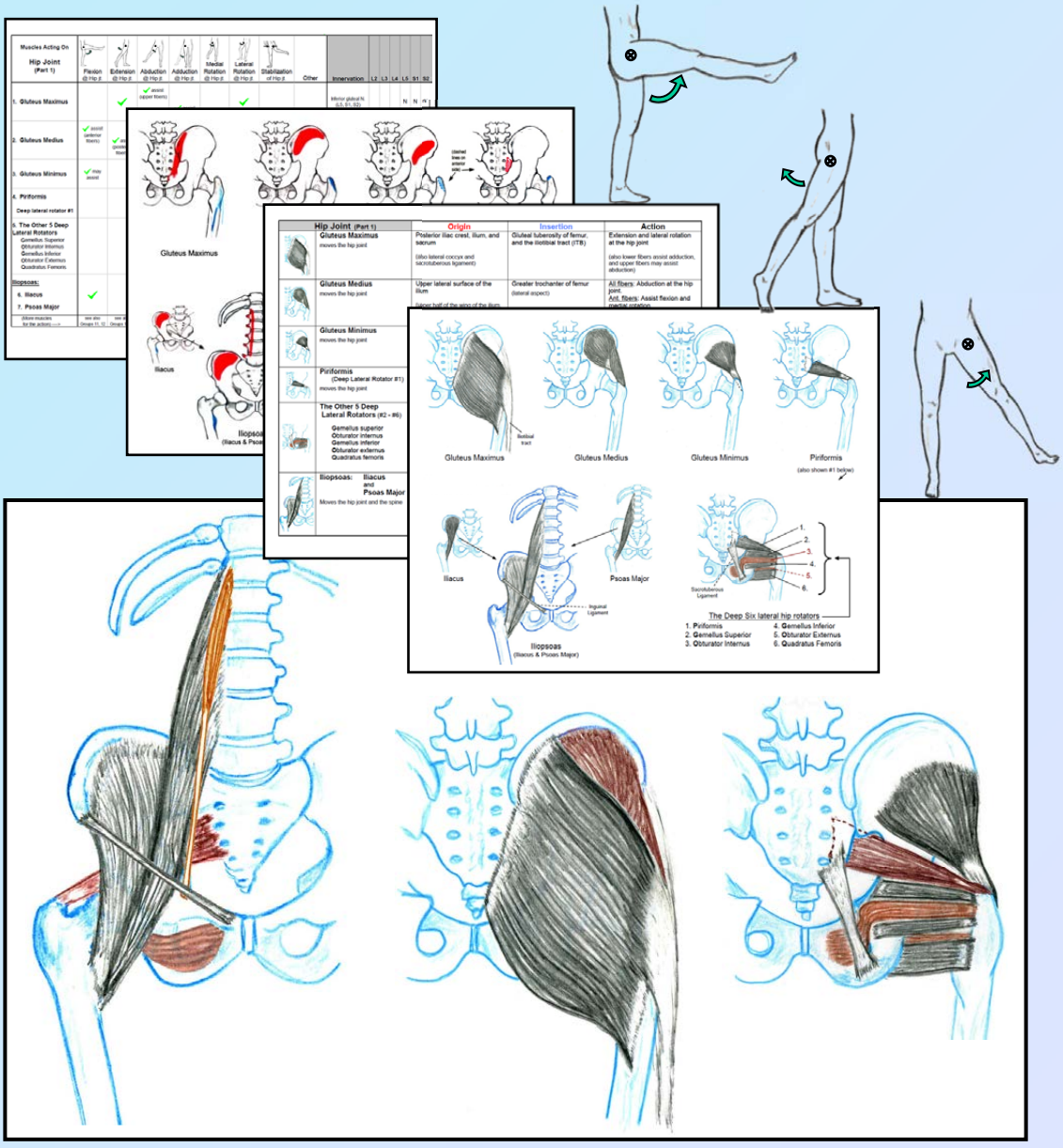
Enhanced E-book

Mastering Muscles & Movement

SECOND EDITION (enhanced E-book version)

A Brain-Friendly System for Learning Musculoskeletal Anatomy and Basic Kinesiology



David M. Campbell

Demonstration Copy

Mastering Muscles & Movement

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A Brain-Friendly System for Learning
Musculoskeletal Anatomy and Basic Kinesiology

Demonstration Copy

This is a special demonstration copy of Mastering Muscles & Movement. Some sections of the early chapters have been removed, and Chapter 6 and the Appendices present the muscles of the **Lower Extremity** in full. This will allow the reader to evaluate how the book is organized and how the interactive enhancements to the e-book work.

The following sections of the book are included.

- Front matter
- Chapters 1 and 2: First few pages of each
- Chapter 3: Included in full
- Chapter 4: Upper Extremity – not included
- Chapter 5: Axial Skeleton – not included
- Chapter 6: **Lower Extremity – Included in full**
- Chapter 7: Lower Extremity actions only
- Chapter 8: First few pages
- Appendix 1: **Lower Extremity** muscles only
- Appendix 2: **Lower Extremity** action pairs only
- Bibliography, Index

DW2

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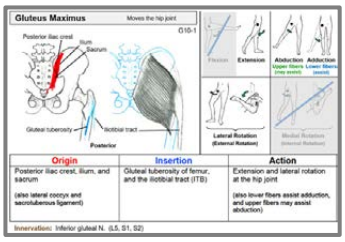
Musculoskeletal Anatomy and Basic Kinesiology

Enhanced E-book Version

The features below have been added to enhance the use of this e-book on a tablet or computer. **These features are <u>not</u> in the printed book.**

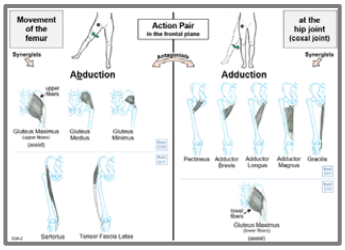
Appendix 1 – Muscle Detail Cards

A 175-page Appendix has been added that contains one-muscle-per-page "Detail Cards". These Cards are linked to the "A" Tables in Chapters 4, 5 and 6.



Appendix 2 – Action Pair Cards

A 75-page Appendix has been added to facilitate learning synergists & antagonists. These Cards are linked to the "B" Tables in Chapters 4, 5 and 6.



Navigation

Several features have been added to facilitate easy navigation to different parts of the book.

Main TOC | Chapter TOC | View Attachments | View Muscles

Please <u>read pages ix-xvi</u> "User Guide" for detailed information about the enhancements to this e-book.

Skip to Table of Contents

What professionals are saying about Mastering Muscles & Movement

"Mastering Muscles & Movement makes human anatomy and kinesiology highly accessible to the reader. The information is presented in a format that accelerates the learning process and creates a long-term functional memory for the student. Accompanied with the study cards, Mastering Muscles & Movement makes learning fun and simple. I highly recommend this book for undergraduate to post-graduate students as well as practitioners in the field of healing arts and musculoskeletal medicine."

Avilio Halme, MPT, COMS

"Mastering Muscles and Movement presents an innovative and practical learning tool for students of Anatomy and Kinesiology. It is the first book that I have seen that actually demonstrates the steps to successful memorization and information retention. It gives you the sense that you are looking through the notes of the best student in class and learning their secret code. The simple, quick access to detailed content and the excellent selection of study tools will make this a book that students reach for first."

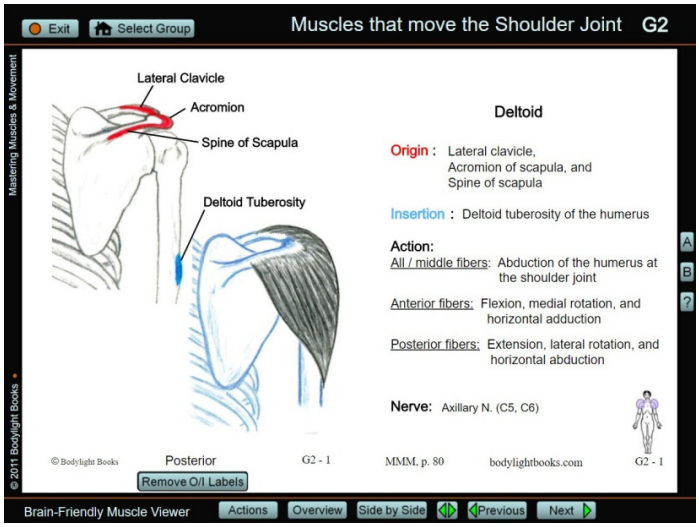
Ellen K. Geary MS, LAc

"Mastering Muscles and Movement outshines every other learning guide I have seen, and it is the ONLY book offering a system that maximizes the learning potential for every student of anatomy, kinesiology, massage therapy, physical therapy, etc. The layout, images, muscle groupings, and tables included in the system are pure genius. The author provides helpful online learning resources that add power and efficiency to the system. The clear and concise images allow for quick referencing of material. I'm impressed with the accuracy and level of detail included on innervation, attachment sites, actions, joints, and ligaments. There is so much information packed into this gem of a book! Additionally, it includes sections on the muscles of the face and jaw as well as the pelvic floor, two areas that are often overlooked in kinesiology textbooks. Mastering Muscles and Movement is truly in a class of its own and it is my first choice for instructing kinesiology courses and as a reference guide in my clinical practice."

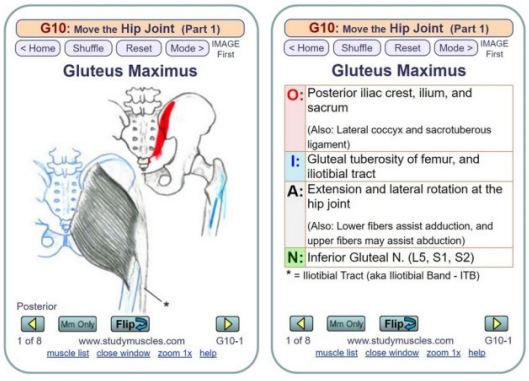
Wren McLaughlin, PT, DPT, PRC, WCS, MS

www.studymuscles.com

Interactive apps and downloadable support materials are available at the companion website.



Brain-Friendly Muscle Viewer App



Flashcard App

Also…

Bony Landmark Flashcards
Study Questions
Interactive Atlas of Bones & Landmarks
Muscle Layering Slide Shows
And more!

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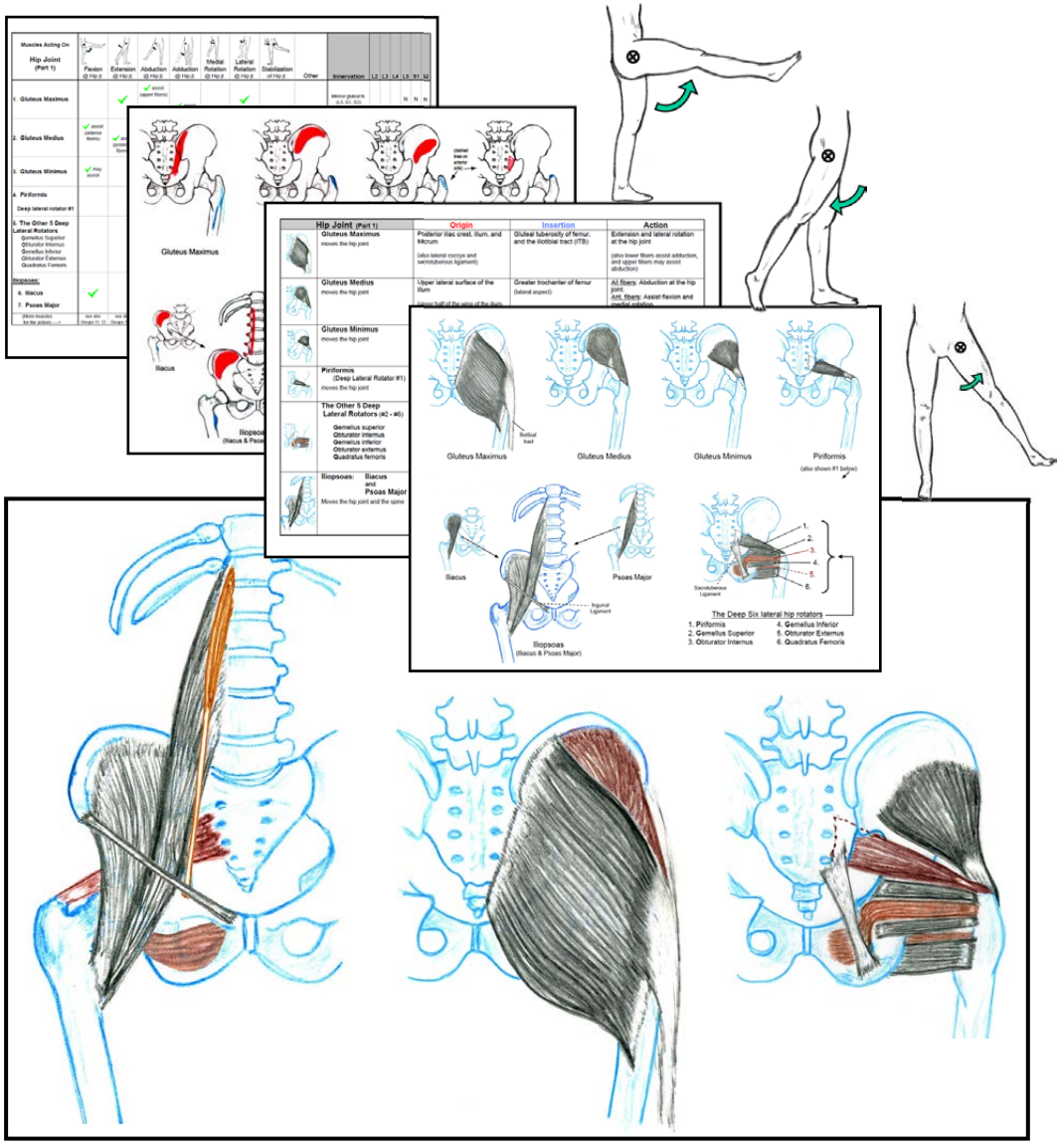

