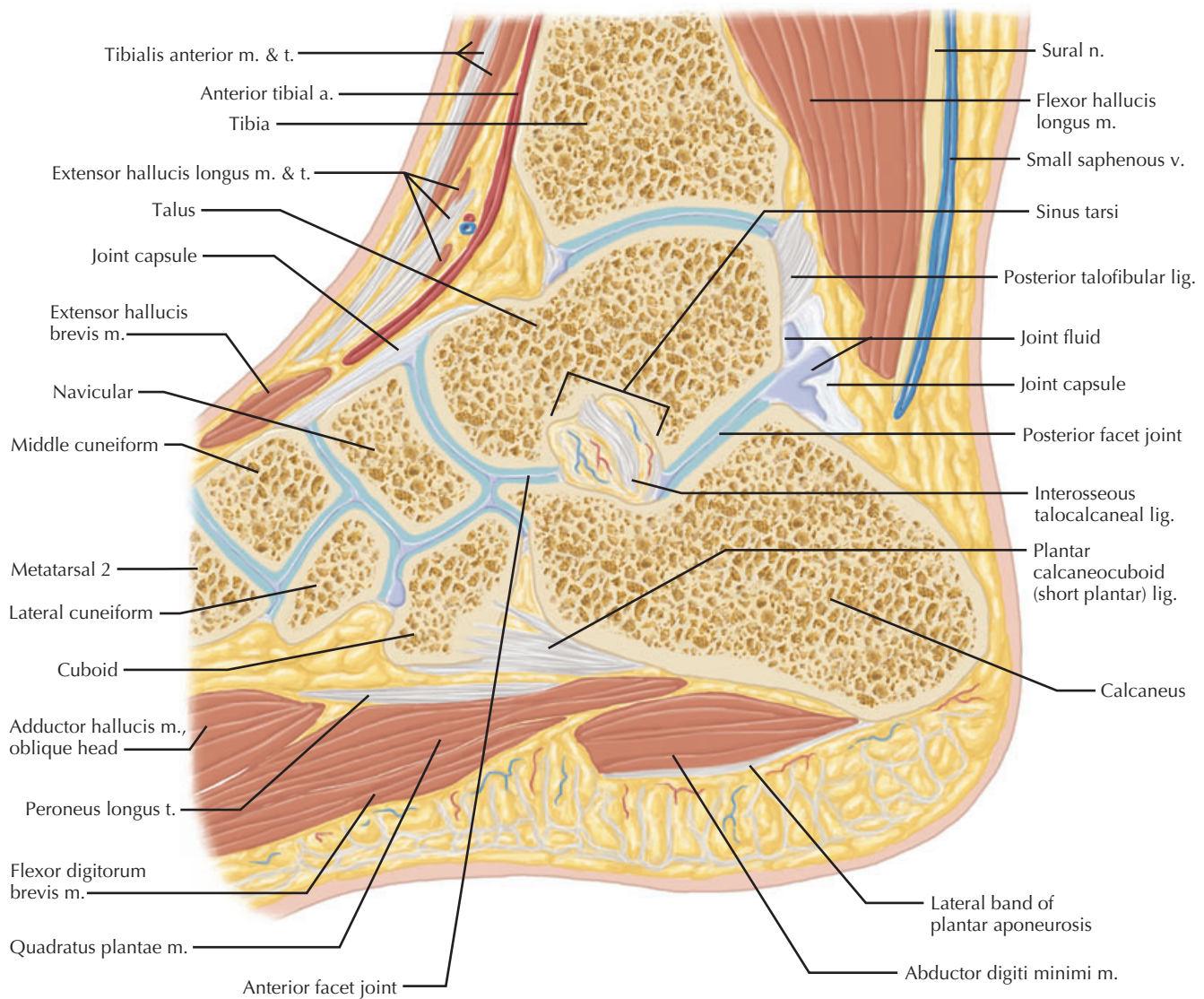












DIAGNOSTIC CONSIDERATION

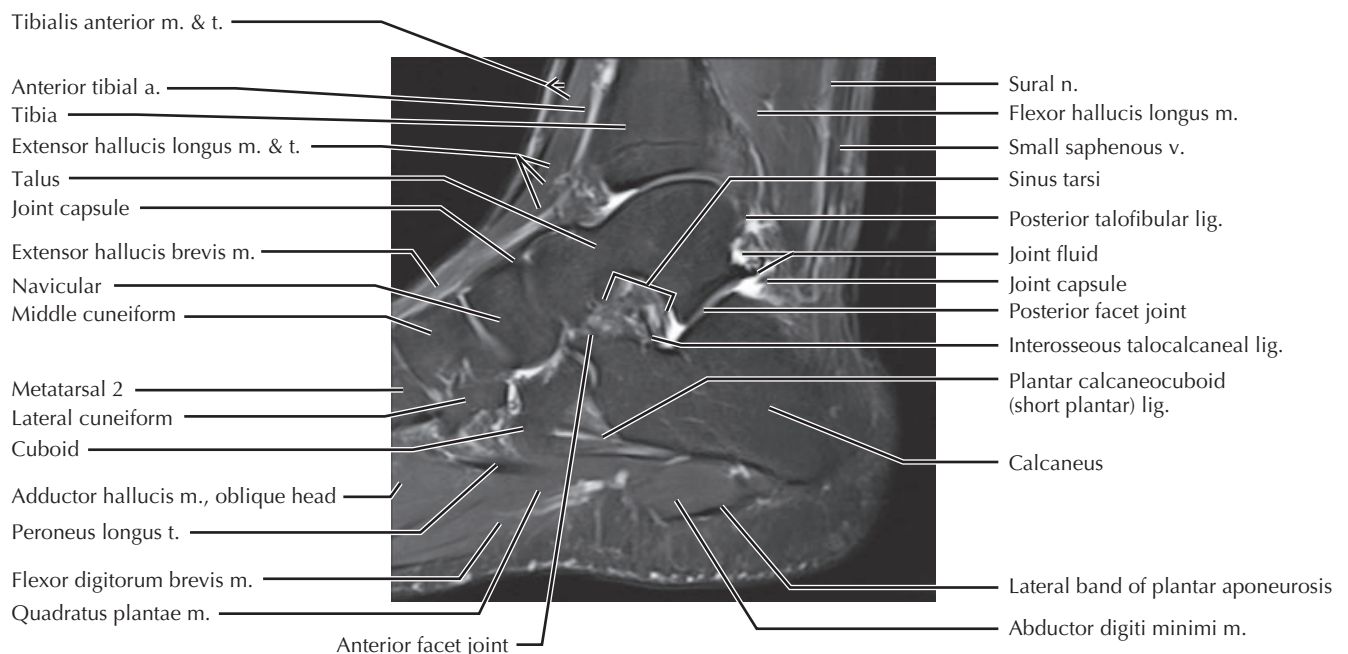
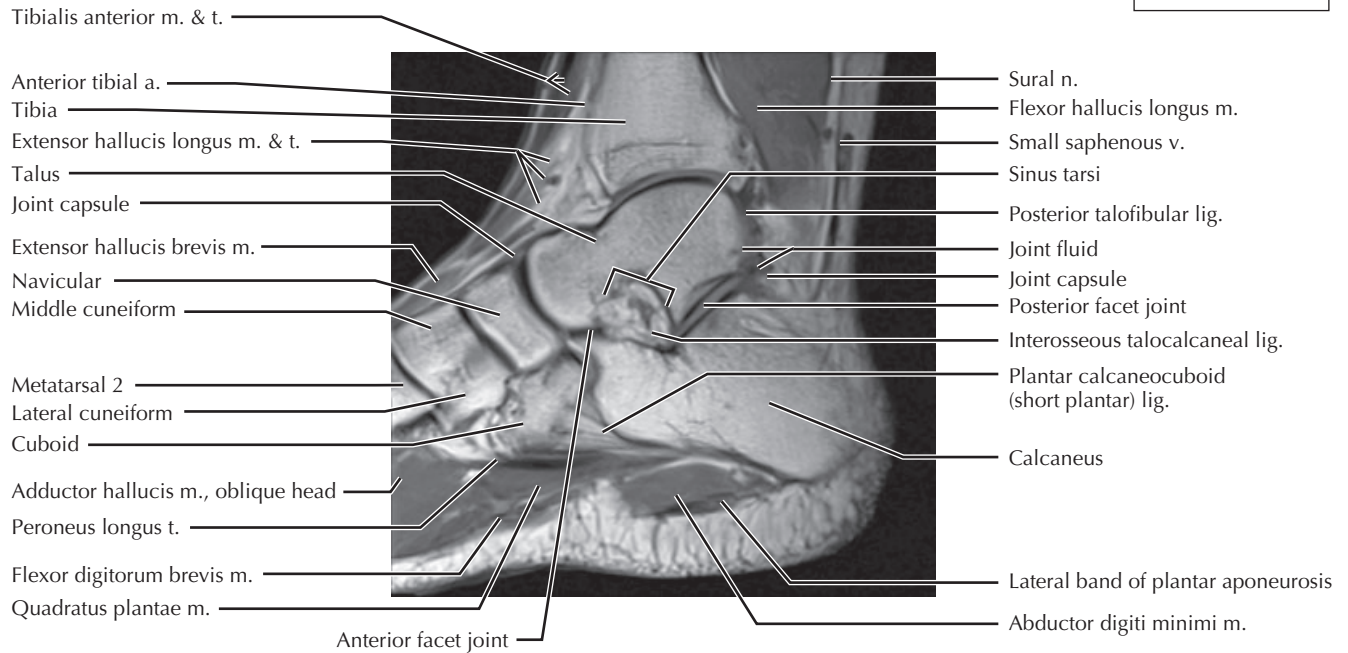
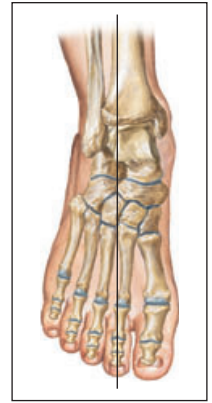
The posterior tibiofibular ligament can resemble a loose body on sagittal imaging when surrounded by joint fluid. Following the structure on multiple images to its insertion site proves it is a ligament and not a loose body.

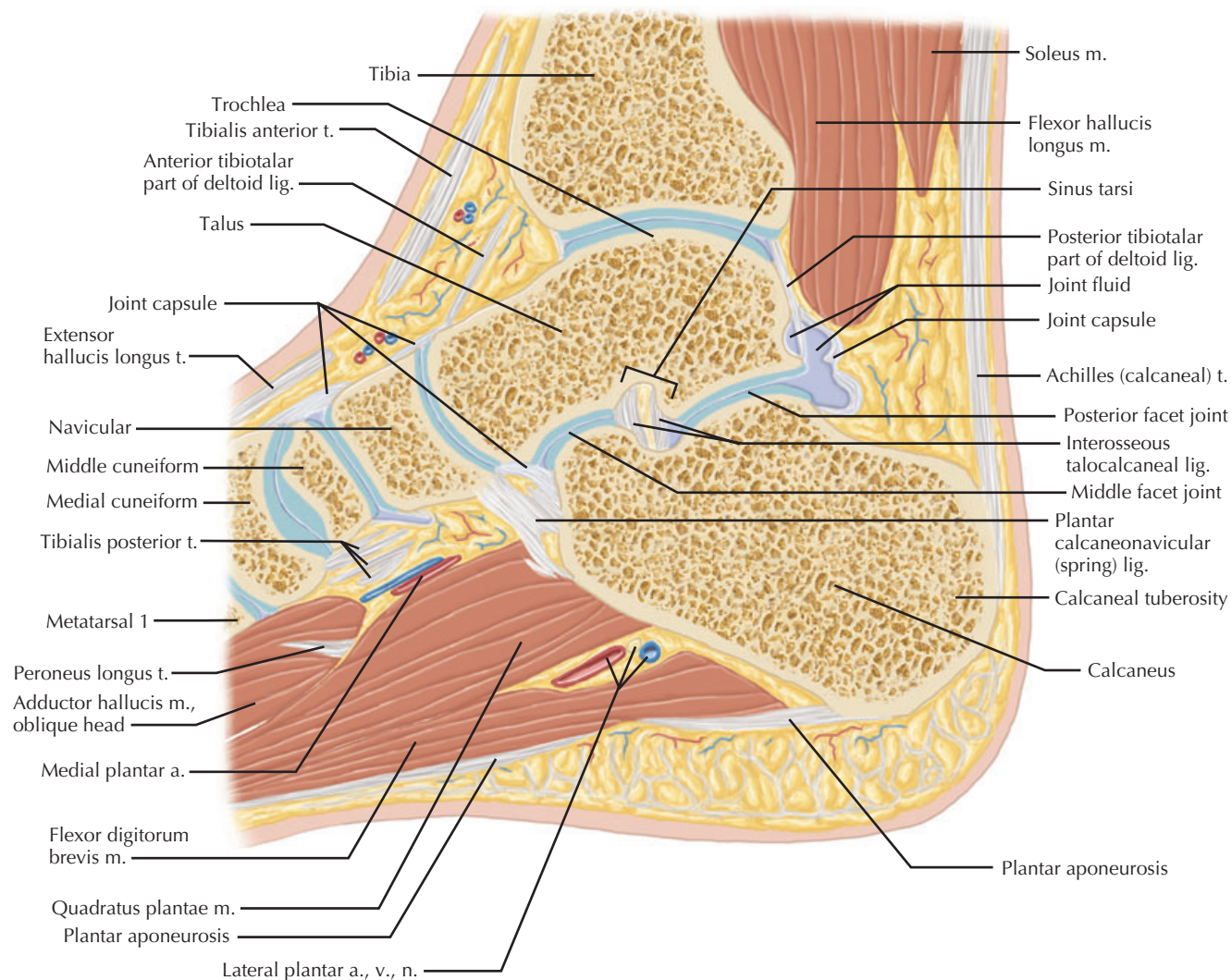
PATHOLOGIC PROCESS

Sinus tarsi syndrome is a clinical diagnosis and can be associated with abnormal MRI when there is replacement of the fat within the sinus tarsi by abnormal signal on the T1-weighted images. Often, there are additional abnormal findings in the hind foot.

NORMAL VARIANT

An entity that can mimic a lesion in the calcaneus noted adjacent to the sinus tarsi is a vascular remnant. Sometimes this remnant can be quite large.