Written and illustrated by **David M. Campbell**

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A Brain-Friendly System for Learning Musculoskeletal Anatomy and Basic Kinesiology

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Preface

Mastering Muscles & Movement – A Brain-Friendly System for Learning Musculoskeletal Anatomy and Basic Kinesiology, provides a unique, strategically organized approach for learning the muscles, bones, joints, movements, and motor innervation of the human body. As the subtitle implies, research in brain-based learning has been richly applied in the design of this book to facilitate understanding, memorization, and mastery of this body of knowledge.

Approach

This book provides a complete set of information for the study of musculoskeletal anatomy and basic kinesiology. While there are many books available that cover the subject, **Mastering Muscles & Movement** (MM&M) presents a fresh *approach* that is designed to leverage the natural ways the brain observes, learns, and recalls this type of information. Rather than employing the usual one-muscle-per-page format, this book treats *groups* of muscles as "movement families" and presents them in a way that provides a rich visual, verbal, and relational learning environment.

The result is a truly **brain-friendly** experience for the student. The myriad details and inter-relationships are easily recognized in simple and natural ways by the innovative arrangement of the muscle information on each page and from page-to-page. The reader comfortably stays aware of the bigger picture while studying any one item, easily compares and contrasts related features and facts, and is enabled to structure study time to play to strengths or to eliminate weaknesses.

Benefits

Some benefits of this approach are:

- Isolates and supports learning and repetition from many directions: visual, verbal, relational.
- Supports the brain in doing what it does best: Consistently encourages the reader, simply by the way the material is laid out and sized on the pages, to compare and contrast, see patterns, perceive interrelationships, and "come at" the information from different directions.
- Muscle and bone information and illustrations are arranged to allow easy and repetitive self-testing while studying.
- Precise and uncluttered presentation clarifies common misunderstandings, and illuminates facts and relationships that are often overlooked.
- While studying, the information is anchored in the brain with multiple "hooks", providing rich cross-neuronal connections that are important for easier recall of details and relationships.
- Material is clearly organized throughout, and has visual cues that always keep the reader aware of where they are within the greater body of knowledge contained in the book.

Audience

The first edition of MM&M has been successfully utilized by students learning massage therapy, yoga instruction, physical therapy, Pilates instruction, athletic training, and dance, as well as students in college undergraduate functional anatomy and anatomical kinesiology classes. This new second edition has incorporated many improvements suggested by students and instructors over the years. The format has been redesigned and new information and illustrations added, while maintaining the original brain-friendly organization and approach that has proved useful in the past.

For many students MM&M has served as a **course textbook**, while in other educational programs it has proved valuable as **supplemental material** (depending on the level of specialization required for the course). In addition, this book has served as an easily accessible **reference** on the shelf of practicing professionals. Finally, because of its clarity of organization and simplicity of approach, it is an excellent **quick-review** book for students who are preparing for examination, and for practicing professionals who want to refresh their knowledge before attending continuing education classes.

Organization

MM&M is organized in a way that flows through a course of study of the musculoskeletal system. The clearly delineated segments allow the reader to focus on a specific portion of information while staying oriented within the whole. Note that the muscle groups in Chapters 4-6 can be taught in any order. Each presentation is independent of the others, allowing instructors to structure their class to their preference.

Chapter 1 – Basic Information provides foundational information for the study of muscles and movement. It gives definitions of terms and establishes a system for describing and analyzing body movement. Basic information is provided for the main body systems that are related to the study of kinesiology: bones, joints, muscles, nerves, and fascia. Finally, it introduces some important kinesiology concepts.

Chapter 2 – Bones, Bony Landmarks, Joints, and Ligaments employs an atlas format to present detailed features of all the bones of the body. This provides a central location that can be quickly referred to while proceeding through learning the muscles of the body later in the book. It gives information about the overall skeleton, as well as details about each individual bone. Master lists of the joints of the body and ligaments of the body are also included. Note that detailed illustrations of the joints and ligaments are provided at the beginning of chapters 4 through 6 as appropriate for the upper extremity, axial skeleton and lower extremity divisions of the body.

Chapter 3 – Using the Brain-Friendly System to Optimize Your Learning is a must-read to prepare the reader to fully utilize the brain-friendly approach employed to describe all the muscles in Chapters 4, 5 and 6. Understanding how to proceed is an essential step to allow the learner to truly master the muscles and movements of the body. Chapter 3 also outlines the types of information to learn and how that information is used in practical applications.

Chapters 4, 5, and 6 provide the bulk of the muscles and movement information in a special format that emphasizes constantly comparing and contrasting facts and pictures. The unique organization allows the reader to comfortably understand, memorize and recall the muscles of the body and study their actions and innervations. This approach helps the brain build a rich neuronal network that will lead to true mastery of the subject.

Chapters 7 – Summary Tables provides a handy presentation that can be quickly referenced once the reader has learned all the muscles in chapters 4, 5, and 6. The tables also reconcile some of the overlaps or gaps that were necessarily created by dividing the muscles into 13 groups for chapters 4-6 (especially multi-joint muscles). These tables are very useful when assessing and analyzing a client's movement patterns or posture, when performing or teaching stretching or strengthening exercises, or when reviewing material prior to an exam. Chapter 7 also includes a comprehensive master table of the motor innervation of the entire musculoskeletal system of the body.

Chapter 8 – Study Aids gives a summary of the ancillary materials currently available on the companion website. These include downloadable PDF files and interactive apps, The end of the chapter also includes some general purpose worksheets that can be photocopied by the purchaser of the book for their personal use. Note that the online materials are likely to evolve over time, given the dynamic nature of the internet.

Ancillary Materials

Online materials based on the text and illustrations in ***Mastering Muscles & Movement*** are available at www.studymuscles.com to support both students and instructors.

Student materials include muscle and bone flashcards, muscle and bony landmark practice sheets, synergist/antagonist practice sheets, muscle tickets, study questions and other study aids. The study tools also include a muscle flashcard app and the **Brain-Friendly Muscle Viewer**, which is an interactive app that presents all the muscles in a style that matches the organization of the textbook.

The instructor resources include downloadable Powerpoint presentations, homework and quiz templates, study questions with keys, and other materials.

Mastering Muscles & Movement

Contents

Muscles – List by Group

Muscles are placed in groups based on the bones and joints they *move* as they contract.

----- Upper Extremity -----
(Chapter 4)

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Pectoralis minor
Subclavius

Group 2 – Shoulder Joint
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Pectoralis major
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Latissimus dorsi
Teres major

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Brachialis
Brachioradialis
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Pronator quadratus
Triceps brachii
Anconeus
Supinator

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9-106
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Palmaris longus
Flexor carpi ulnaris
Flexor digitorum superfi
Flexor digitorum profu
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Extensor carpi rad evis
Extensor carpi u
Extensor digit
Extensor ind

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Flexor pollicis brevis
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Adductor pollicis
Abductor pollicis brevis
Abductor pollicis longus
Extensor pollicis longus
Extensor pollicis brevis

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Intrinsic muscles of the hand

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(Chapter 5)

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Temporalis
Lateral pterygoid
Medial pterygoid
Occipitofrontalis
Platysma
Suprahyoids Group
Geniohyoid, Mylohyoid, Stylohyoid, Digastric
Infrahyoids Group
Sternohyoid, Sternothyroid, Omohyoid, Thyrohyoid
Muscles of facial expre

Group 7 – Neck
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Scalenes group
Longus capit ngus colli
S p
s posterior major
posterior minor
pitis superior
capitis inferior
s capitis
us cervicis
nispinalis capitis
evator scapula*
Trapezius, upper fibers*
*(revisited for reversed O/I actions)

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External intercostals
Internal intercostals
Serratus posterior superior
Serratus posterior inferior
Levator costae
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p. 158-159
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The other 5 lateral rotators
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- Obturator internus
- Gemellus inferior
- Obturator externus
- Quadratus femoris

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(Iliacus & Psoas major)

Group 11 – Hip Joint (Part 2)
p. 175-182
Sartorius
Tensor fascia latae
Pectineus
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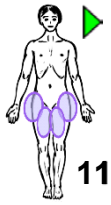
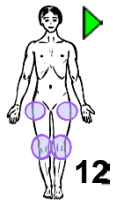
Adductor longus
Adductor magnus
Gracilis

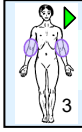


Group 12 – Knee (& Hip Joint, Part 3)
p. 183-190
Rectus femoris
Vastus lateralis
Vastus intermedius
Vastus medialis
Biceps femoris
Semitendinosus
Semimembranosus
Popliteus



Group 13 – Ankle, Foot, Toes
p. 191-197
Gastrocnemius
Plantaris
Soleus
Tibialis posterior
Flexor digitorum longus
Flexor hallucis longus
Fibularis longus (peroneus)
Fibularis brevis (peroneus)
Tibialis anterior
Extensor digitorum longus
Extensor hallucis longus

Bonus Group
p. 198-199
Intrinsic muscles of the foot



Click an icon to go to that Muscle Group

Muscles – Alphabetical List

Muscles – Alphabetical List

About the Information in This Book

Books on muscles and movement are notoriously inconsistent in the details of the muscle attachments, actions and innervation assigned to individual muscles. Variations in artistic renderings of muscles and other structures present an additional challenge when studying musculoskeletal anatomy. There are many valid reasons for these apparent inconsistencies, including human anatomical variation, measurement and analysis methods employed by anatomists, and editorial decision processes.

Suffice it to say, this book necessarily adds one more resource to the fray. As such, I will note the main resources and the process I used while making decisions about the information I present in this book. The Bibliography on page 231 lists the main resources used while developing the material. Some resources were influential in my artistic choices, while others were given varying degrees of influence in my decisions about factual muscle information (origin, insertion, action, innervation), as well as terminology and descriptions regarding physiology and kinesiology.

For muscle, nerve, bone, joint and ligament details, I studied and compared many sources, from introductory muscular system books to high-end anatomy atlases to comprehensive kinesiology textbooks (see bibliography). When differences were not easily reconciled, I turned to the highly detailed analyses of anatomy and function in the Travell and Simons manuals (ref. 33 and 39) and sometimes to newer peer-reviewed articles in the medical literature. In more difficult cases I made tables to compare sources and look for common ground, discussed the information with colleagues, consulted additional books and internet resources, and studied cadaver dissections.

After weighing all of the above, I then "flavored" the presentation based on my specific approach, i.e., to be **brain-friendly**. The information was then incrementally refined while seeing students' responses over many years of teaching kinesiology and cadaver anatomy. Please read the Preface on page *i*, and read Chapter 3 – "Using the Brain-Friendly System to Optimize Your Learning" to better understand the specific approach used in the Mastering Muscles & Movement system.

Acknowledgements

Over the many years I have been developing and improving this book there have been too many influences and contributors to name them all individually. However, the following is an attempt to "name a few" of the people who graciously helped me along the way.

Those making direct contribution to the process and/or content of this book (in alphabetical order): Pat Archer, Jack Blackburn, Elizabeth Fletcher Brown, Barb Collins, Jen Cosgrove, Gwen Crowell, Janae Fletcher, George Gottlieb, Avilio Halme, Kinsey Jackson, Liz Lamm, Whitney Lowe, Anna Mariano, Wren McLaughlin, Brenda Mitchell, Lisa Nelson, Eric Root, Helen Thayer, Diana Thompson, Kristin Torok, and my students and colleagues at the Spectrum Center School of Massage in WA state.