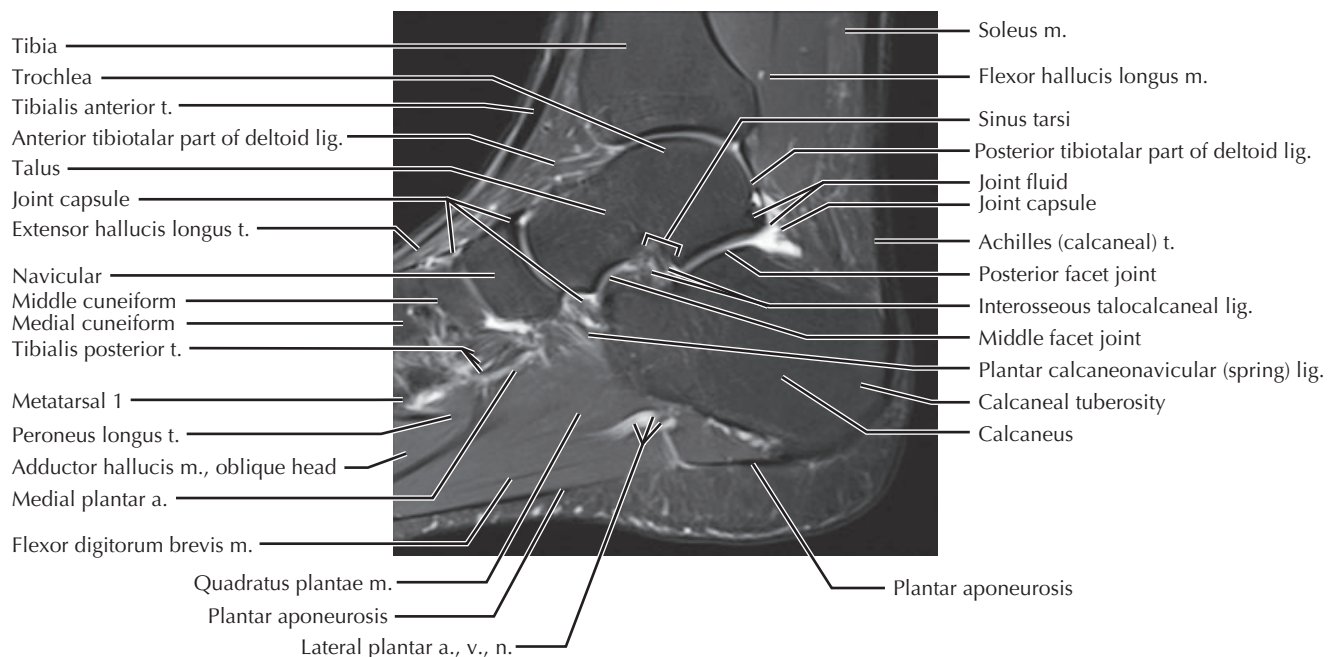
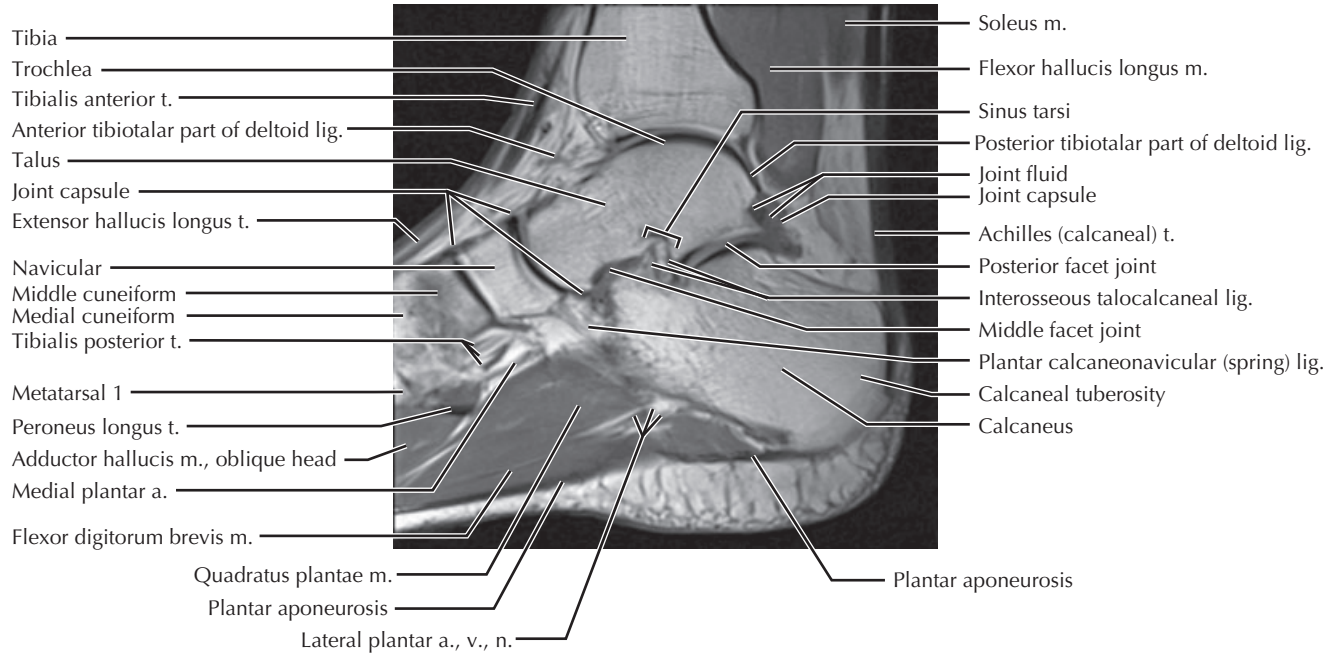
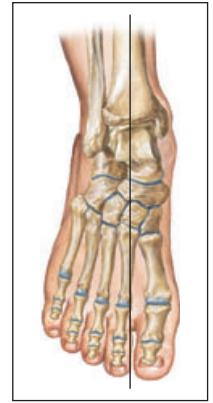


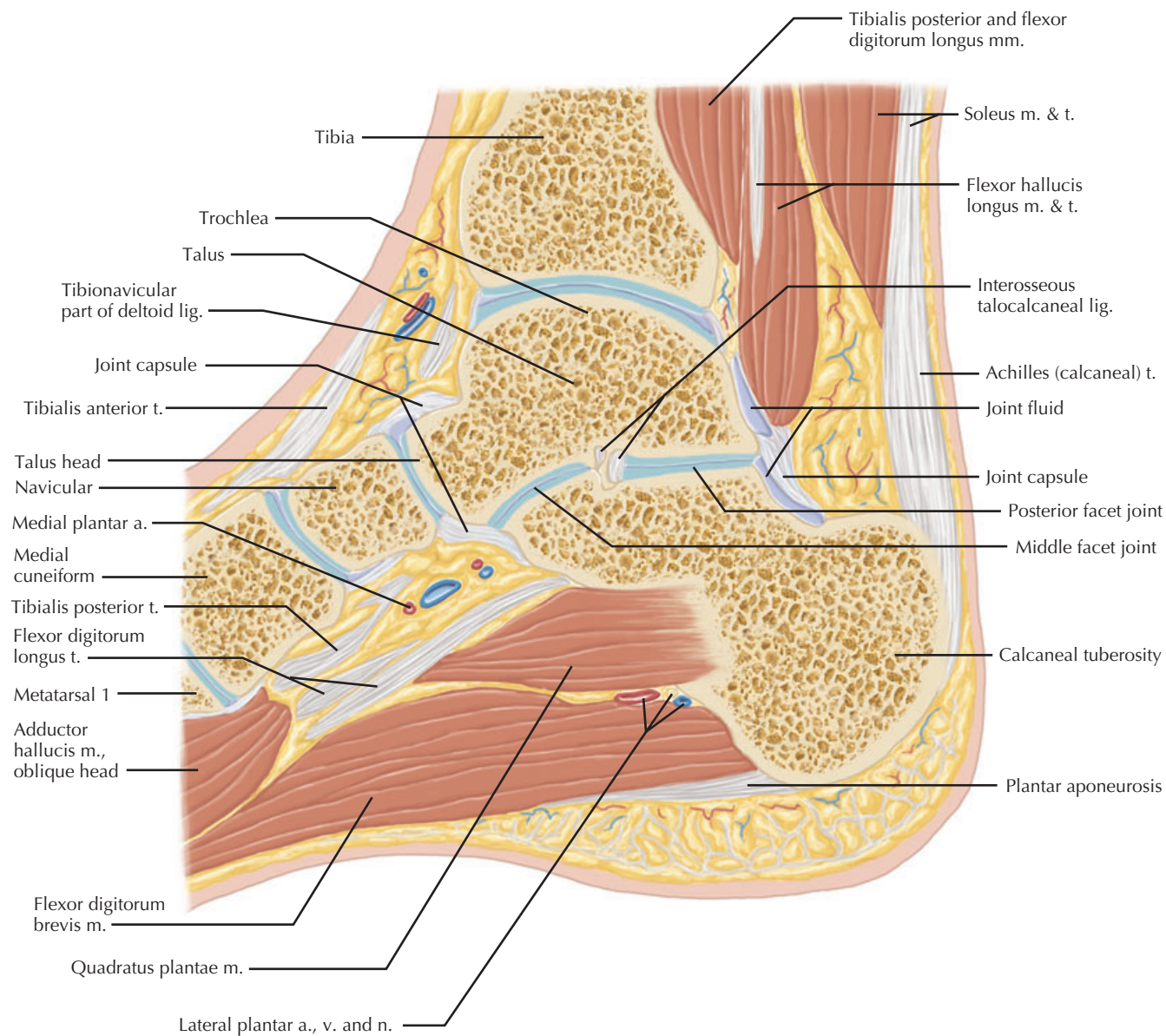
PATHOLOGIC PROCESS

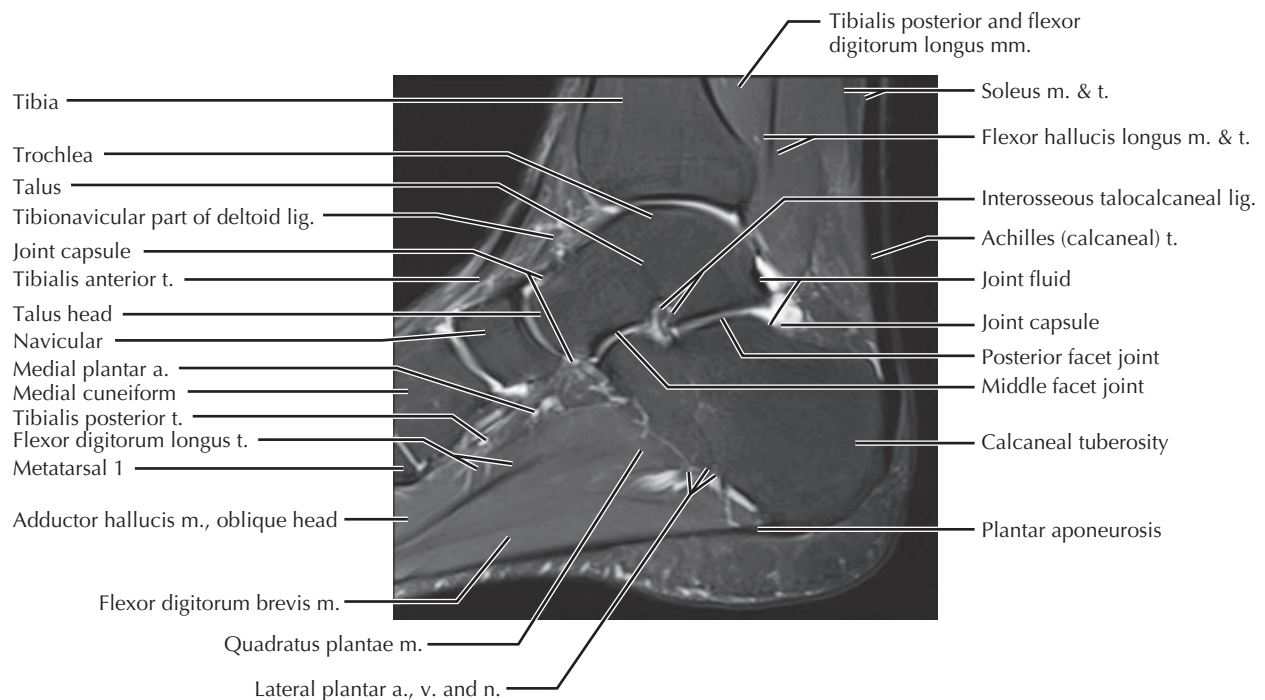
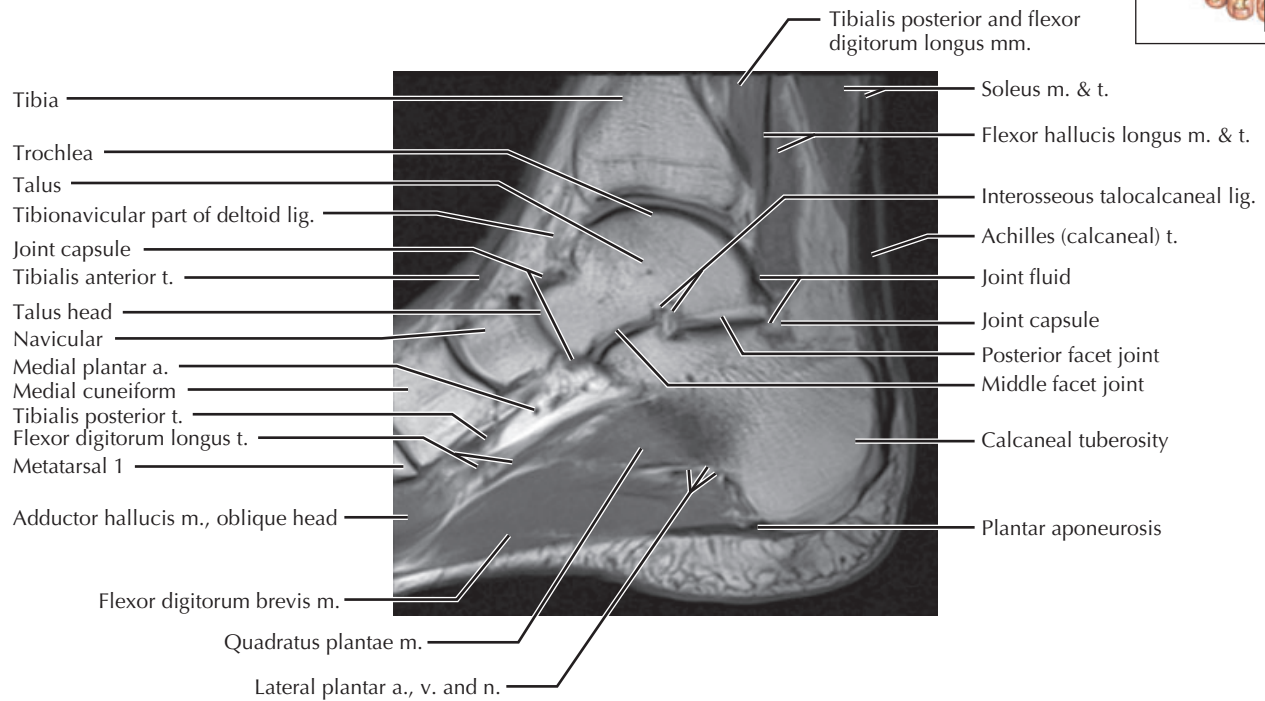
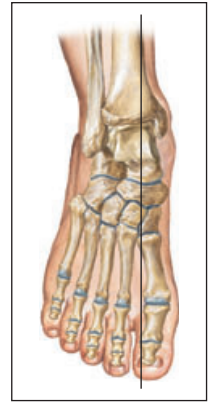
Tendinopathy of the Achilles (calcaneal) tendon can be difficult to distinguish from xanthomas that can occur within the tendon. Both conditions result in intermediate signal and enlargement of the tendon.