And finally for patience, love, support, expert editorial advice, and a little fun in between the hard work: Laurie Pitts.

About the Author/Illustrator

Dave Campbell, BS, LMT, has been an instructor of kinesiology and cadaver anatomy since 2001. He has been a manual therapy practitioner for over 30 years and has an enduring fascination with the intricacies of the human body, mind, and spirit. Dave maintains a bodywork practice at The Natural Health Clinic in Bellingham, WA, specializing in craniosacral therapy, organ- and nerve-specific fascial mobilization, and myofascial therapies.

Dave holds a B.S. in Mathematics from the University of California. A former engineer at the Fairchild Laboratory for AI Research in Palo Alto, CA, he developed his brain-friendly approach to teaching muscles and movement based on years of experience in the study of human perception, artificial intelligence, and graphic representation of scientific information.

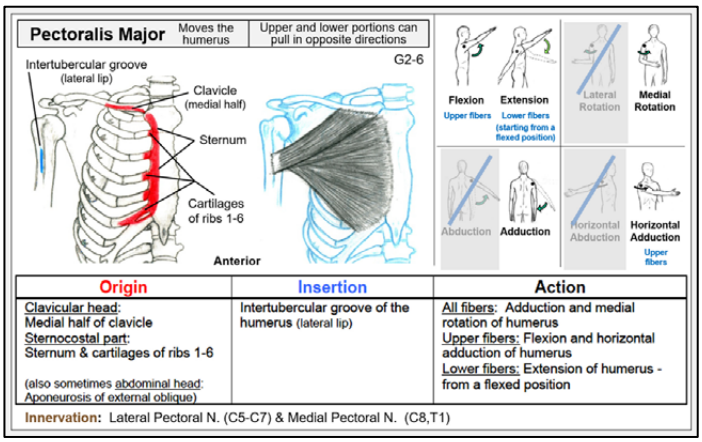
User Guide for the Enhanced E-book – 1

This E-book version of **Mastering Muscles & Movement** uses a fixed-page format that exactly matches the printed book. This retains the page layouts that make the printed book **brain-friendly** and easy to learn from.

In addition, the features below have been added to enhance the use of the book on a tablet or computer. **These features are not in the printed book.**

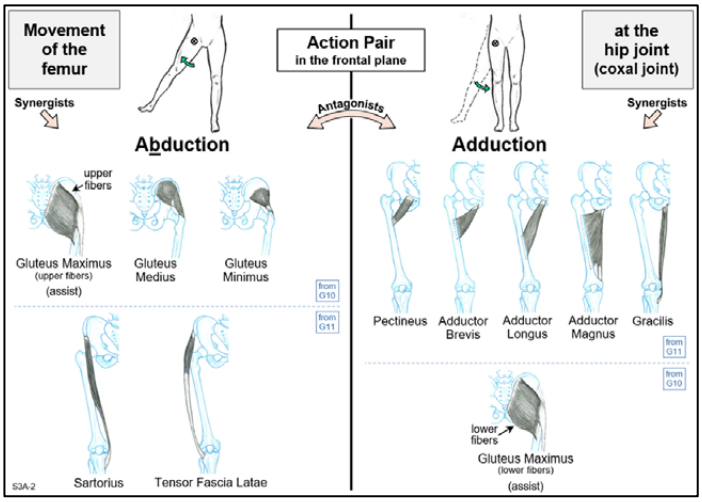
Appendix 1
Muscle Detail Cards

This 175-page Appendix contains one-muscle-per-page “cards” that gather all pertinent information for an individual muscle. These Muscle Detail Cards are connected to the “A” Tables in Chapters 4, 5 and 6. See page x for more information.



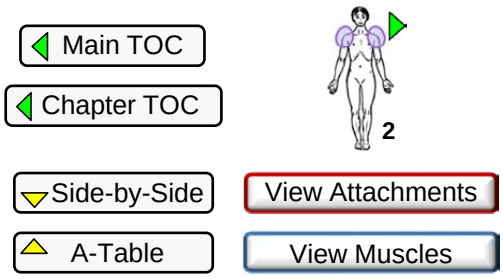
Appendix 2
Action Pair Cards

This 75-page Appendix has been added to facilitate studying how muscles work with each other and oppose each other (synergists & antagonists). These Action Pair Cards are linked to the “B” Tables in Chapters 4, 5 and 6. See page xi for more information.



Navigation

Several buttons and links have been added to facilitate easy navigation to different parts of the book. These allow a reading experience that is more closely aligned with the way a learner would study using the physical book. See pages xii-xvi for more information.



“A” Table pages are linked to Appendix 1 – Muscle Detail Cards

A-Tables (muscle origins, insertions, and actions) in the main text are linked to full-page **Muscle Detail Cards** in Appendix 1. Each “card” gathers and enlarges all the details for an individual muscle.

Click a muscle picture to view its Muscle Detail Card

Click on a muscle

Book will jump to muscle’s **Detail Card** in Appendix 1.

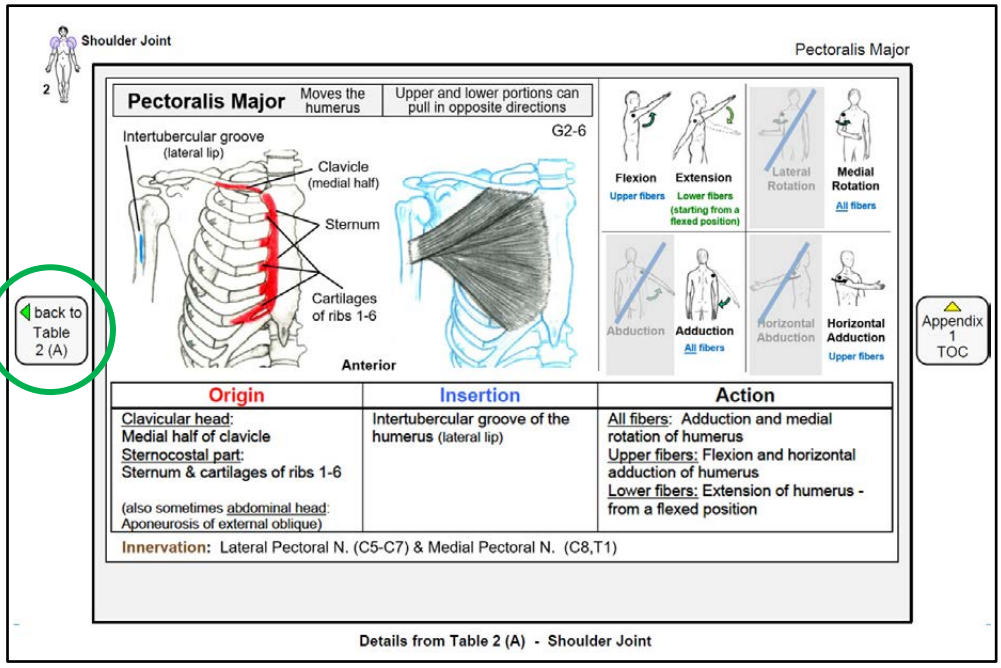
Group 2: Muscles Acting On — GH=Glenohumeral joint (shoulder joint), UL=Unilateral action, BL=Bilateral action

Shoulder Joint	Origin	Insertion	Action
Deltoid moves the humerus	Lateral clavicle, Acromion of scapula, Spine of scapula	Deltoid tuberosity of humerus	All / middle fibers: Abduction of humerus at the GH joint Anterior fibers: Flexion, medial rotation, and horizontal adduction Posterior fibers: Extension, lateral rotation, and horizontal abduction
Supraspinatus moves the humerus	Supraspinous fossa of scapula	Greater tubercle of humerus (superior aspect)	Abduction of humerus at the GH joint, Stabilizes the humerus in the glenoid fossa
Infraspinatus moves the humerus	Infraspinous fossa of scapula	Greater tubercle of humerus (posterior aspect)	Lateral rotation of humerus at the GH joint, Stabilizes the humerus in the glenoid fossa
Teres Minor moves the humerus	Lateral/axillary border of the scapula	Greater tubercle of humerus (posterior aspect, inferior to infraspinatus tendon)	Lateral rotation of humerus at the GH joint, Stabilizes the humerus in the glenoid fossa
Subscapularis moves the humerus	Subscapular fossa of scapula	Lesser tubercle of humerus (on anterior humerus)	Medial rotation of humerus at the GH joint, Stabilizes the humerus in the glenoid fossa
Pectoralis Major moves the humerus	Clavicular head: Medial half of clavicle Sternocostal part: Sternum & cartilages of ribs 1-6 (also sometimes abdominal head: Aponeurosis of external oblique)	Intertubercular groove of the humerus (lateral lip)	All fibers: Adduction and medial rotation of humerus Upper fibers: Flexion and horizontal adduction of humerus Lower fibers: Extension of humerus - from a flexed position
Coracobrachialis moves the humerus	Coracoid process of scapula	Shaft of humerus -- on the medial side half way down	Flexion and adduction of the humerus at the GH joint (also assists horizontal adduction)
Latissimus Dorsi moves the humerus and the trunk & spine	Spinous processes of lower 6 thoracic and all lumbar vertebrae, sacrum, posterior iliac crest, lumbar fascia, lower 3 or 4 ribs (and sometimes the tip of the inferior angle of the scapula)	Intertubercular groove of the humerus (medial lip)	Extension, adduction, and medial rotation of the humerus at the GH joint. Also affects lower trunk & spine: UL: lateral flexion, BL: extension of spine & anterior pelvic tilt
Teres Major moves the humerus	Inferior angle and lower lateral border of scapula (dorsal side)	Intertubercular groove of the humerus (medial lip)	Extension, adduction, and medial rotation of the humerus at the GH joint.

(MMM page 86)

back to Table 2 (A)

Click the ”back to” button to return to the A-Table



Appendix 1 can be used as a Stand-alone Muscle Atlas

For stand-alone mode, use the Muscle Group **Table of Contents** on page 232.

Or use the **Alphabetical Index of Muscles** on pages 407-408.

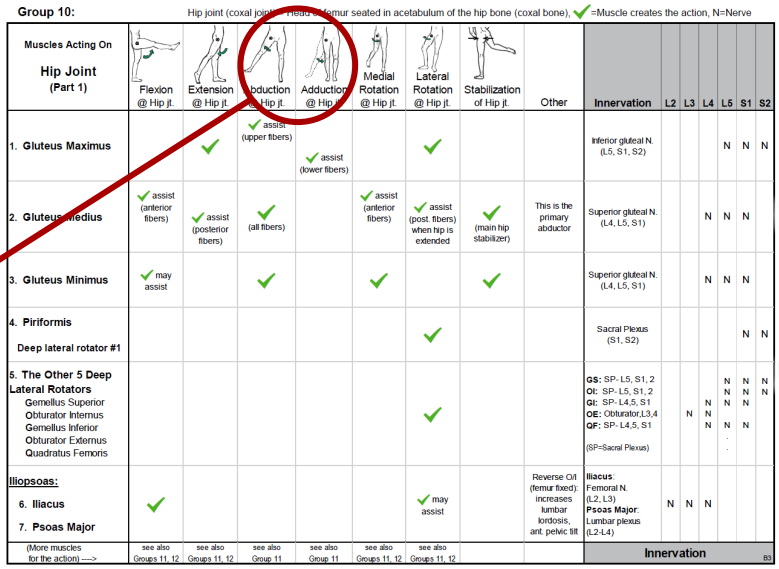
“B” Table pages are linked to Appendix 2 – Action Pair Cards

B-Tables show the synergists and antagonists for all of the actions available to a Muscle Group. The B-Tables in the main text are linked to full-page **Action Pair Cards** in Appendix 2 that graphically display the information.

Click an Action picture to view ***all*** of its synergists & antagonists

Click on an action picture

Book will jump to the **Action Pair Card** in Appendix 2.

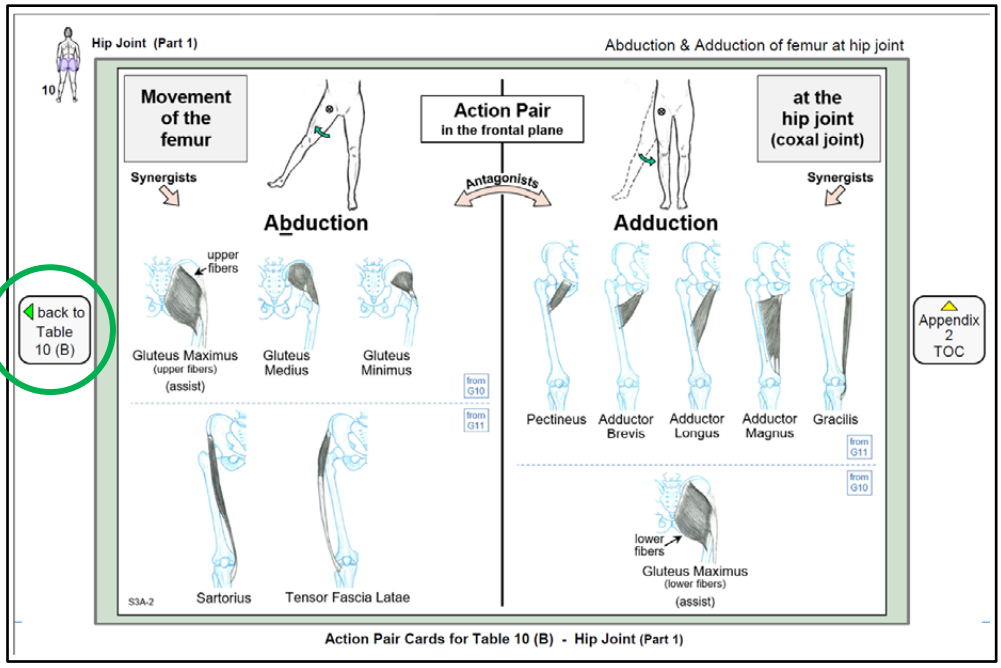


Group 10: Hip joint (coxal joint) – Head of femur seated in acetabulum of the hip bone (coxal bone). ✓=Muscle creates the action, N=Nerve

Muscles Acting On Hip Joint (Part 1)	Flexion @ Hip jt.	Extension @ Hip jt.	Abduction @ Hip jt.	Adduction @ Hip jt.	Medial Rotation @ Hip jt.	Lateral Rotation @ Hip jt.	Stabilization of Hip jt.	Other	Innervation	L2	L3	L4	L5	S1	S2
1. Gluteus Maximus		✓	✓ assist (upper fibers)	✓ assist (lower fibers)		✓			Inferior gluteal N. (L5, S1, S2)				N	N	N
2. Gluteus Medius	✓ assist (anterior fibers)	✓ assist (posterior fibers)	✓ (all fibers)		✓ assist (anterior fibers)	✓ assist (post. fibers) when hip is extended	✓ (main hip stabilizer)	This is the primary abductor	Superior gluteal N. (L4, L5, S1)			N	N	N	
3. Gluteus Minimus	✓ may assist		✓		✓		✓		Superior gluteal N. (L4, L5, S1)			N	N	N	
4. Piriformis Deep lateral rotator #1						✓			Sacral Plexus (S1, S2)					N	N
5. The Other 5 Deep Lateral Rotators: Gemellus Superior, Obturator Internus, Gemellus Inferior, Obturator Externus, Quadratus Femoris						✓			GS: SP- L5, S1, 2 OI: SP- L5, S1, 2 GI: SP- L4,5, S1 OE: Obturator,L3,4 QF: SP- L4,5, S1 (SP=Sacral Plexus)		N	N N N	N N N	N N N	N N
Iliopsoas: 6. Iliacus 7. Psoas Major	✓					✓ may assist		Reverse O/I (femur fixed): increases lumbar lordosis, ant. pelvic tilt	Iliacus: Femoral N. (L2, L3) Psoas Major: Lumbar plexus (L2-L4)	N	N	N			
(More muscles for the action) ---->	see also Groups 11, 12	see also Groups 11, 12	see also Group 11	see also Group 11	see also Groups 11, 12	see also Groups 11, 12			Innervation						

(MMM page 172)

back to Table 10 (B)



Click the ”back to” button to return to the B-Table

Appendix 2 can be used Stand-alone to study Synergists & Antagonists

For stand-alone mode, use the
Appendix 2 – Action Pair Cards - Table of Contents on page 410.

User Guide for the Enhanced E-book – 4

Navigation

Several buttons and links have been added to facilitate easy navigation to different parts of the book. These allow a reading experience that is more closely aligned with the way a learner would study using the physical book.

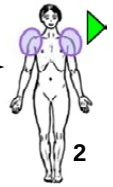
Main TOC (Table of Contents):

Click on a **blue chapter line** ▶ to jump to that chapter.

Chapter TOC (Table of Contents page at start of each chapter):

Chapters 1-3 and 7-8: Click on a **blue section line** ▶ to go to that section.

Chapters 4-6: Click on a Muscle Group icon to jump to the section for that group. →



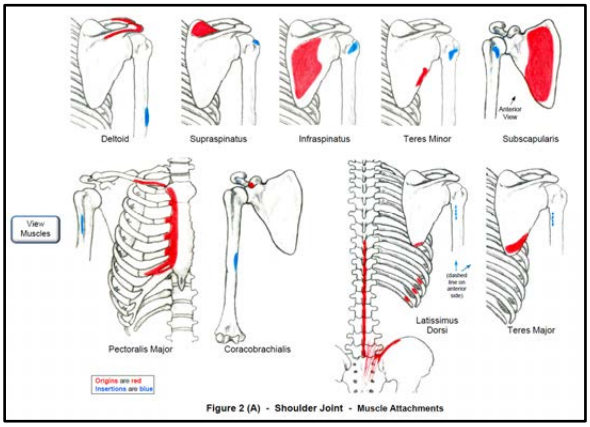
◀ Main TOC button returns to the Main TOC.

Sections within each chapter:

◀ Chapter TOC button returns to the start of the chapter.

Bookmark Outline: Built-in bookmarks to jump to any book section.

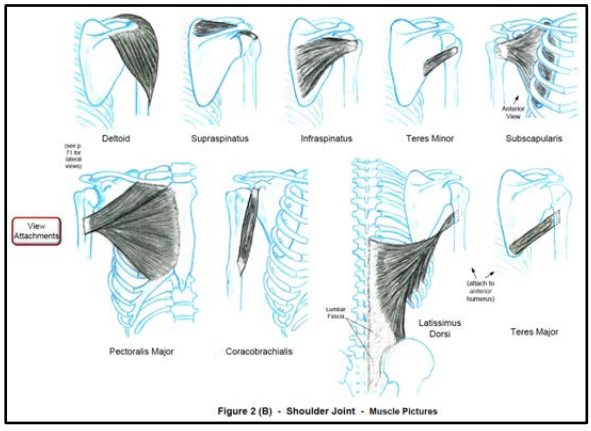
Side-by-Side Muscle Comparison Pages are Linked



Pages showing **side-by-side** pictures have buttons that allow jumping back and forth to compare the **muscle** and the **origin/insertion** pictures.

View Muscles

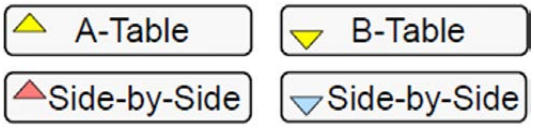
View Attachments



Special Navigation in Chapters 4 - 6

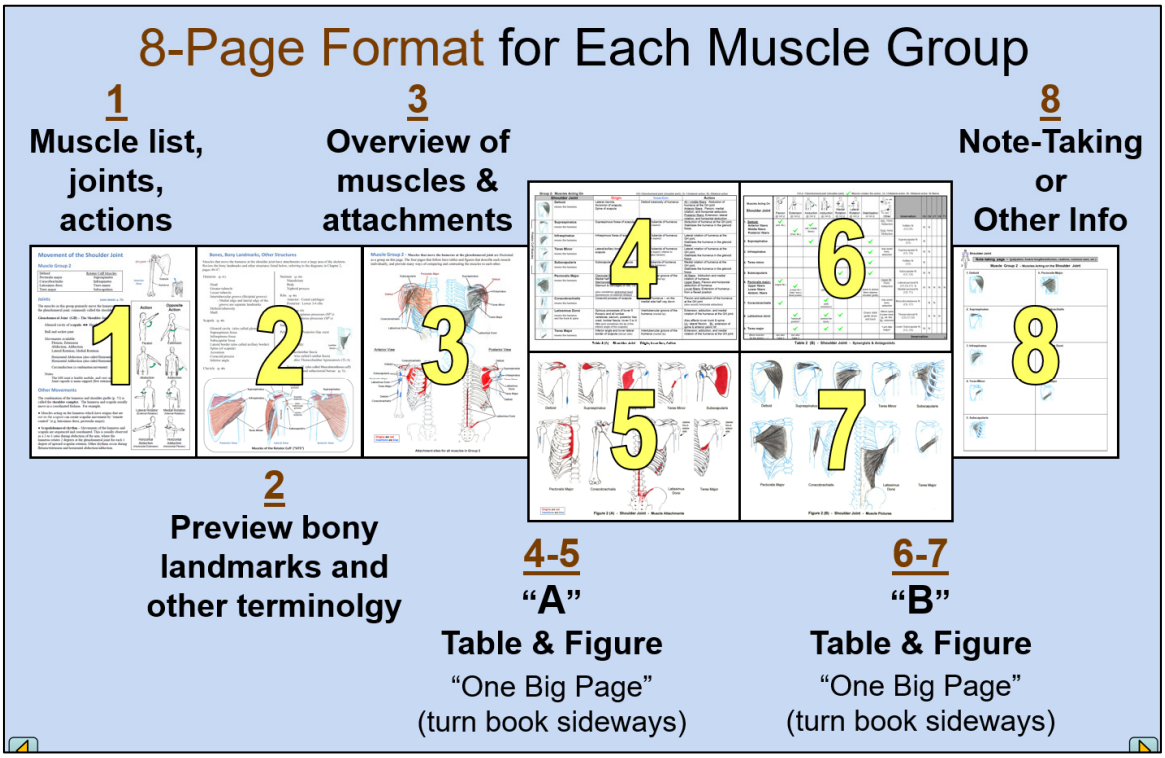
Chapters 4, 5,and 6 contain the bulk of the muscle information that students need to understand and memorize. In the physical book, the page layouts of facts, figures and tables create a rich learning environment.

In the enhanced e-book, color-coded buttons help the reader to navigate the layouts that the physical book provides.



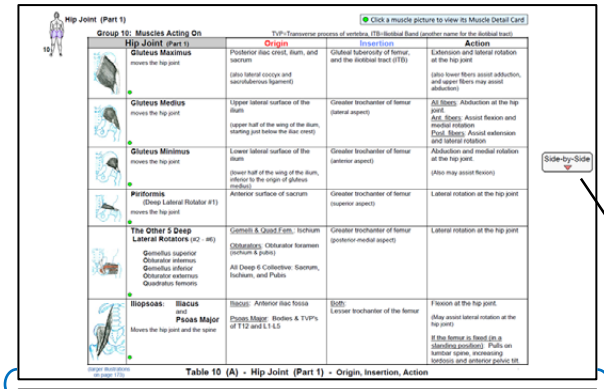
E-book Simulates How a Learner Uses the Physical Book

Each Muscle Group in Chapters 4, 5,and 6 is presented in a consistently organized format (please read Chapter 3 “Using the Brain-Friendly System to Optimize Your Learning” for a complete description). The format, which spans 8 pages, is shown in the diagram below.



As you can see in the diagram above, pages 4-5 and 6-7 allow the reader to turn the book sideways and have “one big page” to study and compare visual and verbal information. In this e-book, interactive buttons have been added to facilitate how a learner would study and memorize muscles using the two-page layouts in the physical book. These buttons are described on the following page.

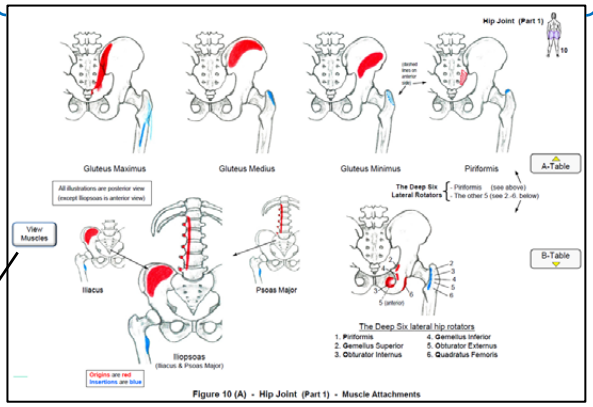
Navigating Two-page Layouts



Each Muscle Group employs two-page spreads so that the reader has all information available to study and memorize a group of muscles. However, an e-book is only practical for viewing one page at a time. These buttons facilitate easily jumping back and forth in the book's two-page spreads.