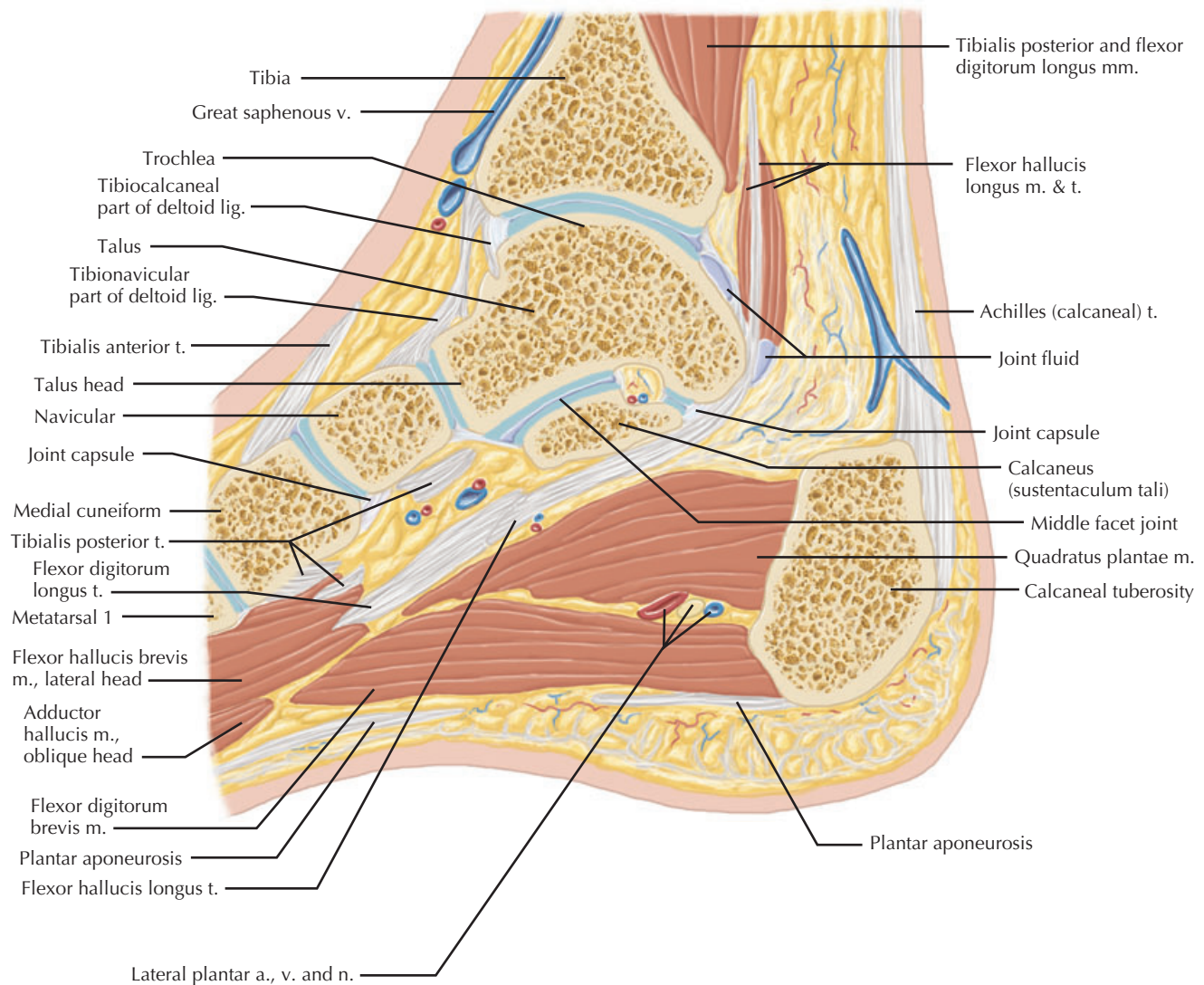
NORMAL ANATOMY

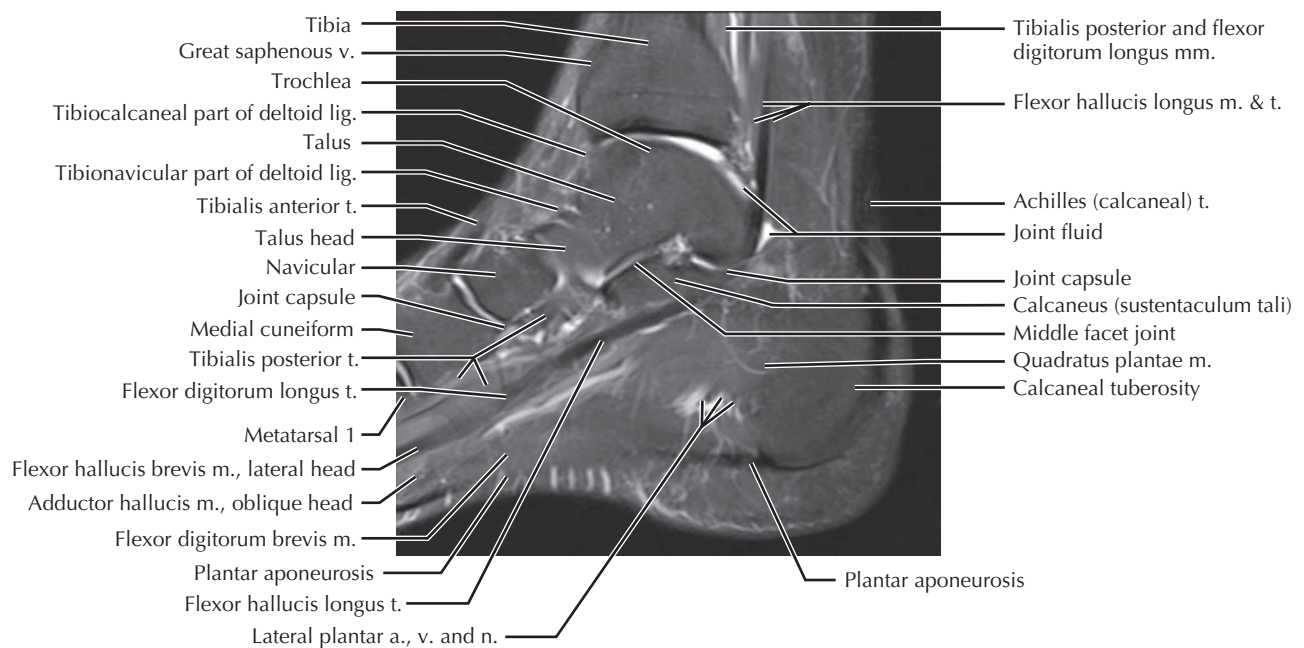
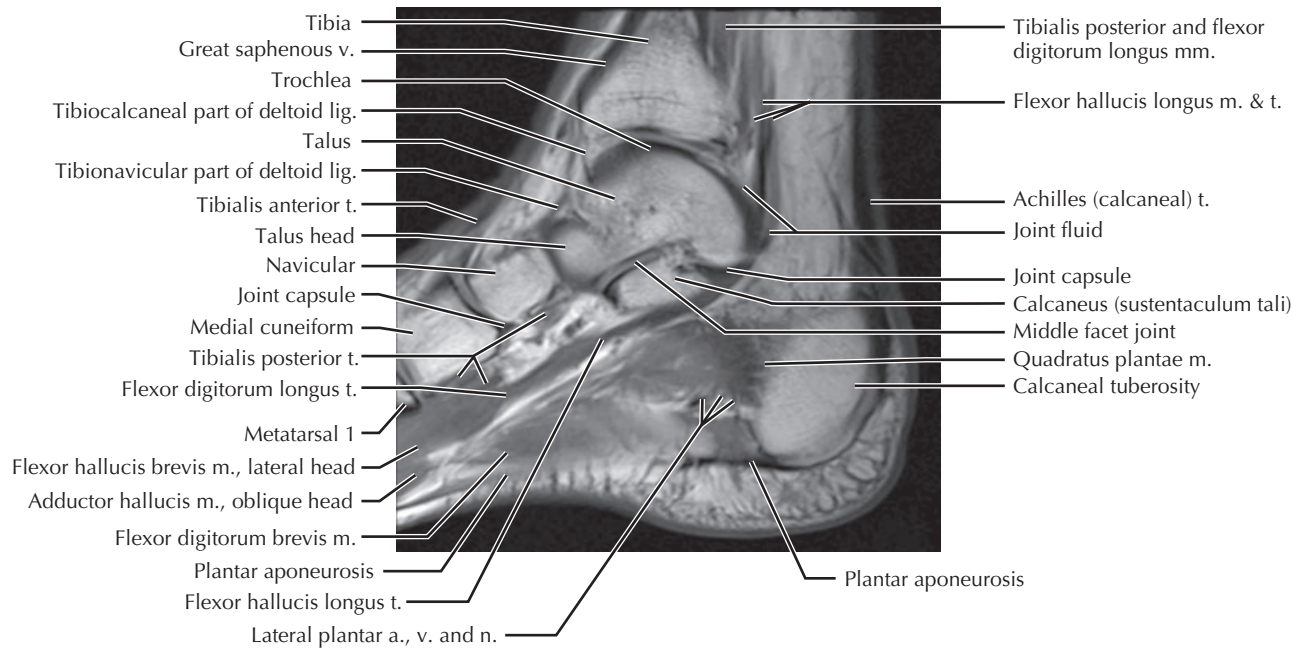
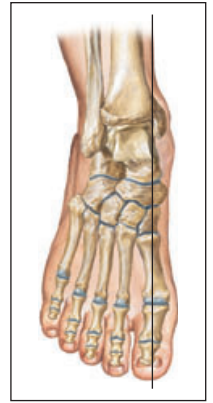
The subtalar joint has three parts: anterior, middle, and posterior facets.