Side-by-Side

Click back and forth between the two pages



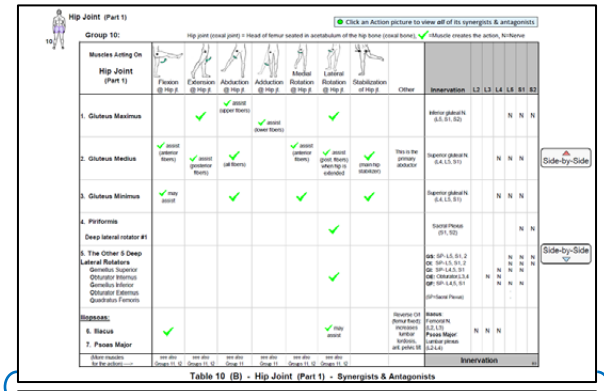
A-Table

B-Table

Move forward to the next two-page spread

View Muscles

Compare Attachment pictures & Muscle pictures



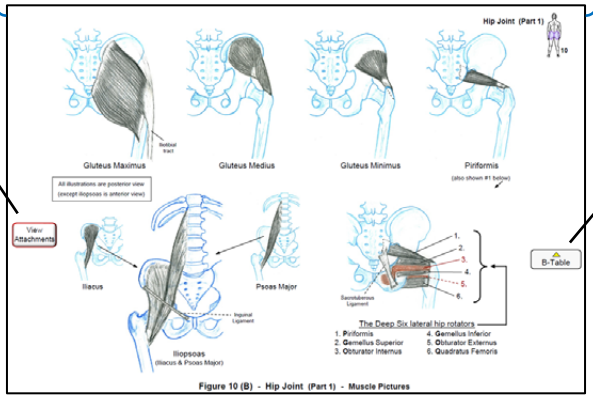
Side-by-Side

Go back to the previous two-page spread

Side-by-Side

Click back and forth between the two pages

View Attachments

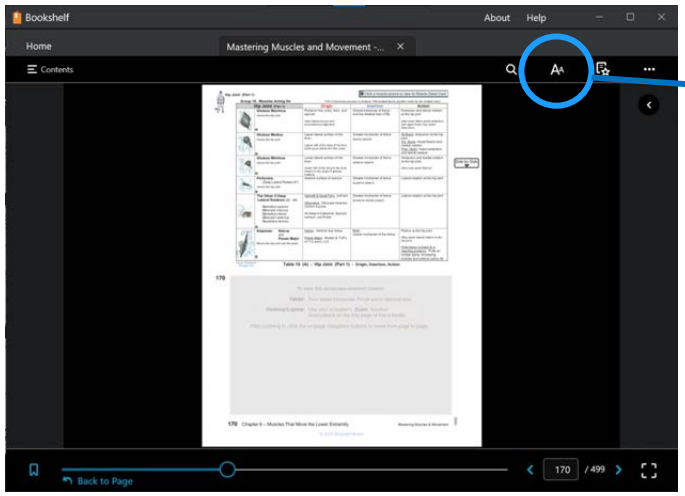


B-Table

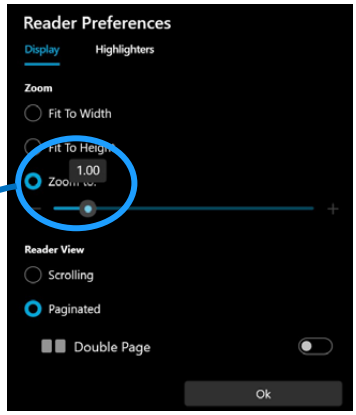
VitalSource Bookshelf – Reading Landscape-Oriented Pages

Landscape pages are displayed in the top half of portrait-shaped pages.

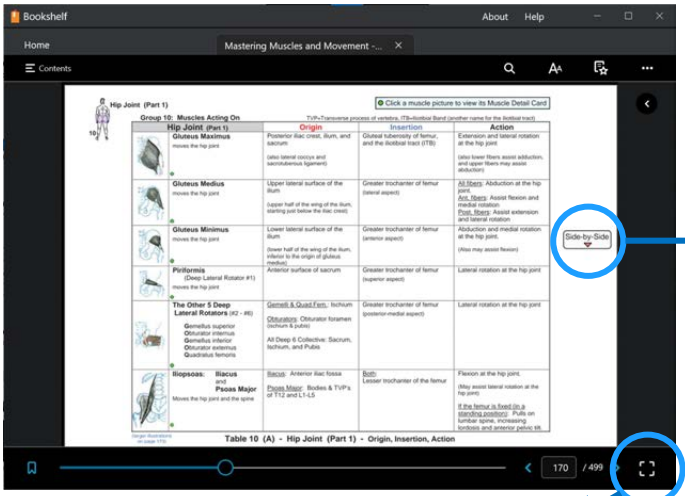
As an example, here is Table 10 (A) viewed using the Windows app on a laptop:



Click AA button for Reader Preferences.



Use "**Zoom to:**" slider to enlarge the table.



Once enlarged, use the built-in buttons to move between landscape pages.

(see pages x - xiv for details)

For the largest view, click the button to enter full-screen mode.

Zoom levels on a standard laptop

For full screen mode, set zoom = 1.25

For normal mode, set zoom = 1.00

Suggestion: Try reading the entire book zoomed in as described above. On portrait pages, it's very easy to do a short scroll between the top and bottom of the page.

Keyboard shortcuts in full-screen mode

Scroll up and down on the current page:	Use up & down arrow keys, or use mouse wheel or trackpad.
Go to next page or previous page:	Ctrl-PageDown, Ctrl-PageUp

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Chapter 1
Basic Information

Introduction

The essential definition of the term **kinesiology** is "the study of movement". To study movement of the human body one must learn the muscles, their functions, the joints they cross, and the places on bones where they attach. That knowledge is then utilized in a variety of practical applications.

Chapter 1 – Basic Information provides foundational information and terminology that need to be understood before learning all the muscles that are presented later in the book. Once these basics are covered, the rest of the book proceeds as follows.

Chapter 2 – Bones, Bony Landmarks, Joints, and Ligaments employs an atlas format to present detailed features of all the bones of the body. This provides a central location that can be quickly referred to while studying the musculoskeletal system. Master lists of joints and ligaments are also included, which then refer to the more detailed information given in chapters 4 - 6.

Chapter 3 – Using the Brain-Friendly System to Optimize Your Learning is a must-read to prepare the reader to fully utilize the brain-friendly approach employed when describing all the muscles in Chapters 4 - 6. Understanding how to proceed is an essential step to allow the learner to truly master the muscles and movements of the body.

Chapters 4, 5, and 6 provide the bulk of the muscles and movement information in a special format that emphasizes constantly comparing and contrasting facts and pictures. The unique organization allows the reader to comfortably understand, memorize and recall the muscles of the body and study their actions and innervations.

Chapter 7 – Summary Tables provides a handy set of summary action and innervation tables that can be quickly referenced once the reader has learned all the muscles in chapters 4, 5, and 6.

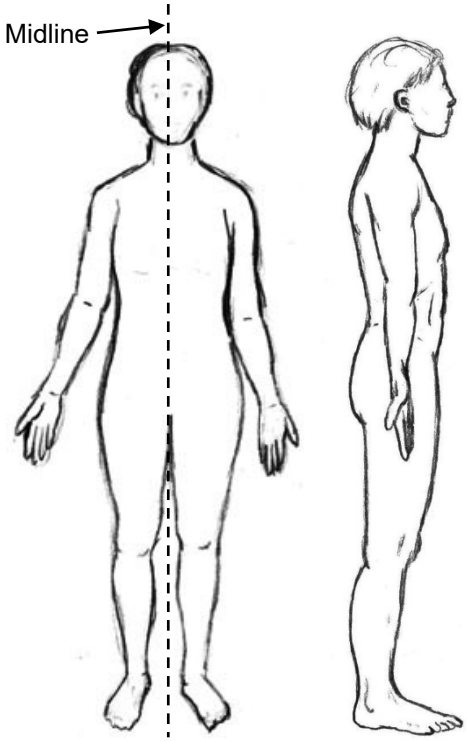
Anatomical Terms

Anatomical Position

Anatomical position is a standing posture in which the parts of the body are placed in specific ways. It provides a *reference position* that is used as the basis to name and describe body movements, positions, and directions. The components of anatomical position are:

- Erect posture
- Face forward
- Feet forward
- Arms at sides
- Palms of hands forward
- Fingers and thumbs in extension (straight, not closed in fists).

A vertical line called the **midline** divides the body into right and left symmetrical halves. Note that the body is not symmetrical from front to back, so the midline does not apply when viewing the body from the side.



Anatomical Position

Terms of Direction and Position

The following terms are used to describe the relationships of one body structure to another, and to clarify body positions and movements. These terms are defined for a person standing in anatomical position. Therefore, it is easiest to learn the terms while visualizing the body in that position. Once learned, the terms can be used to precisely describe body positions and directions no matter what orientation the body is in.

Superior / Cranial (also cephalad) – Closer to the head; situated above another structure. Example: The right lung is *superior* to the liver.

Inferior / Caudal – Closer to the feet; situated below another structure. Example: The umbilicus (belly button) is *inferior* to the chin.

The terms *cranial* and *caudal* are primarily used when referring to the head, neck and torso.

Anterior / Ventral – Front of the body, or a structure closer to the front than another structure. Example: The abdomen is *anterior* to the spine.

Posterior / Dorsal – Back of the body, or a structure closer to the back than another structure. Example: The spine is *posterior* to the sternum (breast bone).

The terms *ventral* and *dorsal* are primarily used when referring to the head, neck and torso.

Medial – Refers to a structure that is closer to the midline or median plane of the body. Example: The eyes are *medial* to the ears.

Lateral – A structure that is further away from the midline. Example: The little toes are *lateral* to the big toes (in anatomical position).

Proximal – Nearer to the trunk or point of origin of a limb. Example: The knee is *proximal* to the foot.

Distal – Further from the root of a limb. Example: The hand is *distal* to the elbow.

The terms *proximal* and *distal* are primarily used when referring to the arms and legs.

Deep – Beneath or inward from the surface of the body. Example: Muscles are *deep* to the skin, and bones are deep to the muscles.

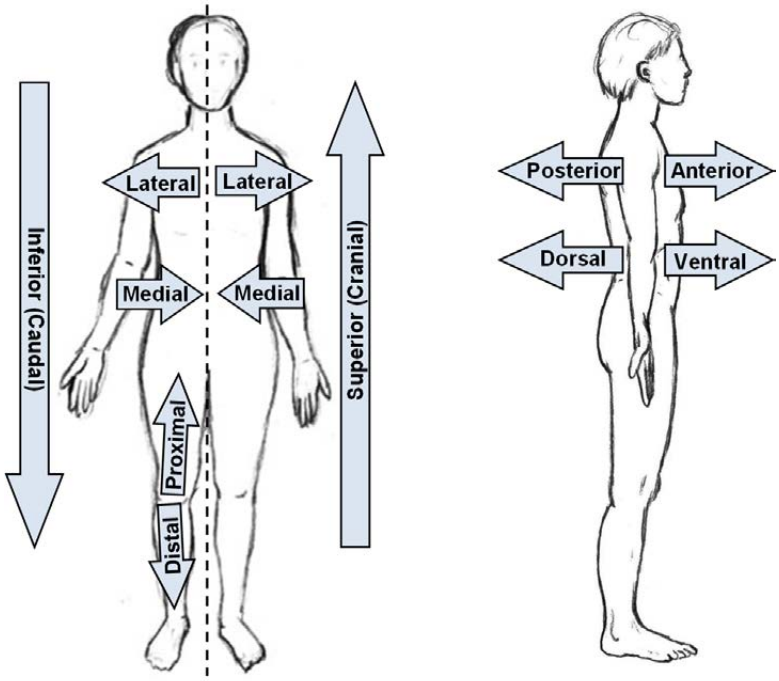
Superficial – Near the surface, or closer to the surface than another structure. Example: The muscles are *superficial* to the bones.

Ipsilateral – Indicates that a structure is on the same side of the body as another structure. Example: The shoulder and ipsilateral hip moved toward each other.

Contralateral – Refers to a structure being on the opposite side of the body from another structure. Example: Touch your foot with your contralateral hand.

Supine – Lying on the back (face up, belly exposed).

Prone – Lying on the belly (face down, back exposed).

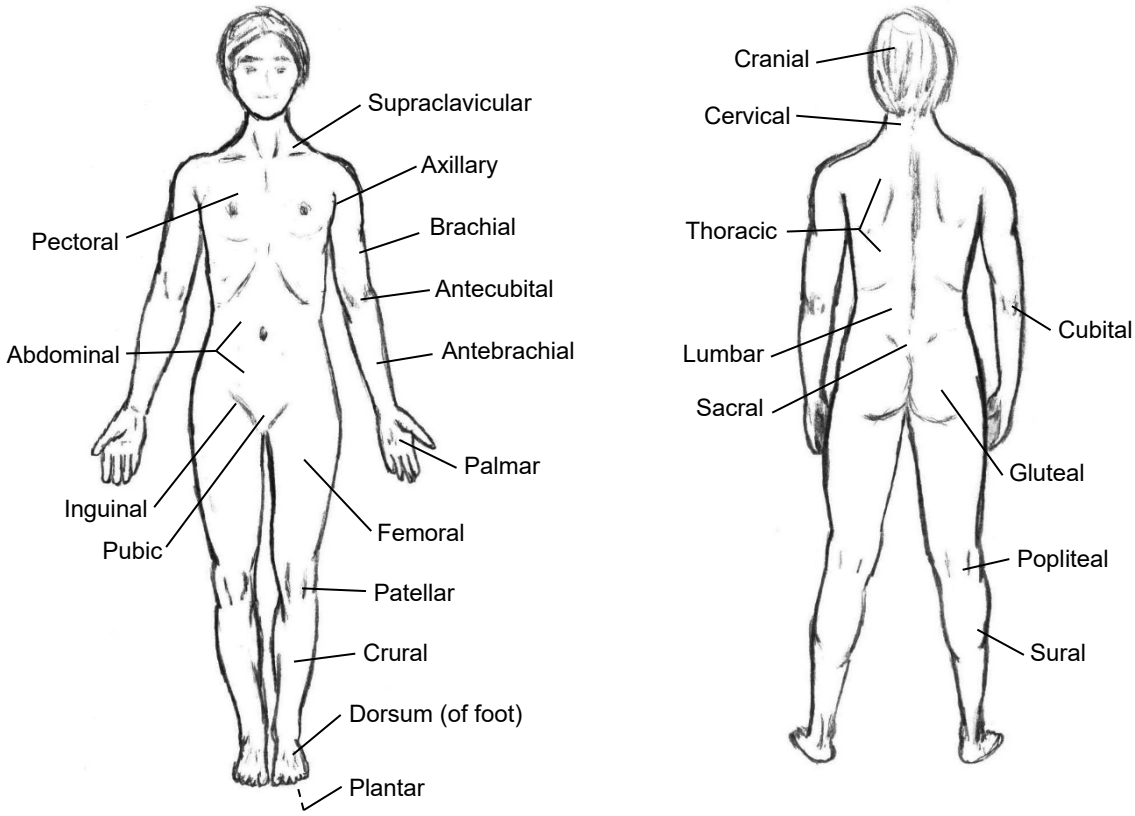


Terms of Direction and Position

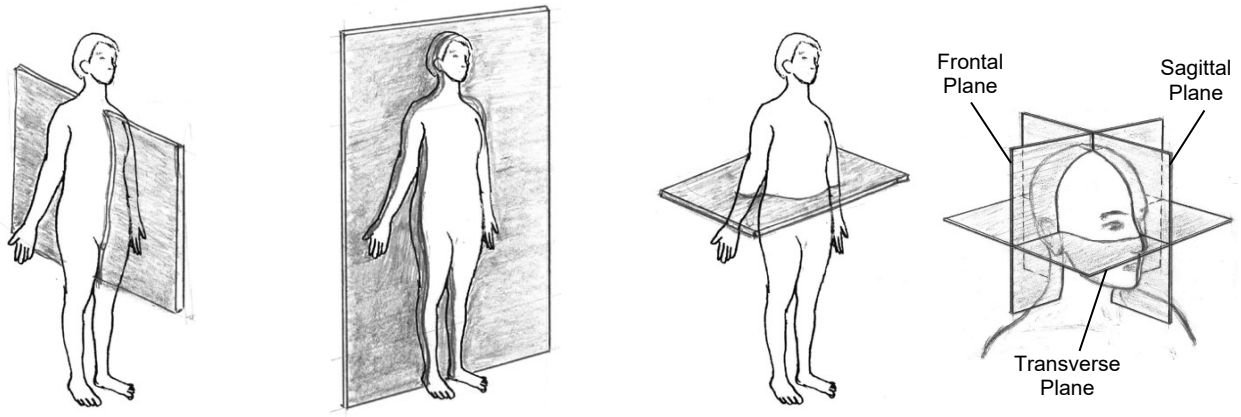
Regions of the Body

The body can be divided into many regions. Knowing the names of regions allows efficient and precise communication when talking about locations on the body. Here are some regional terms that are useful when studying kinesiology:

Cranial	- head	Lumbar	- lower back
Cervical	- neck	Sacral	- base of spine, tail bone
Thoracic	- upper trunk, ribcage	Inguinal	- where lower abdomen meets thigh
Supraclavicular	- above the clavicle	Pubic	- genital region
Axillary	- armpit	Gluteal	- buttocks
Pectoral	- upper chest	Femoral	- thigh
Abdominal	- area between ribs and pubis	Patellar	- kneecap, front of knee
Brachial	- arm (upper arm)	Popliteal	- behind knee
Antebrachial	- forearm	Crural	- leg (below knee)
Cubital	- elbow	Sural	- calf of leg
Antecubital	- front of elbow	Dorsum	- top of foot, also back of hand
Palmar	- palm side of hand	Plantar	- bottom (sole) of foot



Regions of the Body



Sagittal Plane | Frontal (Coronal) Plane | Transverse Plane | All 3 Planes

The Three Cardinal Planes

Planes

A **plane** is an imaginary flat surface (visualize a pane of glass or flat piece of cardboard). Basic body movements are defined to occur *in* one of three **cardinal planes**:

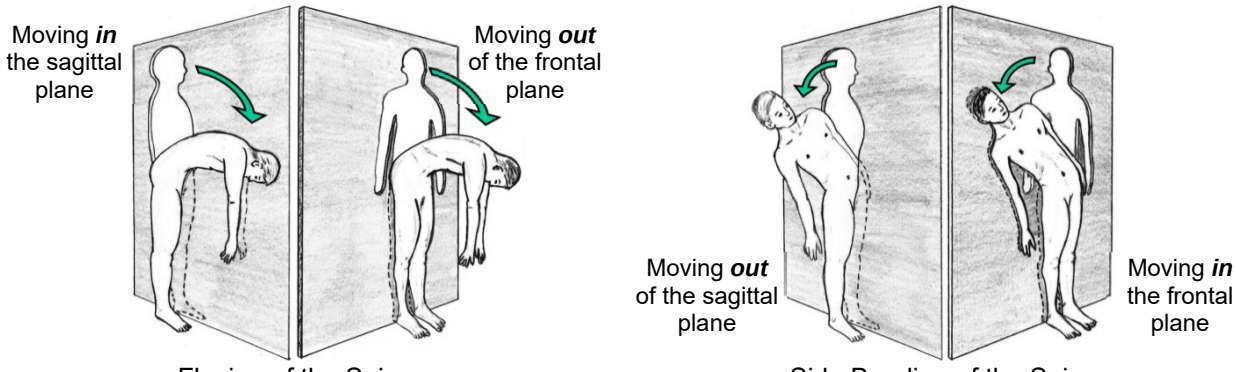
Sagittal Plane – A vertical plane passing from front to back, dividing the body into right and left portions. A special sagittal plane called the **median plane** (also called the **midsagittal plane**) passes through the midline and divides the body into equal halves. Forward and backward body movements occur in the sagittal plane.

Frontal (Coronal) Plane – A vertical plane extending from side to side, dividing the body into anterior and posterior portions. Side-to-side movements occur in the frontal plane.

Transverse Plane – A horizontal plane that divides the body into upper and lower portions. Rotational or twisting movements occur in the transverse plane.

Moving In a Plane: To visualize a body part moving in a plane, first place the plane so it passes through the joint that is moving. Pick a point on the body part that is doing a certain action, and that point will stay in contact with the plane throughout the movement. For example, if you are going to bend the neck and trunk forward (flexion of the spine), then place a sagittal plane at the midline of the body so it passes through the joints along the spine. Note that your nose lies in the plane, and as you flex forward notice how the tip of your nose travels (it stays *in* the plane).

Moving Out of a Plane: Moving in one of the vertical planes constitutes moving *out* of the other vertical plane. For example, moving from anatomical position in the sagittal plane causes movement out of the frontal plane. In the above spine flexion example, your nose moves forward out of the frontal plane.



Flexion of the Spine | Side Bending of the Spine

Moving In a Plane vs. Moving Out of a Plane

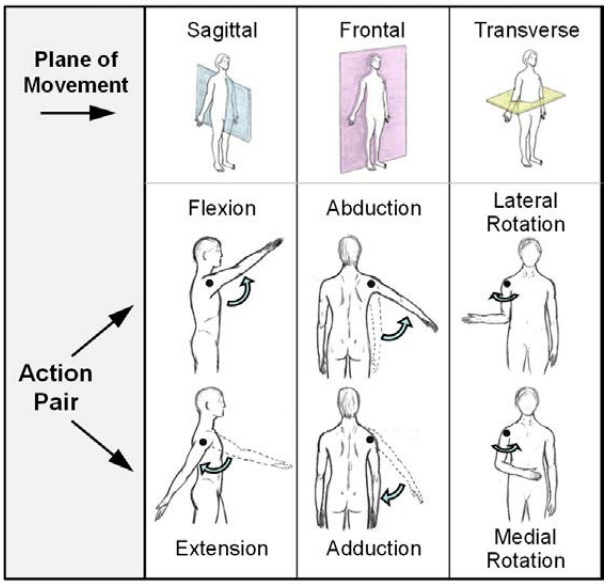
Movement Definitions (Actions)

The terms defined in this section enable clear and concise description of the movements (also called actions) of all parts of the body. These terms, like the terms of position and direction on page 3, are initially defined and most easily learned referring to a body in anatomical position. They may then be used to describe movements of the body in any orientation or position. It is useful to think of actions as matched in pairs of opposing actions.

Action Pairs

Defining the action of a body part moving in space involves two components: (1) specify the joint where the body part is connected to the body, and (2) observe the plane in which the body part is moving. The body part can then move in one direction or the opposite direction while staying within that plane. These two opposing movements are called an **action pair**. When observing a body part moving, it is important to stay aware that there is always an opposing movement possible. Below are examples of the action pairs possible when the humerus is moving at the shoulder joint.

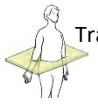
Action Pairs at the Shoulder Joint



Main Actions

Main actions are "standard" actions that apply to many parts of the body. Two bones meet at a joint, and they stay in contact at that joint as one bone moves relative to the other bone. The moving bone stays in one of the three cardinal planes as it moves, defining the action. The main actions are listed in the table below, and illustrated on page 7.

Main Actions

Moving in the:	Action Pairs	Applies to:
 Sagittal plane	Flexion Extension	Limbs, neck, and torso
 Frontal plane	Abduction Adduction	Limbs
	Lateral Flexion to the right Lateral Flexion to the left	Neck, torso
 Transverse plane	Lateral Rotation Medial Rotation	Limbs
	Right Rotation Left Rotation	Neck, torso

Special-Purpose Actions

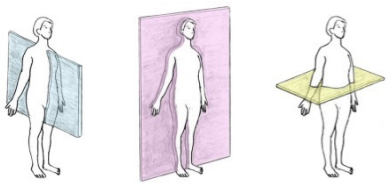
These are separately named actions that apply to specific structures of the body. They have special names either because they do not fit the "standard" movements described above, or simply to clarify unique types of movement that occur with certain structures. Special-purpose actions are listed in the table below, and illustrated on page 8.