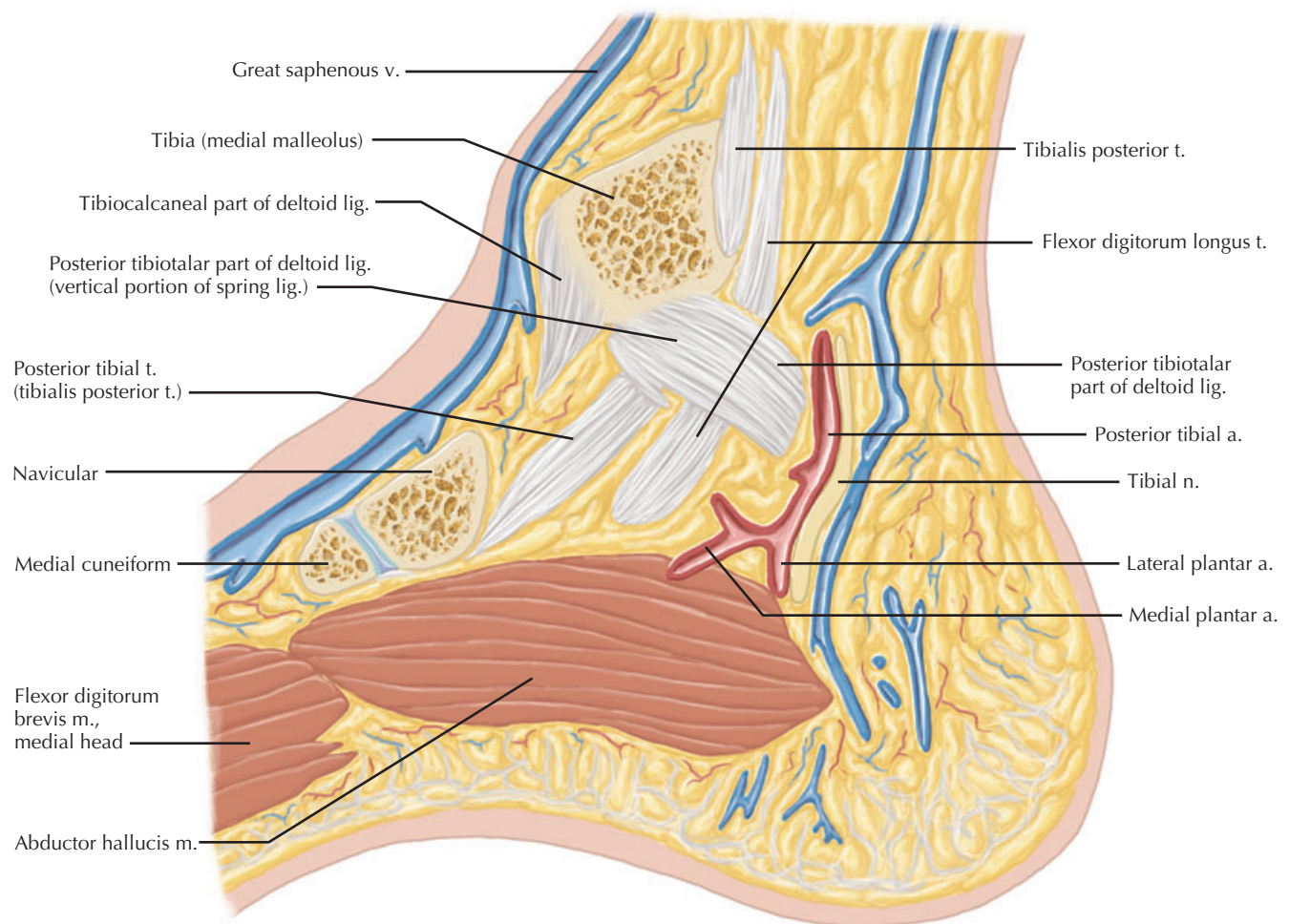


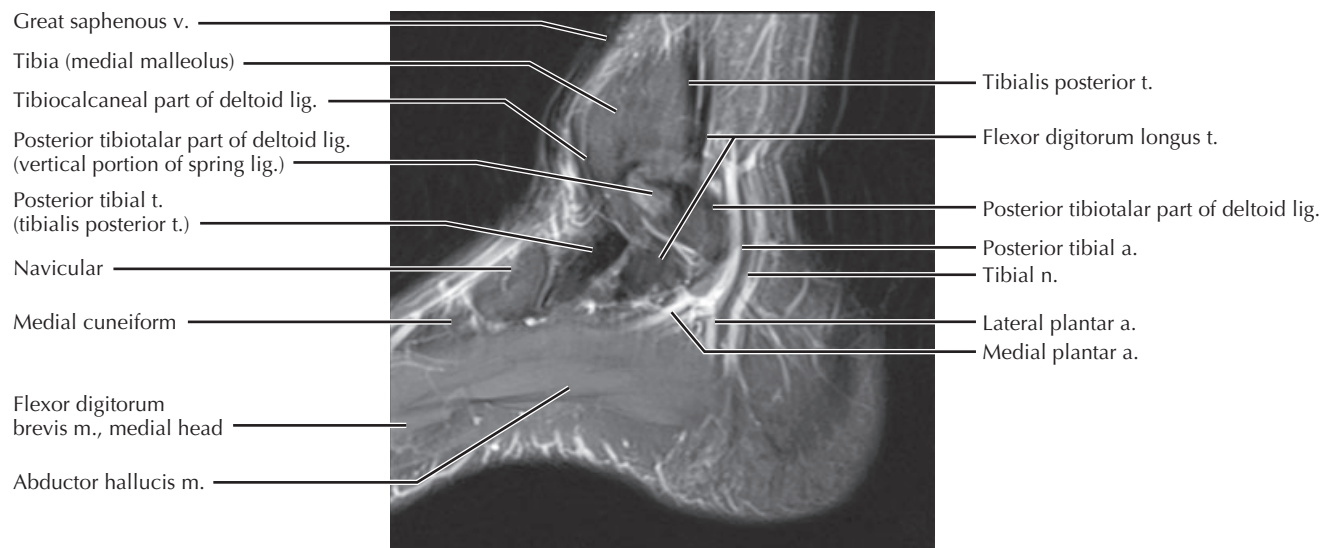
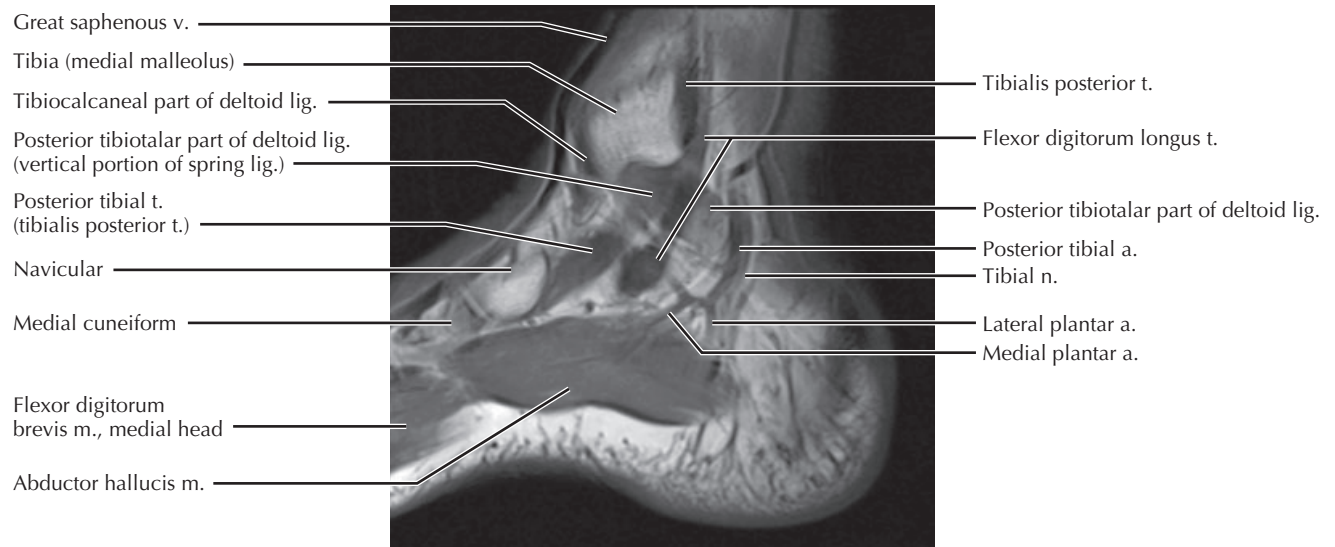
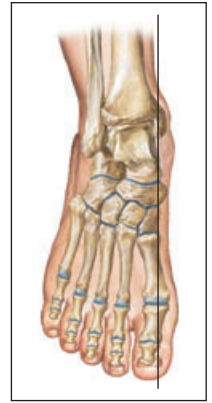


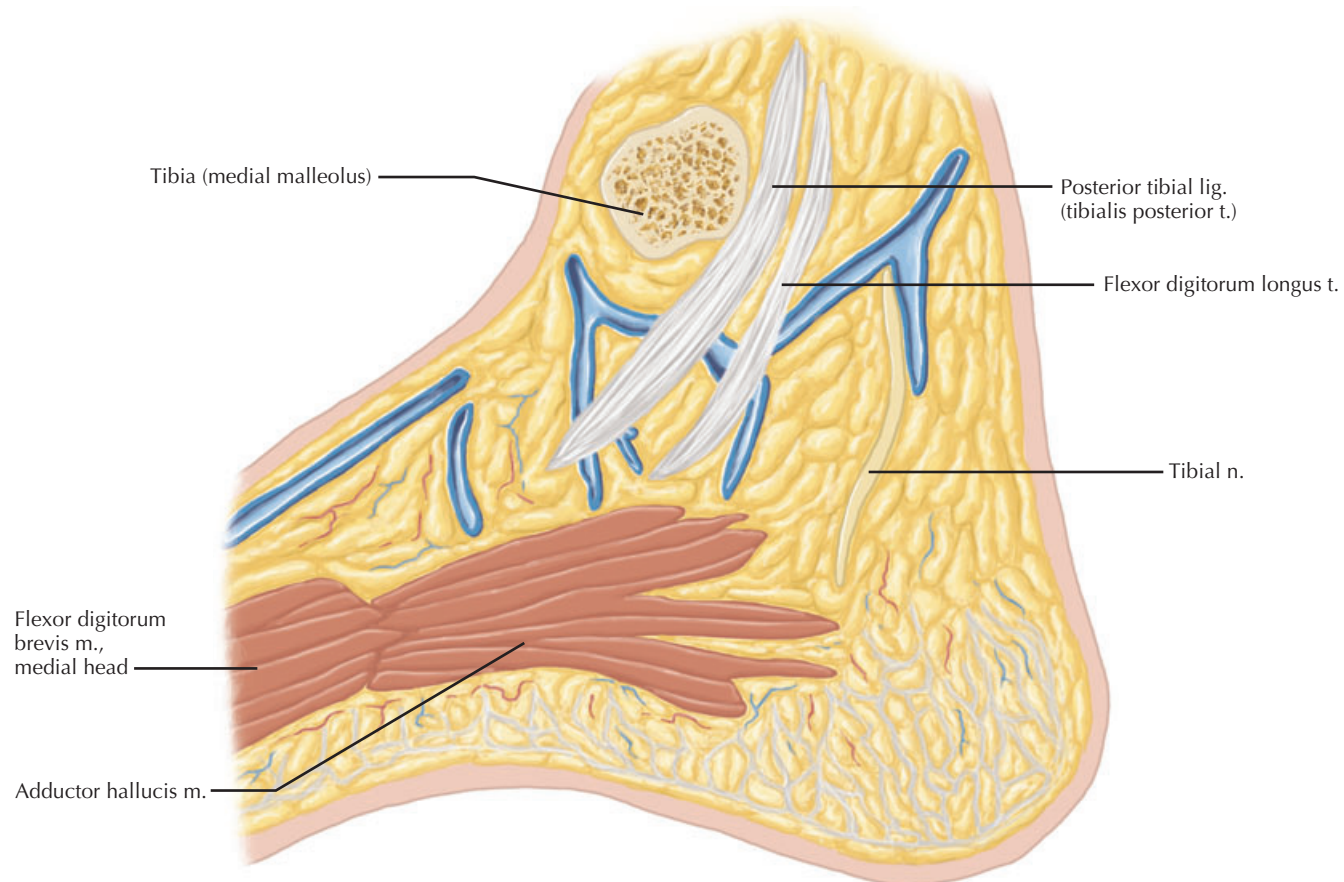


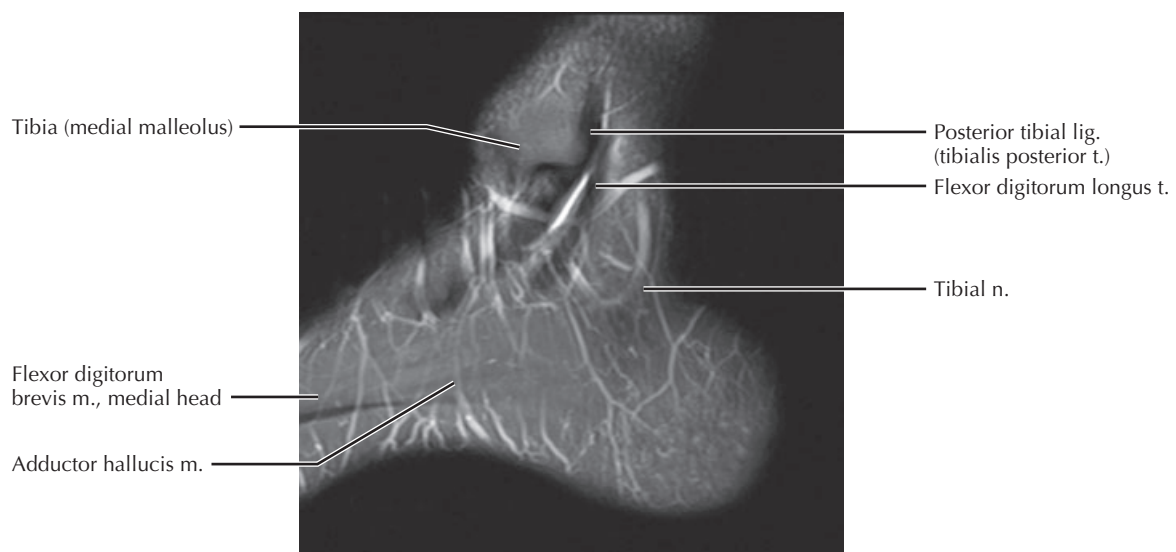
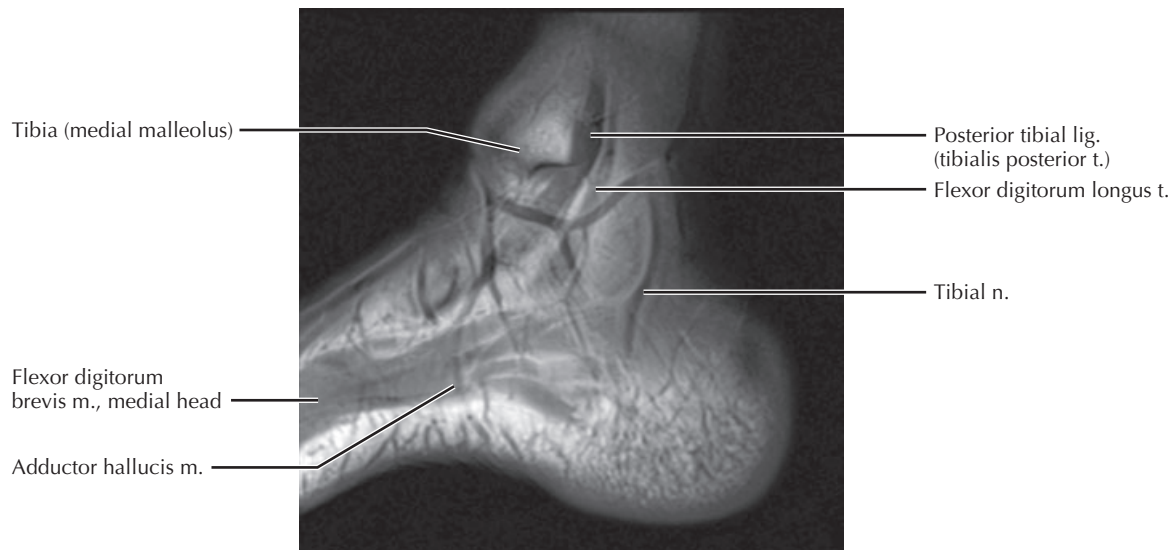
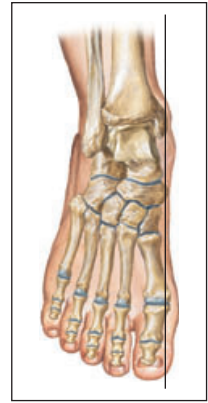