Special-Purpose Actions

Action Pair	Applies to:
Pronation Supination	Forearm
Plantar flexion Dorsiflexion	Ankle
Inversion Eversion	Subtalar joint (below ankle)
Protraction Retraction	Scapula, mandible
Elevation Depression	Scapula, mandible, ribs
Upward Rotation Downward Rotation	Scapula
Radial Deviation Ulnar Deviation	Wrist
Horizontal Abduction Horizontal Adduction	Shoulder joint
Circumduction	A combination action at ball & socket and ellipsoid joints

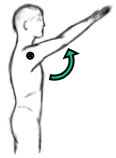
Main Actions (shown as action pairs)

= Direction of movement
= Location of joint that is moving



Front / back - in the Sagittal plane

Flexion


Shoulder joint


Elbow


Wrist

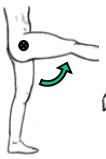

(MP+PIP)
Fingers

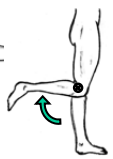

Thumb


Neck/Head (upper spine)

Flexion

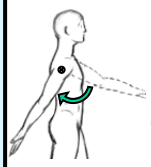

Spine


Hip


Knee


(plantar flexion)
Ankle


Toes




(MP+PIP +DIP)


(thumb is in coronal plane)

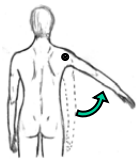
Extension


(dorsi-flexion)

Extension

Side-to-side - in the Frontal plane

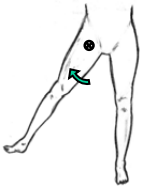
Abduction


Shoulder joint


(radial deviation)
Wrist

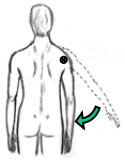

Fingers


Thumb


Hip

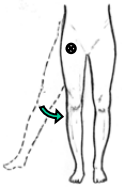

Toes

Abduction




(ulnar deviation)


(thumb is in sagittal plane)



Adduction

Adduction

Lateral Flexion Right

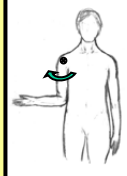

Neck (cervical spine)


Trunk (spine)

Left Lateral Flexion

Rotation - in the Transverse plane

Lateral Rotation (External Rotation)


Shoulder joint


(supination)
Radioulnar joint

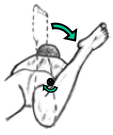

Hip


Hip (different view)

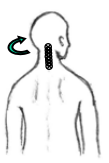

Knee (limited amount, and only when flexed)

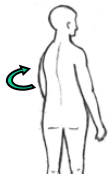
Medial Rotation (Internal Rotation)

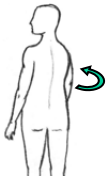

(pronation)



Right Rotation


Neck (cervical spine)


Trunk (spine)

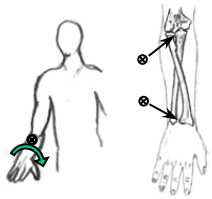


Left Rotation

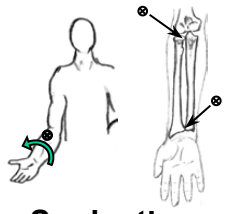
Special-Purpose Actions (shown as action pairs)

= Direction of movement
= Location of joint that is moving

Pronation



T Radioulnar joints

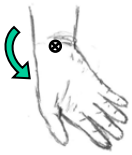


Supination

Radial Deviation

(Abduction)

F Wrist

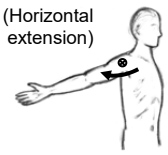


(Adduction)

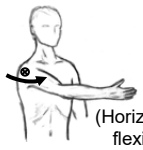
Ulnar Deviation

Horizontal Abduction

(Horizontal extension)



T Shoulder joint

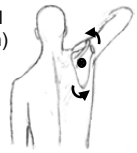


(Horizontal flexion)

Horizontal Adduction

Upward Rotation

(Lateral rotation)



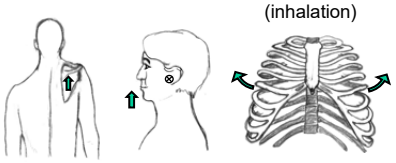
F Scapula

(Medial rotation)

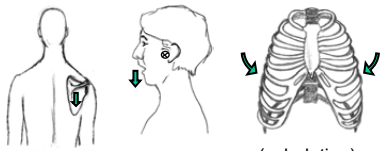
Downward Rotation

Elevation

(inhalation)



Scapula F | Mandible S | Ribs F+S

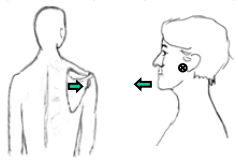


(exhalation)

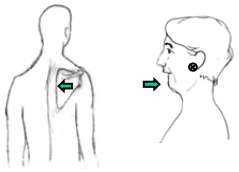
Depression

Protraction

(Abduction) (Protrusion)



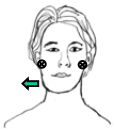
T Scapula Mandible



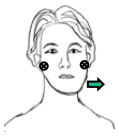
(Adduction) (Retrusion)

Retraction

Lateral Deviation Right



T Mandible



Left Lateral Deviation

Plantar flexion

S Ankle joint

Dorsiflexion

Inversion

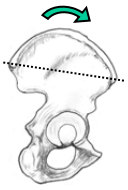
(Supination)

F Subtalar joint

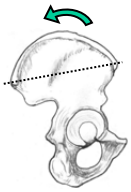
(Pronation)

Eversion

Anterior Tilt

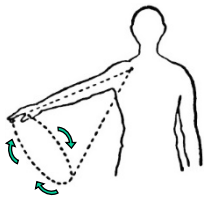


S Pelvis



Posterior Tilt

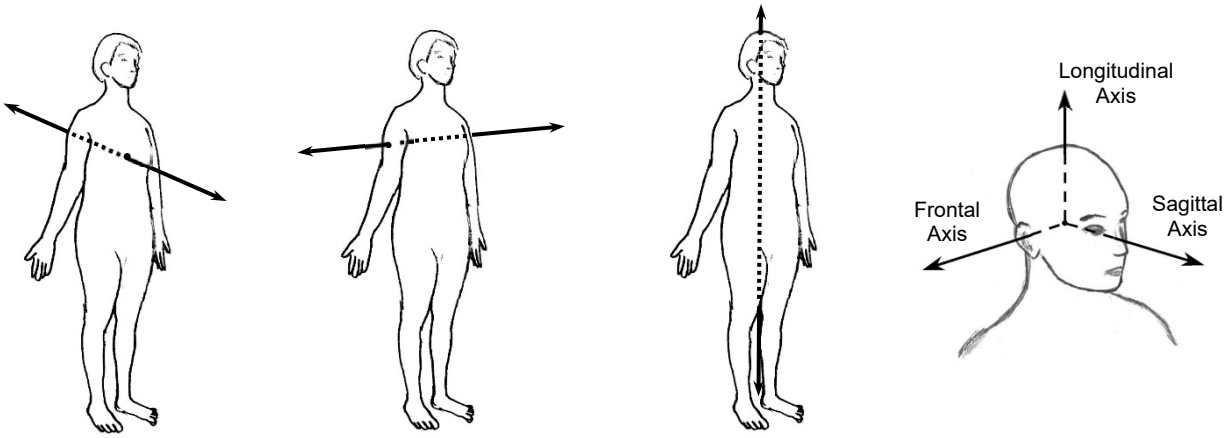
Circumduction



S = Sagittal Plane

F = Frontal Plane

T = Transverse Plane



Sagittal Axis (Anterior-Posterior Axis) | Frontal Axis (Medial-Lateral Axis) | Longitudinal Axis (Vertical Axis) | All 3 Axes

The Three Axes of Rotation

Axis of Rotation

Movements are defined to occur *in* a plane and *about* an axis. The plane and axis are positioned so that they both pass through the joint that is moving. The concept of moving in a plane was discussed earlier in this chapter on page 5. This section will now define the **axis of rotation**. Then, the next section will describe how to put a plane and axis together to set up a more complete system for describing movements.

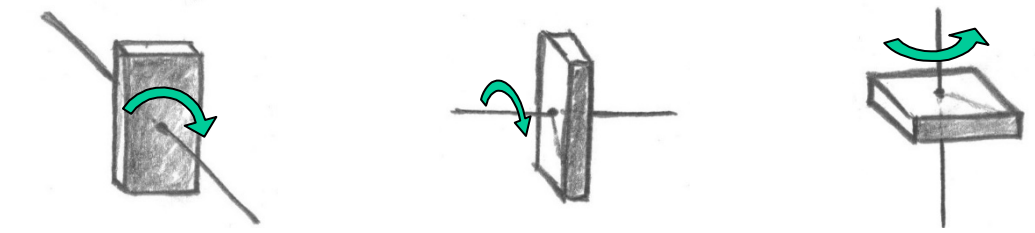
Three Axes

An **axis** is a straight line around which an object rotates (plural is axes). Visualize an arrow sticking through a target or a wagon axle that the wheels rotate around. Three axes at right angles establish an axis system for describing body movements in three dimensions. The figure above shows these axes in relation to the body in anatomical position. The two horizontal axes are named for the planes in which they lie. For easier understanding, the axes are also named to indicate the direction they travel.

1. **Sagittal Axis** – A horizontal front-to-back line, lying in the sagittal plane and at right angles to the frontal plane. This axis is also called the **Anterior-Posterior axis** (AP axis).
2. **Frontal Axis** – A horizontal side-to-side line, lying in the frontal plane and at right angles to the sagittal plane. This axis is also called the **Medial-Lateral axis** (ML axis).
3. **Longitudinal Axis** – A vertical top-to-bottom line, lying at right angles to the transverse plane. This axis is also referred to as the **Vertical axis**.

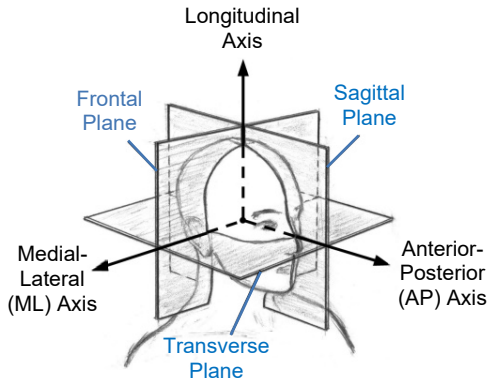
Moving About an Axis

To visualize moving about an axis, consider an axis skewering a block of wood (see figure below). Assume the hole the axis is going through is loose enough to allow the block to spin on the axis. The block spinning on the axis is moving in a plane that is perpendicular (at right angles) to the axis. Much like a wheel on the axle of a car, the block is prevented from moving in any other direction.



Anterior-Posterior axis sticking through a Frontal plane | Medial-Lateral axis sticking through a Sagittal plane | Longitudinal axis sticking through a Transverse plane

Rotational Movement About Each Axis



Planes and Axes – A System for Describing Movement

As a body part moves in a given plane, the joint turns about an axis. The axis is perpendicular (at right angles) to the plane, and the axis passes through the joint that is turning as the movement progresses. The figure below illustrates the three planes and their associated right-angle axes, along with some examples of actions for each (from page 7). The three plane-axis combinations are:

1. A sagittal plane goes with a medial-lateral axis (ML axis).
2. A frontal plane goes with an anterior-posterior axis (AP axis).
3. A transverse plane goes with a longitudinal axis (vertical axis).

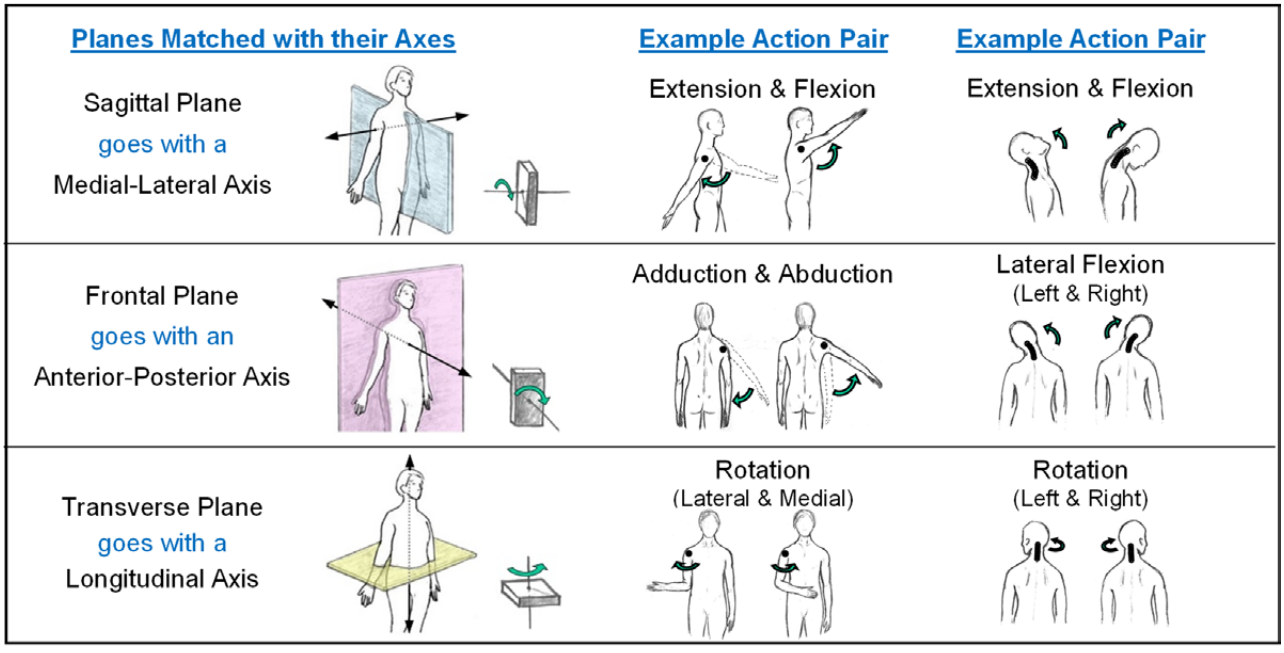
When talking about movement, the plane is usually named when describing a body part moving through space, and the axis is used when describing what the joint is doing at the point where the two bones articulate. For example, "When Brenda's arm swung forward in the sagittal plane, the shoulder joint was turning about a medial-lateral (frontal) axis."