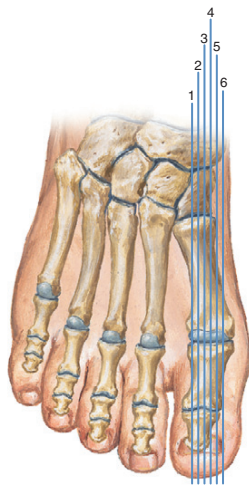


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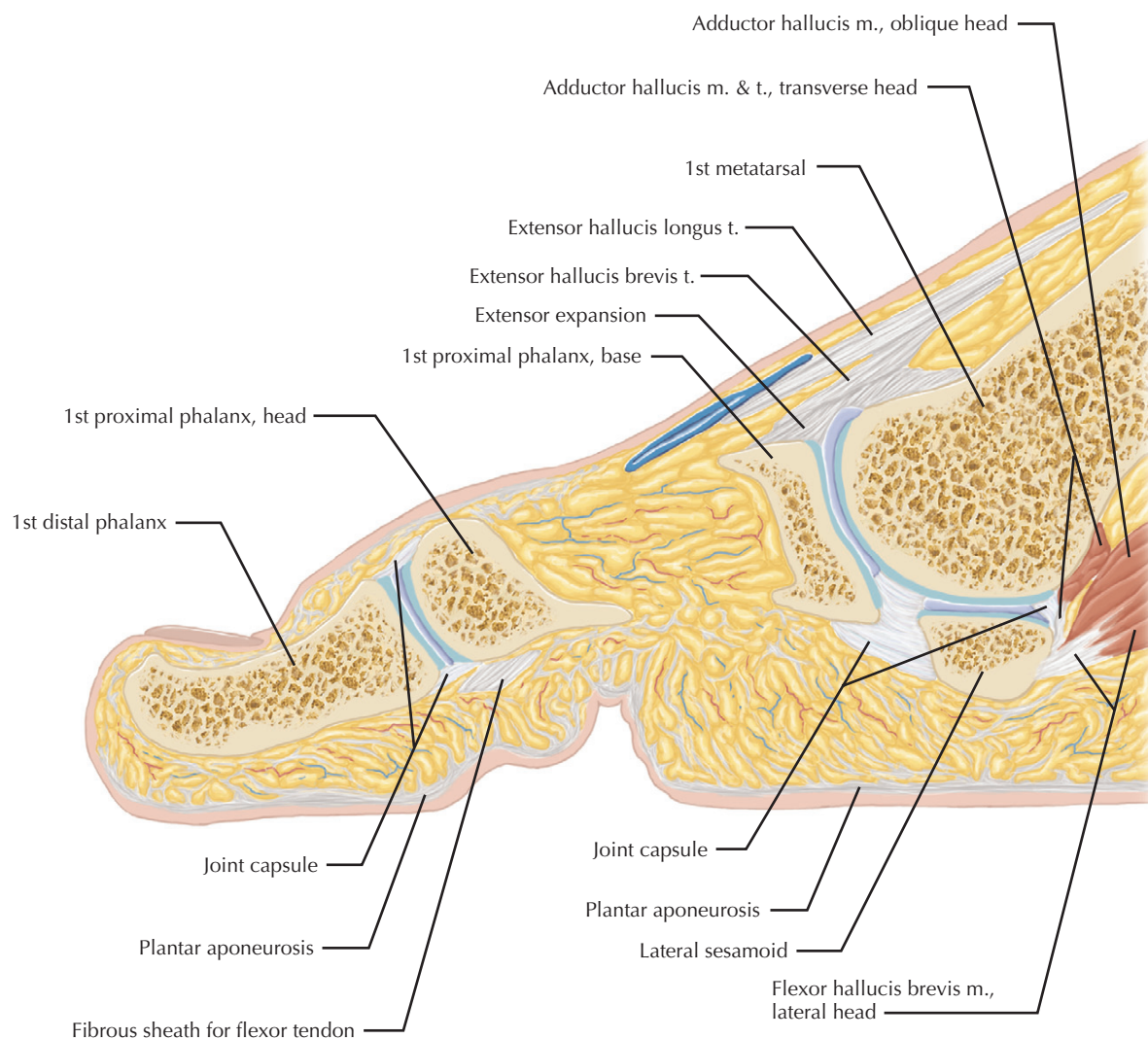
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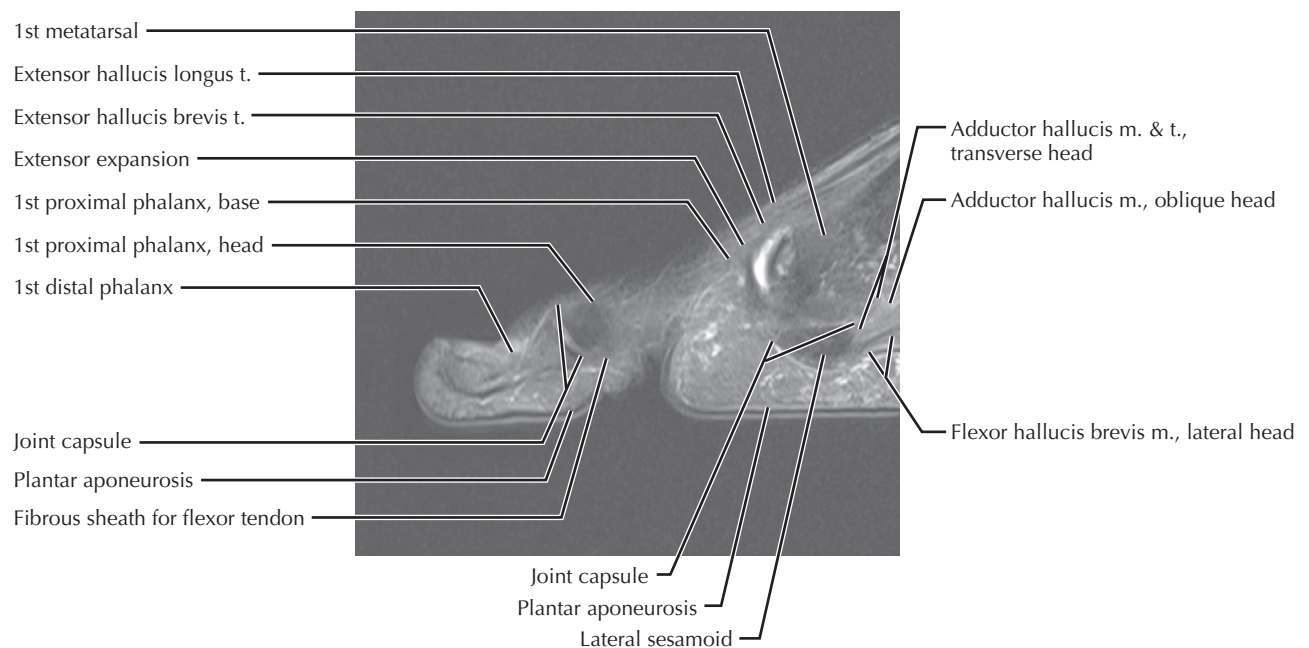
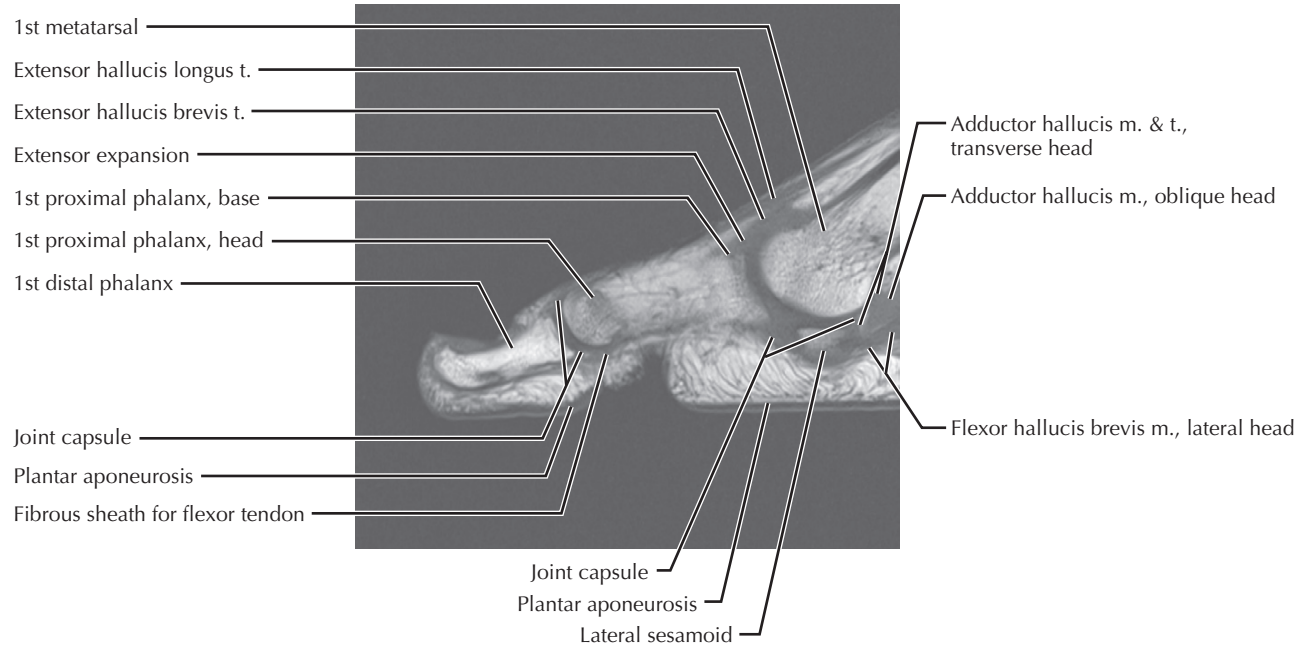
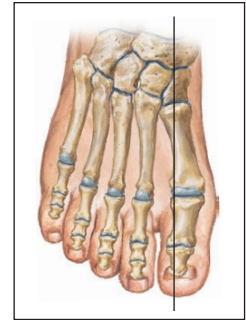
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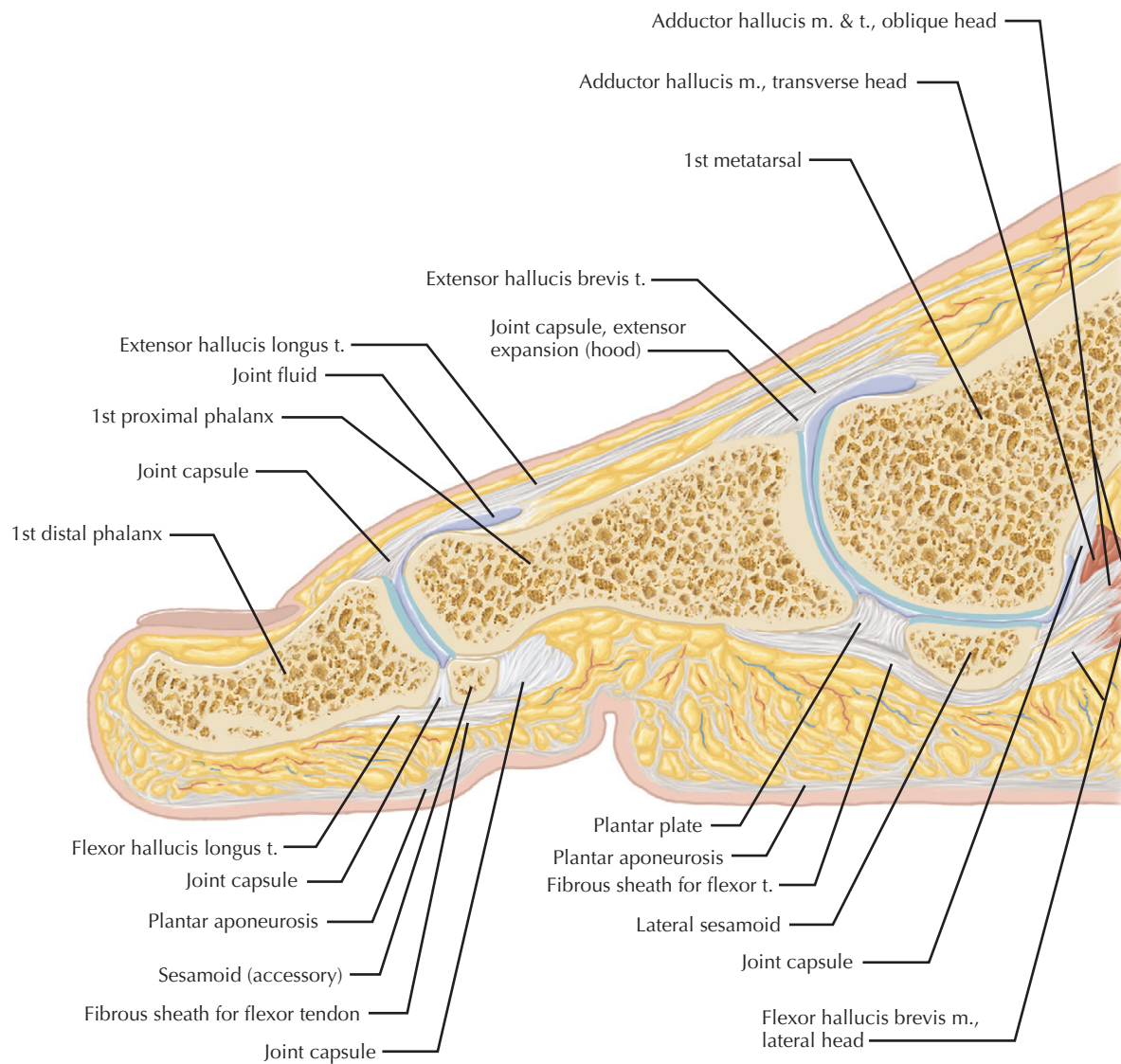
PLANTAR PLATE



SAGITTAL 602

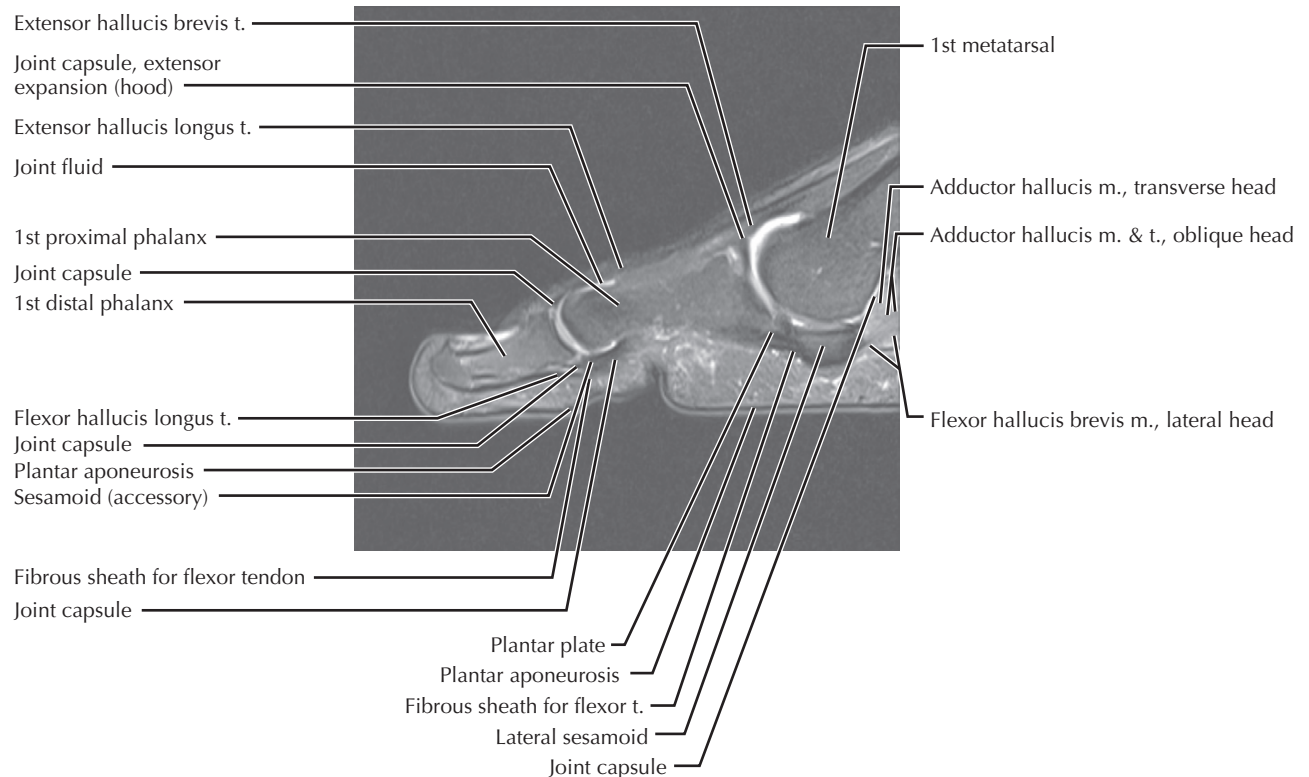
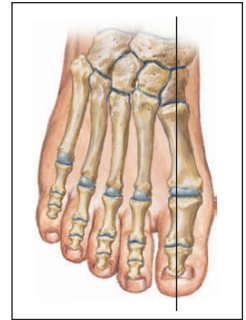
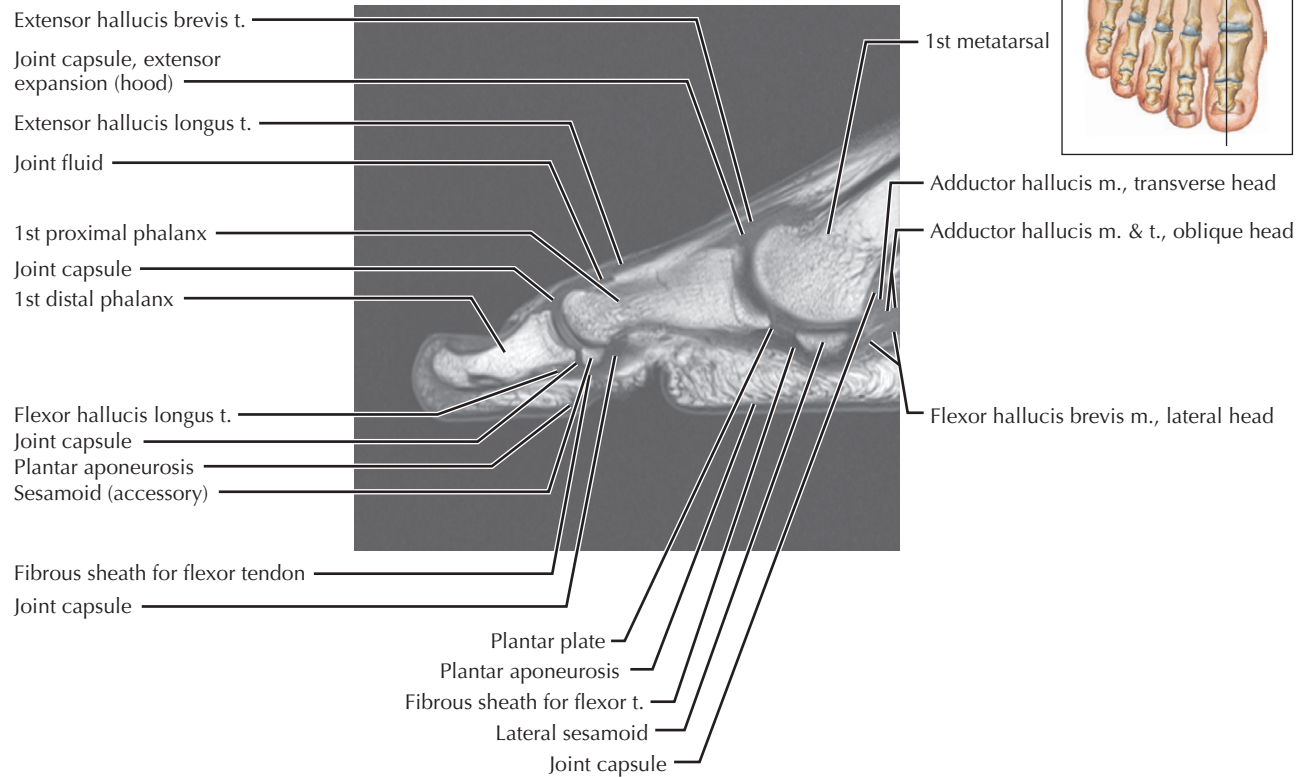


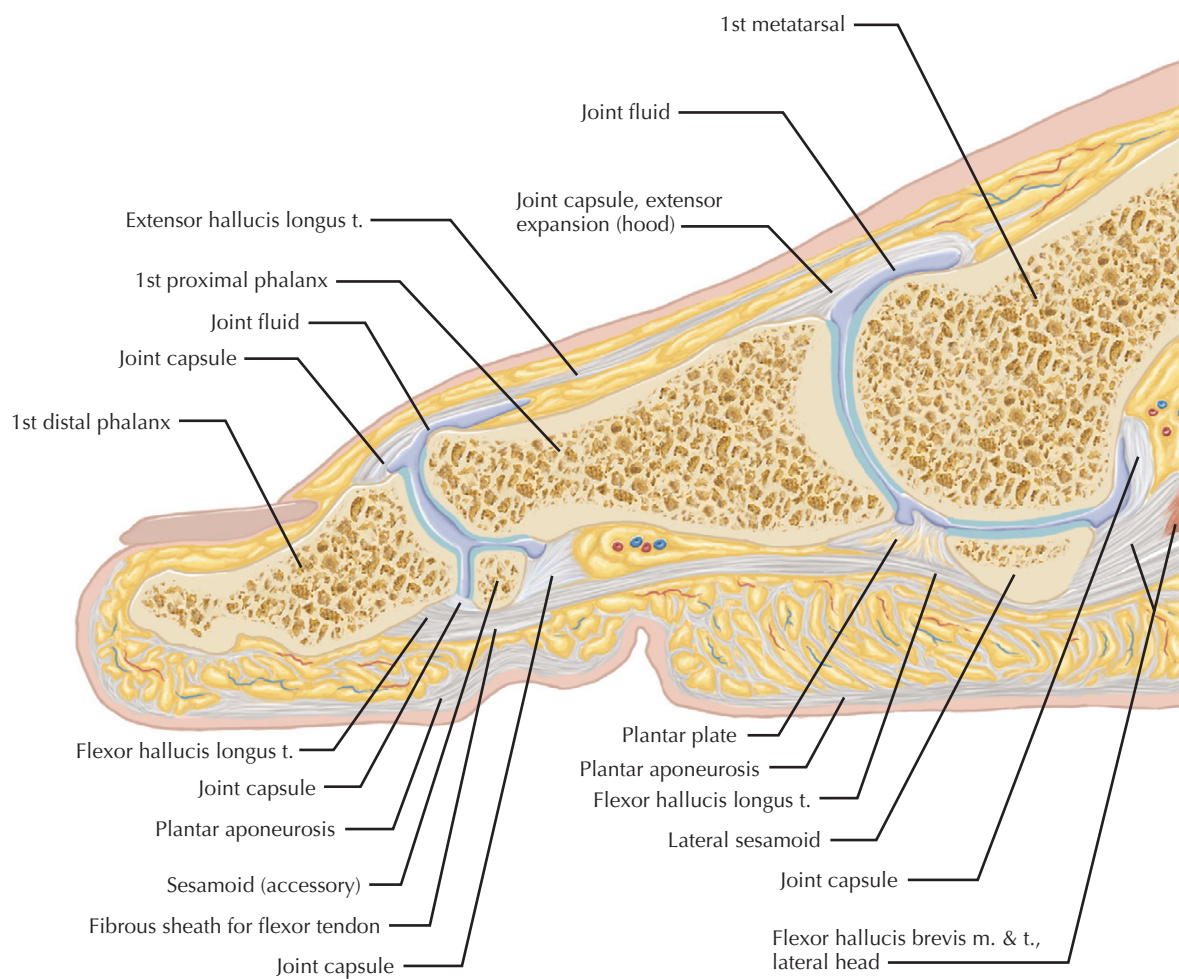


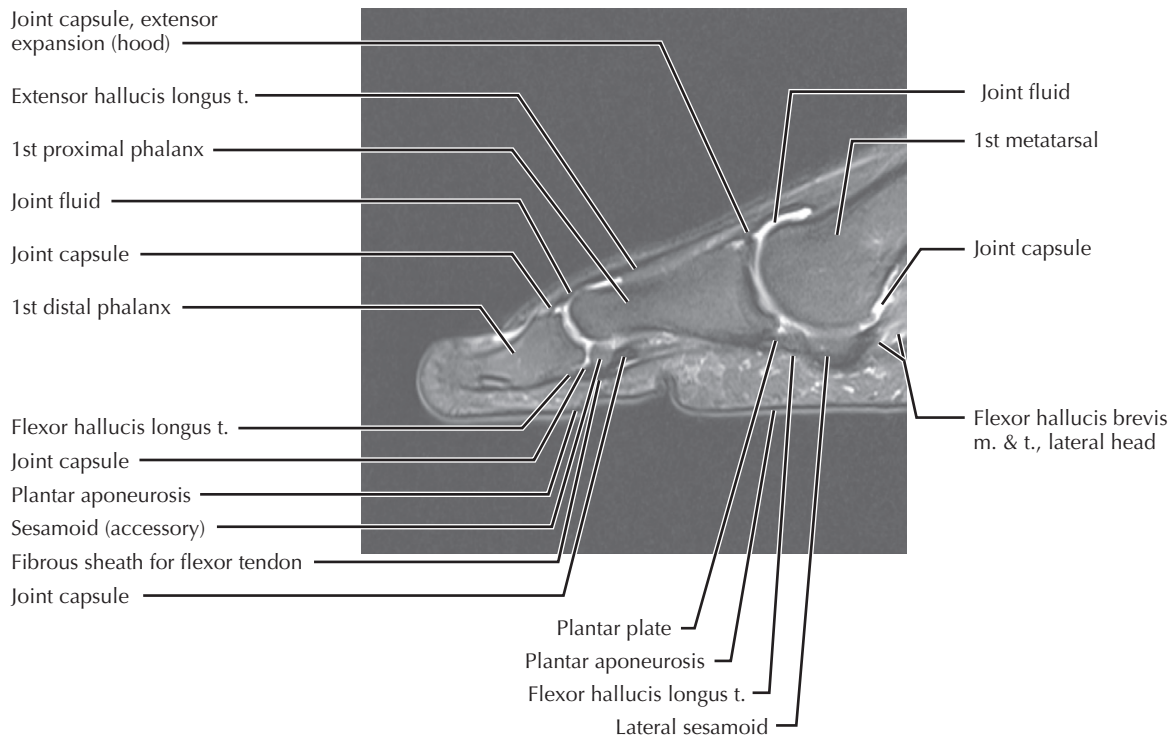
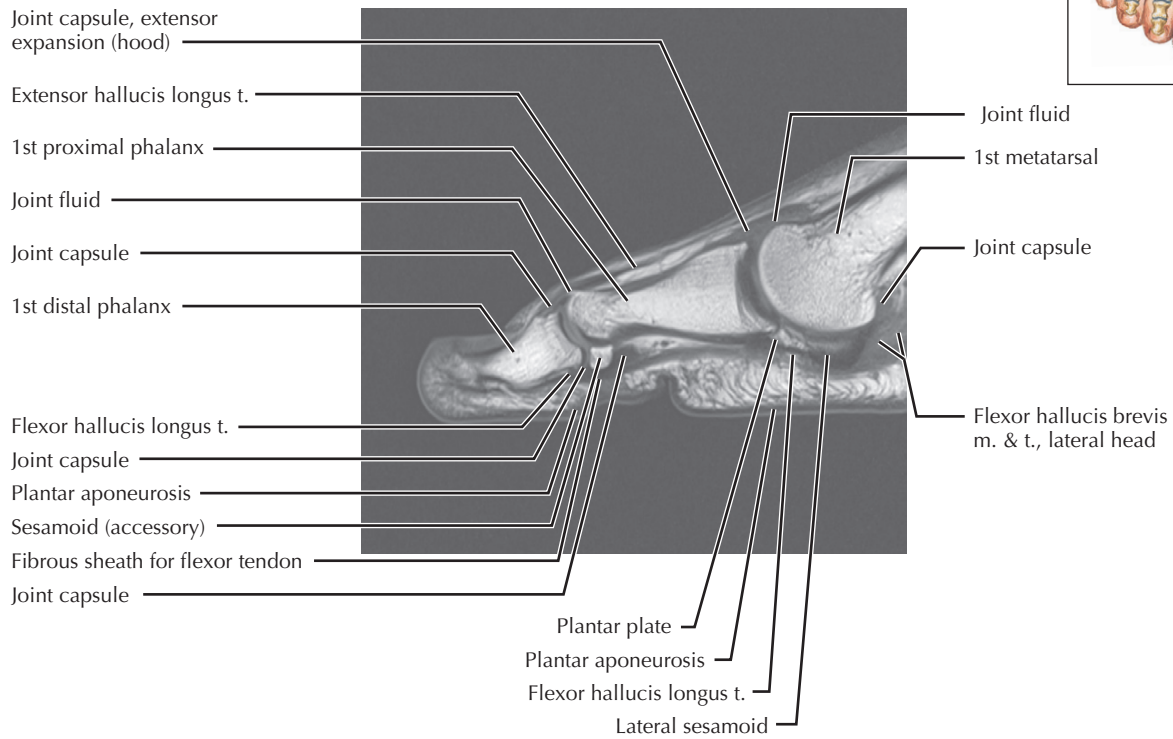
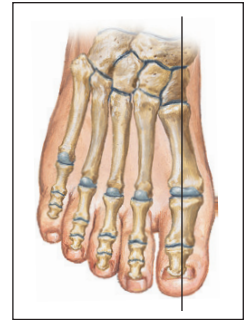


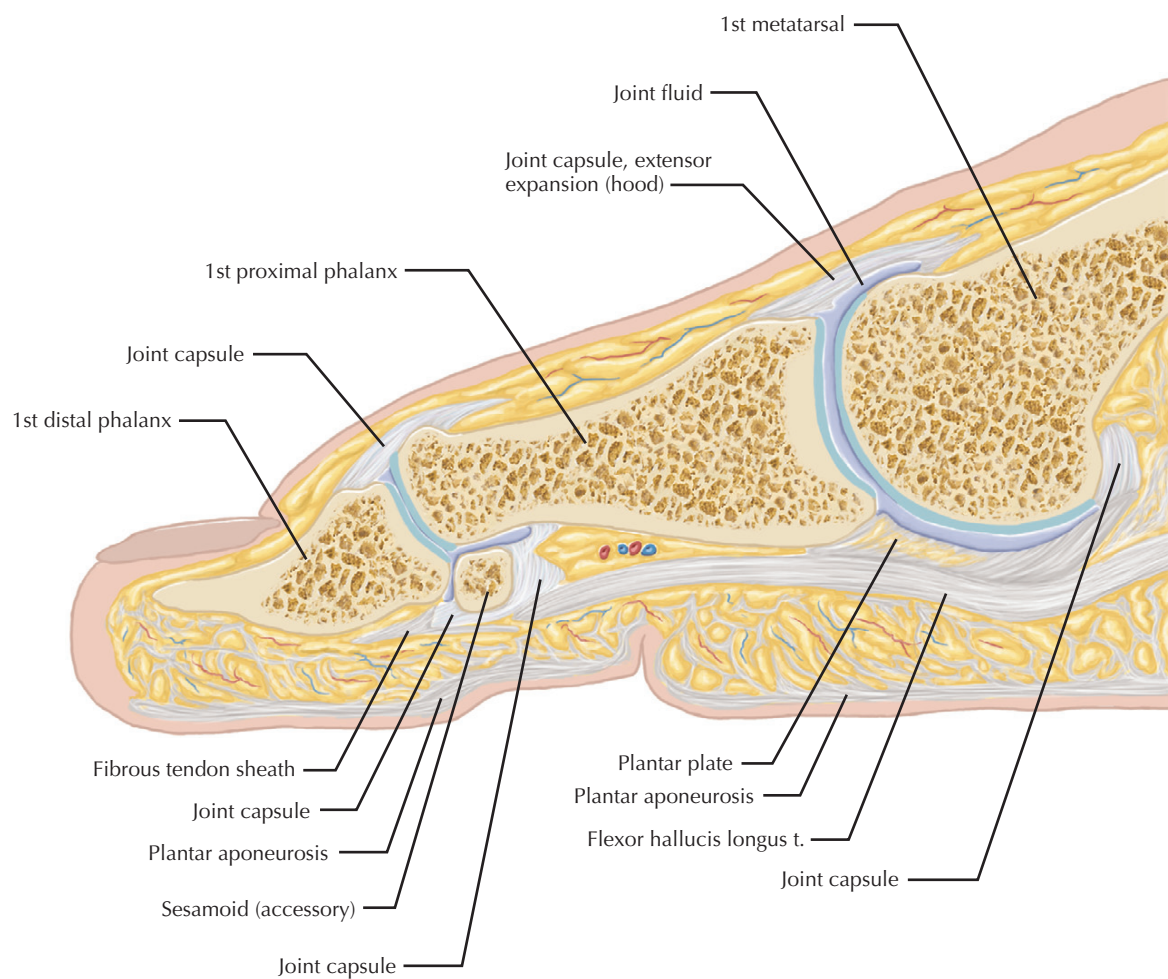
PATHOLOGIC PROCESS

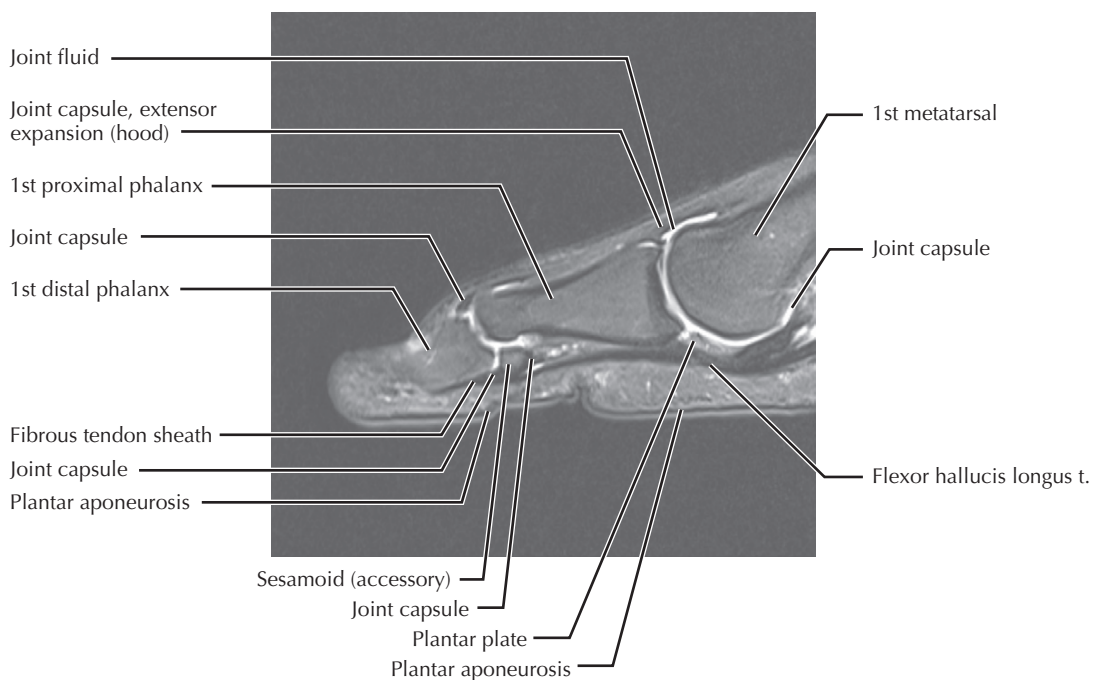
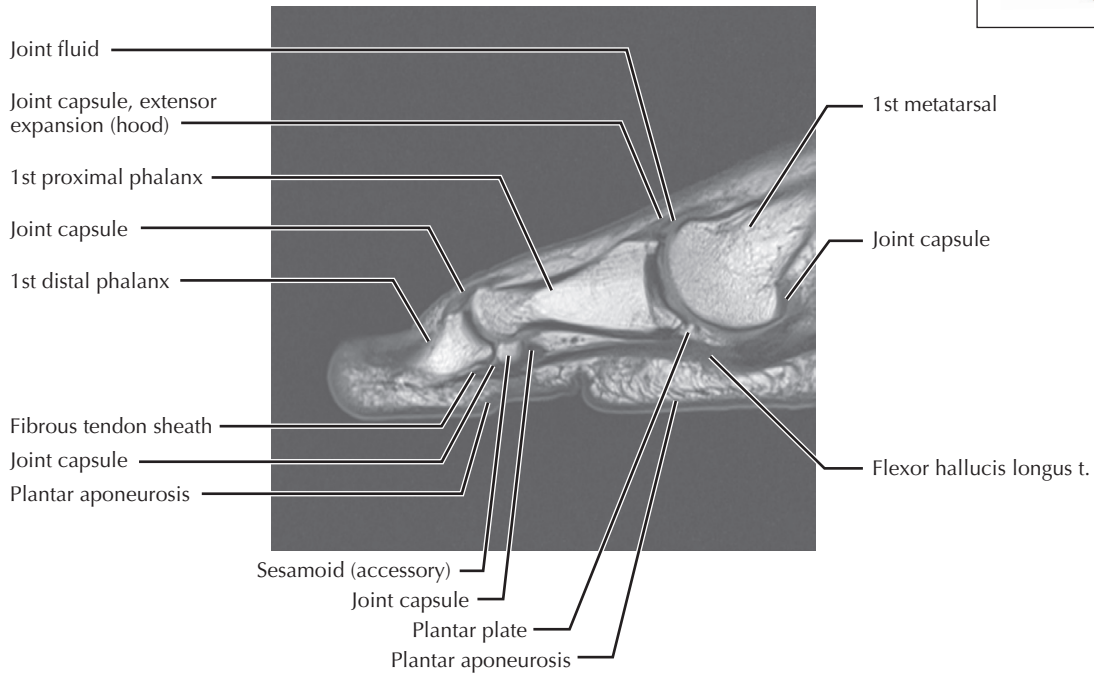
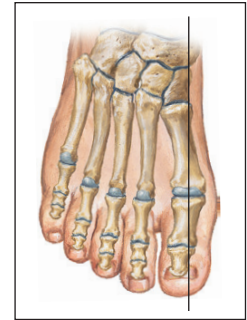
"Turf toe" is a result of hyperdorsiflexion of the first metatarsophalangeal joint, with disruption of the plantar capsular tissues. Sesamoid dislocation or subluxation may occur in conjunction with turf toe.

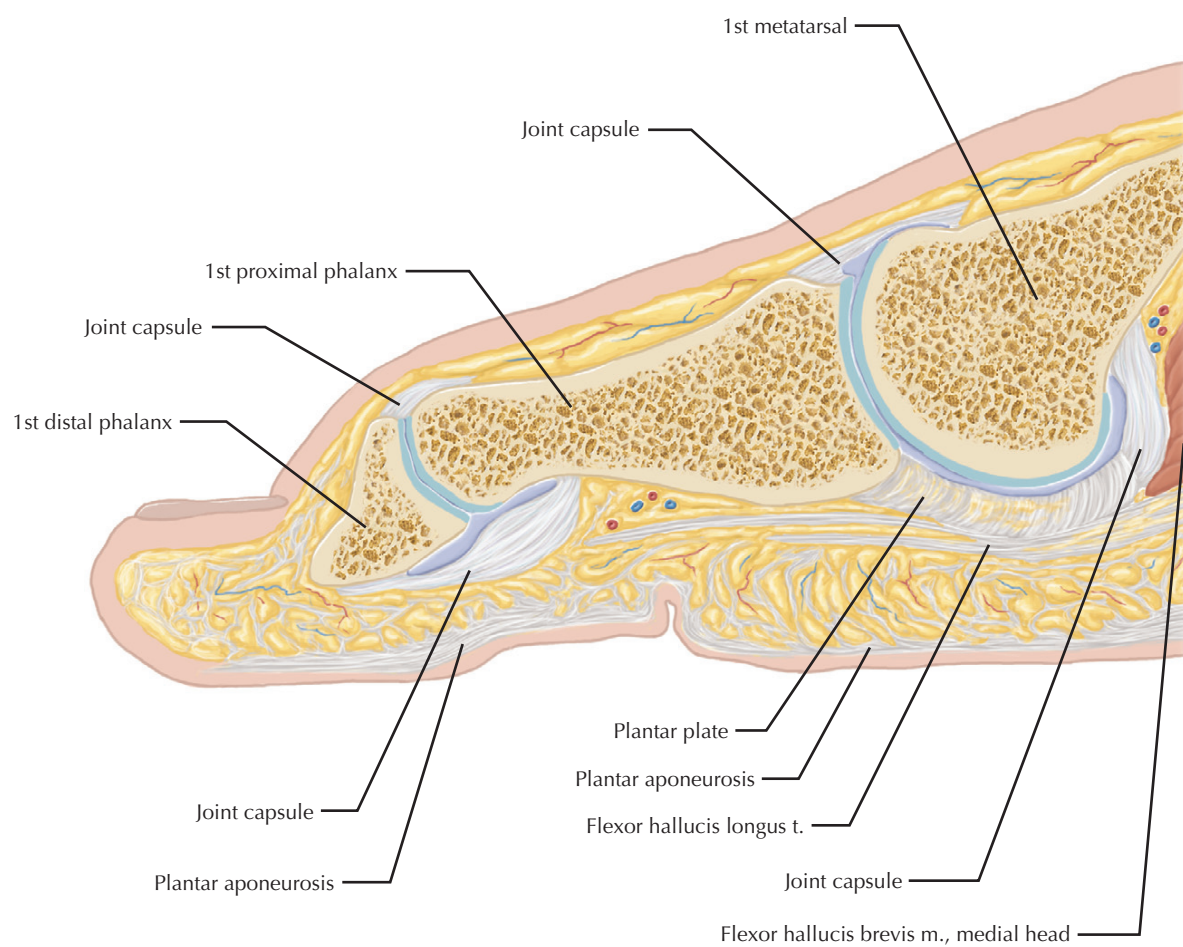


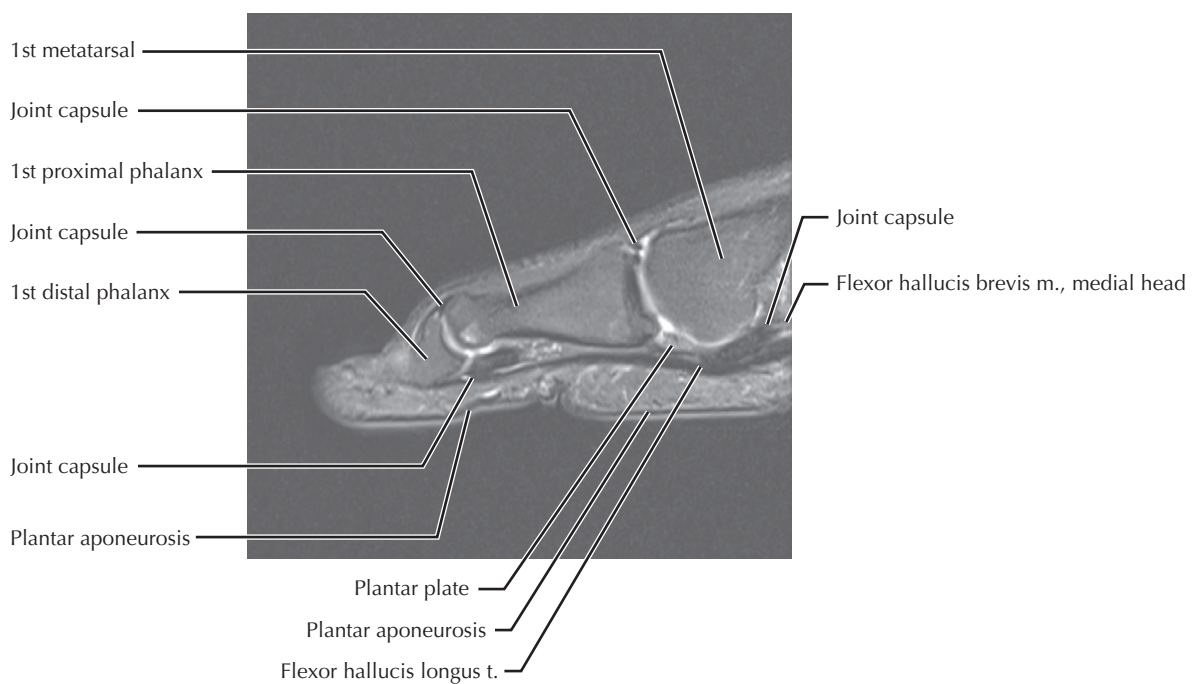
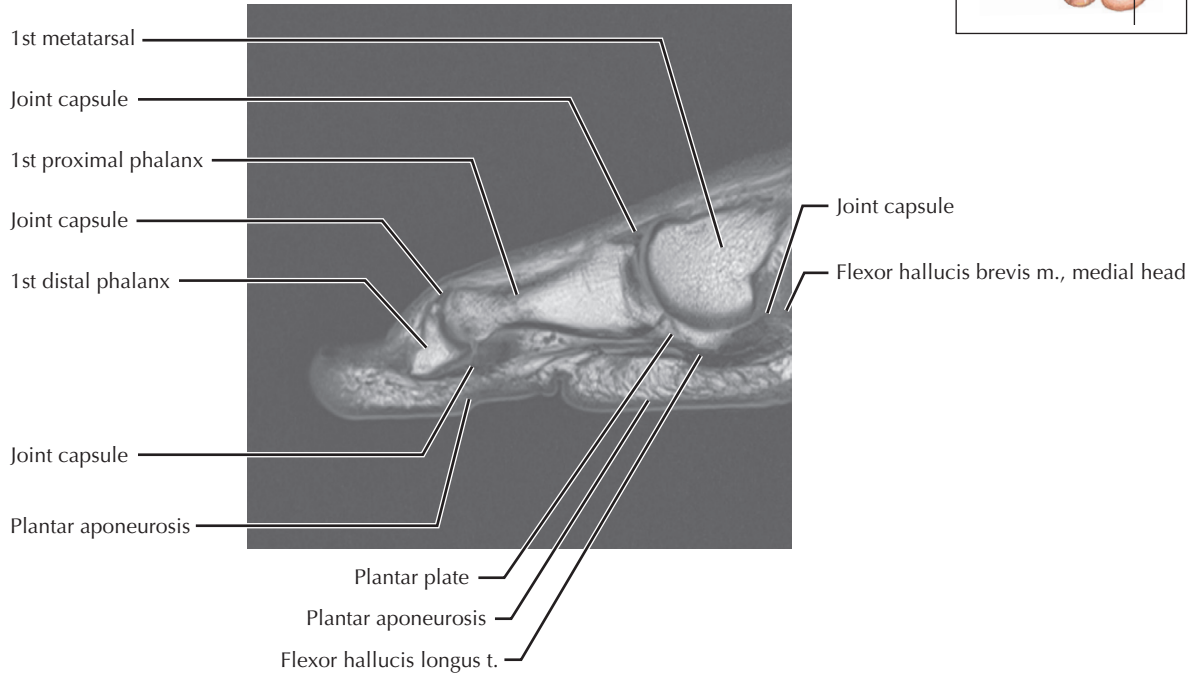
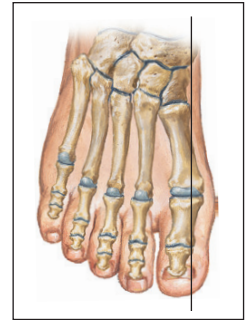


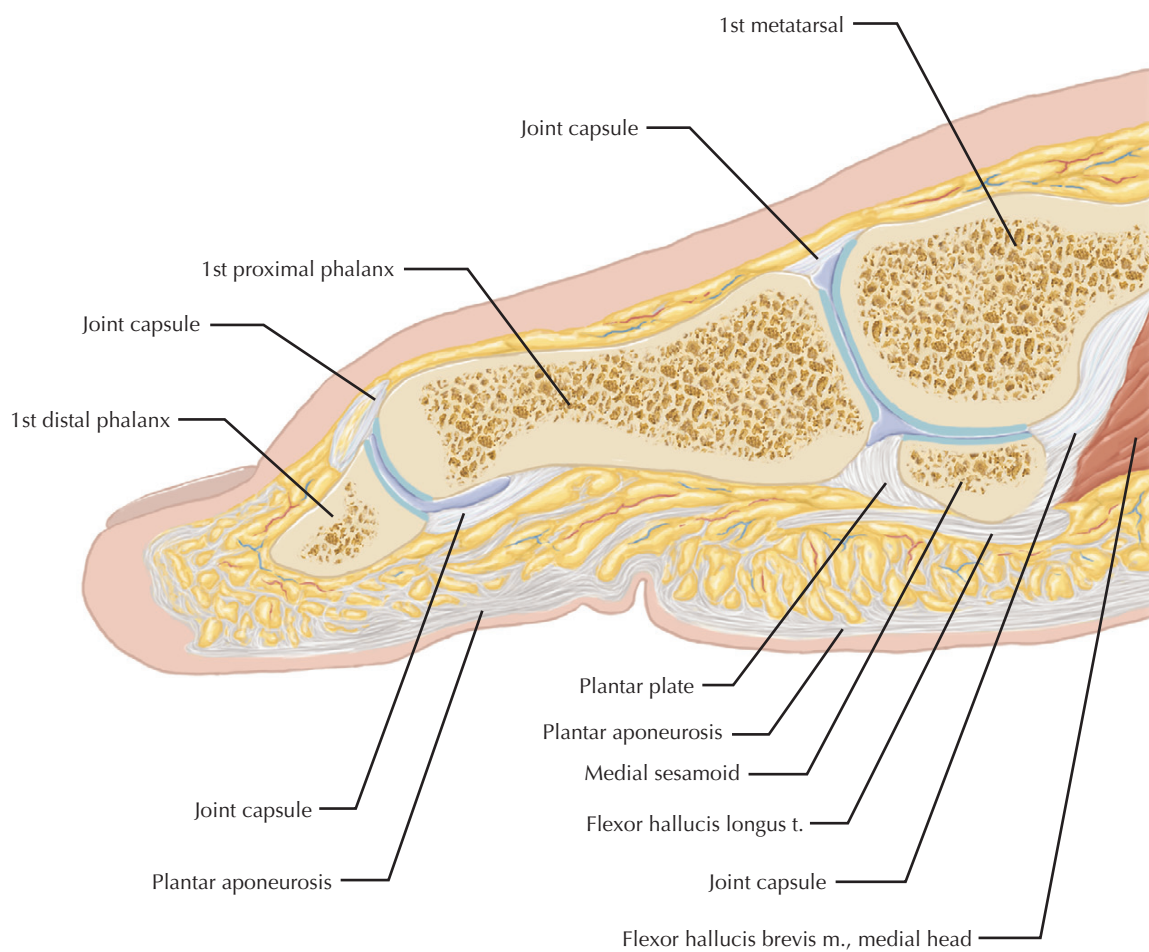


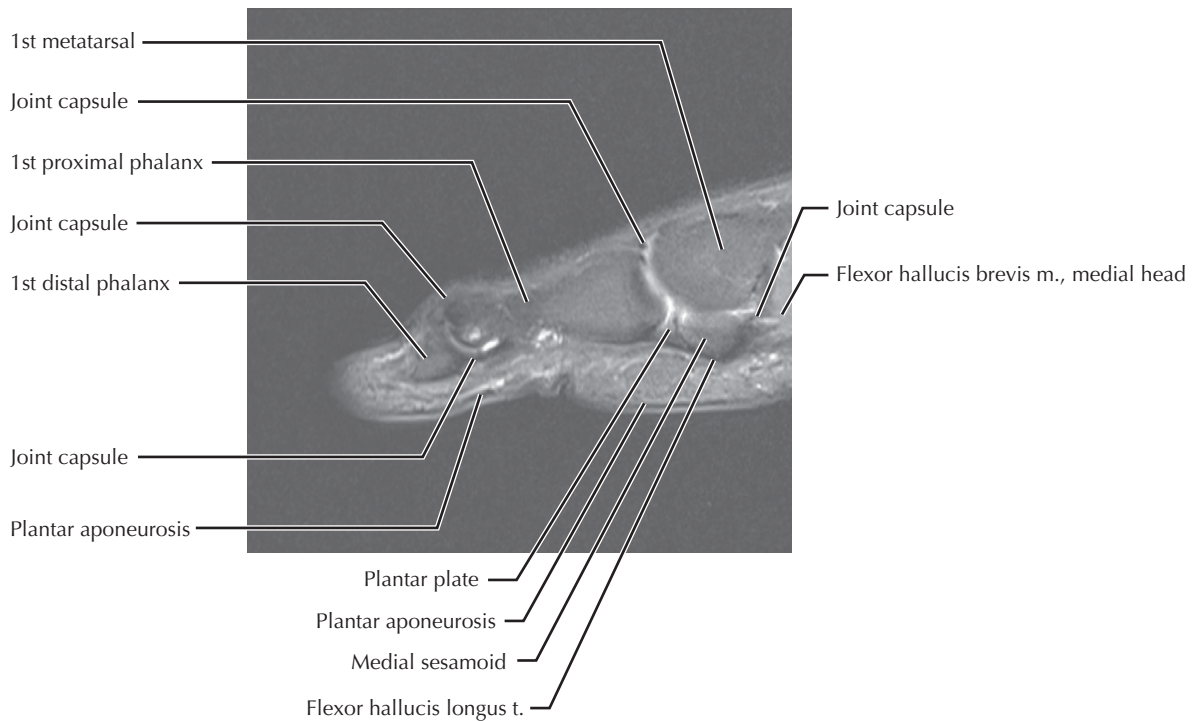
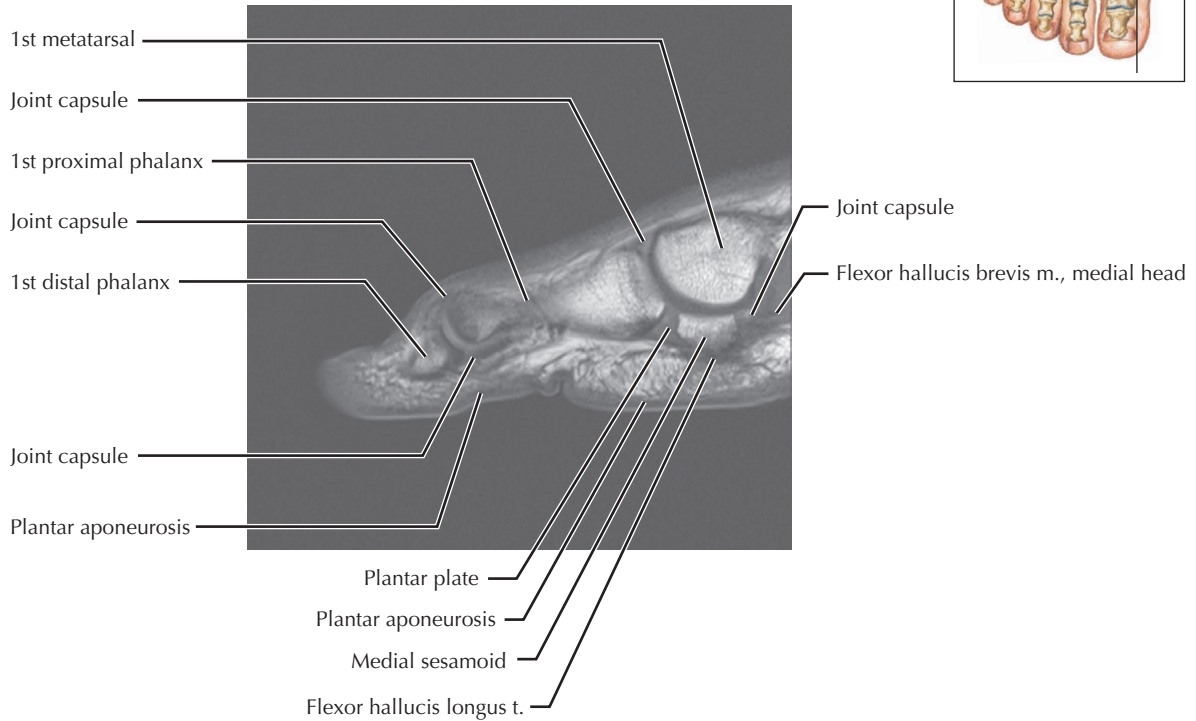
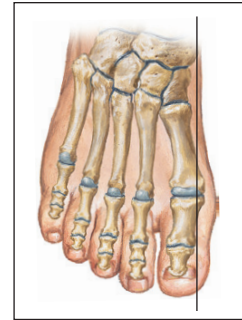












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