Non-Planar and Non-Axial Movements

Many movements a person does in real life are complex and not purely in one cardinal plane. The plane and axis system defined above, however, allows us to categorize and analyze body movement for the study of kinesiology.

For example, movements that do not fit into the simple 3-plane/3-axis system are:

- Oblique/diagonal/circular movements: They are described as combinations and sequences of the basic planar movements. For example, moving an arm out from the body at an angle has components in sagittal and frontal planes.
- Specialty action pairs: Elevation/depression, protraction/retraction, lateral deviation (see page 8) are sliding or gliding movements, i.e., they don't turn about an axis. These movements are separately named and applied as "exceptions" to the basic 3-axis system.



Skeletal System – The Bones

This section gives a brief overview of the skeletal system, which is made up of bones and cartilage. The human body has (at least) 206 bones. The bones are connected to each other at the joints to form the skeleton, which is the internal framework of the body. The joints, also called articulations, will be discussed in the next section.

Skeleton

A complete skeleton is shown on page 12. A primary function of the skeleton is to give support and shape to the rest of the body. It also provides protection for vital organs such as the heart, lungs, brain, and spinal cord. The bones also perform physiological functions, such as storing calcium and producing red blood cells. Finally, and most important for the study of kinesiology, bones and joints form a system of levers that muscles attach to and pull on to create body movement.

The human skeleton is organized into two major divisions:

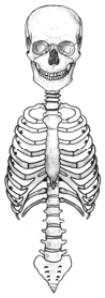
Axial Skeleton – The central structure of the body: Head, spine, ribcage (80 bones).

Appendicular Skeleton – The extremities: Shoulder girdles, arms and hands, hip bones, legs and feet (126 bones).

Basic List of Bones

Below is a basic list of bones to get started. A complete list of bones and an atlas giving details about each bone of the body are presented in **Chapter 2 – Bones, Bony Landmarks, Joints, and Ligaments**. As we present the muscles in each area of the body in Chapters 4, 5 and 6, we'll add more details about the bones in that part of the body, and will refer back to pertinent pictures in Chapter 2.

Axial Skeleton



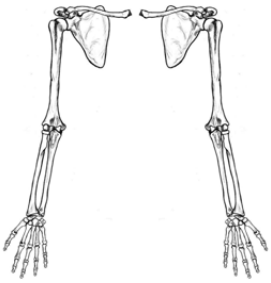
Skull:
- Cranial bones:
  - Occiput, Parietal, Temporal, Frontal, Sphenoid, Ethmoid
- Facial bones:
  - Zygomatic, Maxilla, Nasal, Lacrimal, Palatine, Vomer, Inferior Nasal Concha Mandible

Hyoid

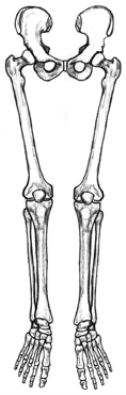
Spine:
- Cervical Vertebrae
- Thoracic Vertebrae
- Lumbar Vertebrae
- Sacrum
- Coccyx

Ribs
Sternum

Appendicular Skeleton

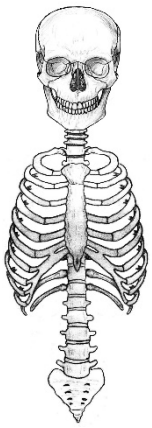


Upper Extremity:
- Clavicle
- Scapula
- Humerus
- Ulna
- Radius
- Carpals
- Metacarpals
- Phalanges of the hand

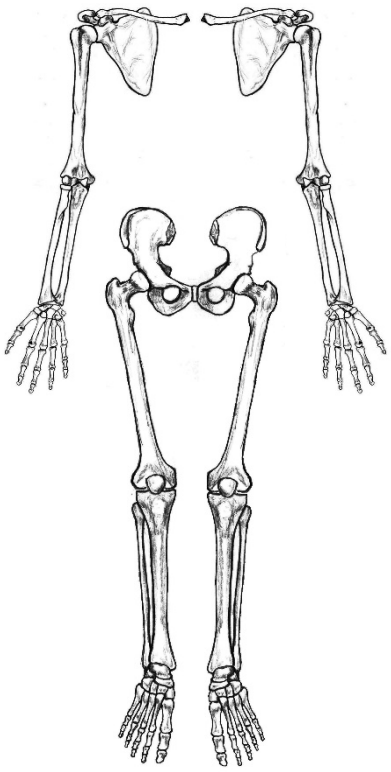


Lower Extremity:
- Hip (coxal) bone:
  - Ilium
  - Ischium
  - Pubis
- Femur
- Patella
- Tibia
- Fibula
- Tarsals
- Metatarsals
- Phalanges of the foot

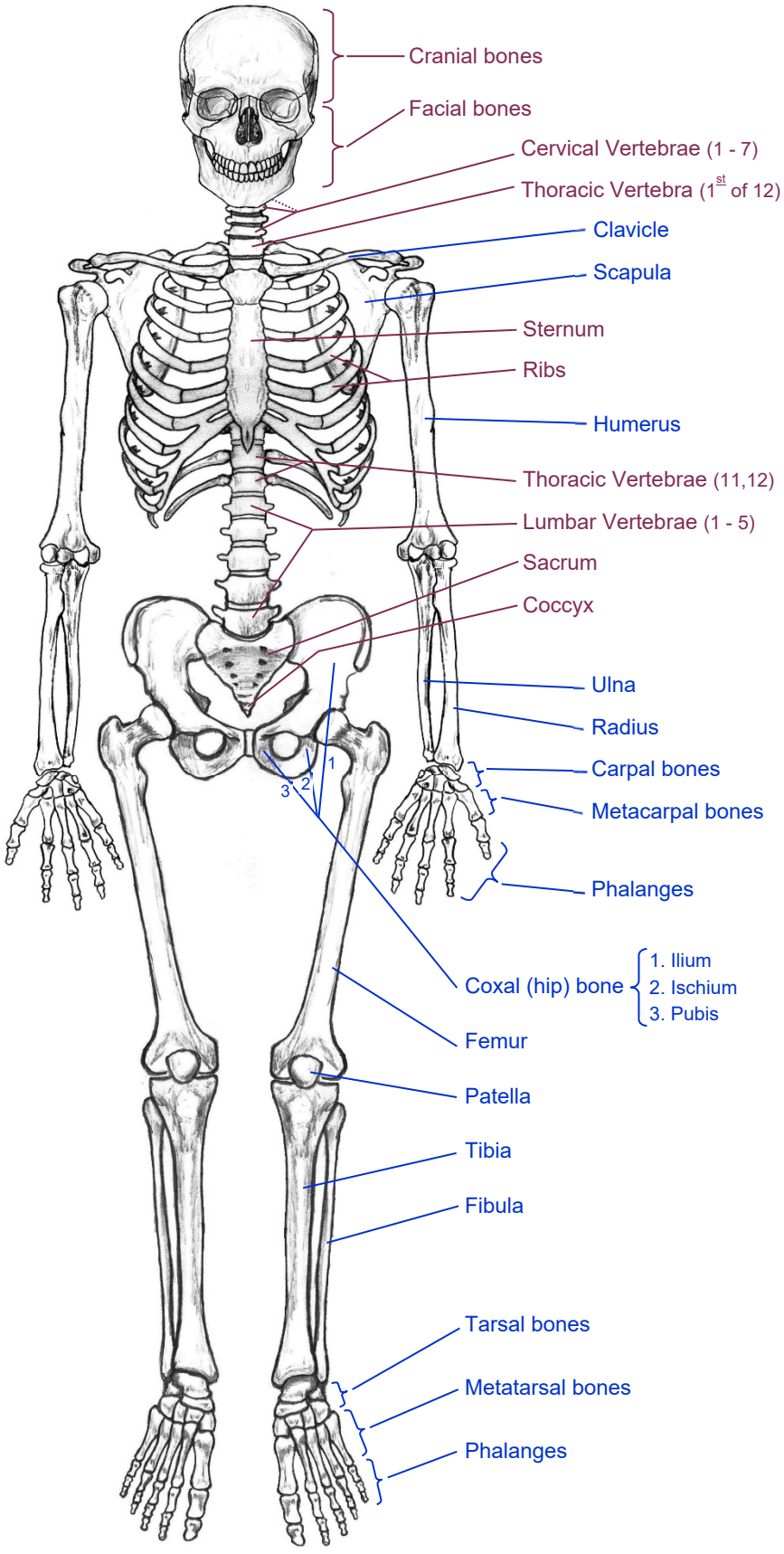
The Skeletal System



Axial Skeleton



Appendicular Skeleton



Classification of Bones by Shape

One way bones are classified is by their general shapes. Shape categories are based on the physical attributes of the bones, but the shapes also indicate certain functional or physiological features as well. For example, long bones function as levers for muscles to pull on and move body parts. Or physiologically, flat bones produce more red blood cells than other shapes. Most bones can be placed in one of the five categories shown in the table. However, some individual bones do not easily fit into one of these categories.

Bones – Classified by Shape

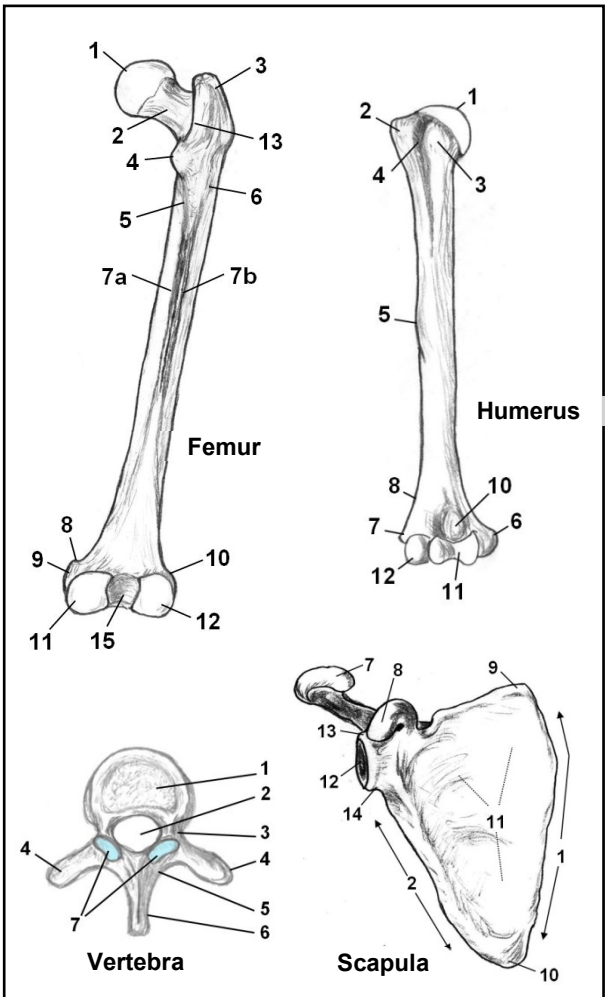
Shape	Description	Examples
Long Bones	Shaft with widened articulating ends	Humerus, fibula, phalanges
Short Bones	More or less cube-shaped	Carpal bones, most tarsal bones
Flat Bones	Have flat broad surfaces	Scapula, ribs, ilium, parietal
Irregular Bones	"Other" varied shapes	Vertebrae, sphenoid, calcaneus
Sesamoid Bones	Oval, small, suspended in tendon	Patella, a pair under base of big toe

Bony Landmarks

Bony landmarks are words that name specific locations and features on bones. These words are used when identifying origins and insertions of muscles, i.e., the places where muscles attach to bones. Naming bony landmarks also creates a precise method for referring to other features of bones, such as specific holes, grooves and edges. **Chapter 2 – Bones, Bony Landmarks, Joints, and Ligaments** has detailed illustrations for all bony landmarks used in this book. The figure to the right shows a few sample bony landmark drawings (see Chapter 2 for full size versions).

Some Common Bony Landmark Terms

Term	Description	Examples
Process	A part of a bone that "sticks out"	#8 on Scapula, #4, #6 on Vertebra
Tubercle, Tuberosity	A bump or bulging place on a bone	#2, #5 on Humerus
Fossa	A smooth, flat part of a bone (often slightly concave)	#11 on Scapula
Head	Enlarged rounded end of a long bone	#1 on Femur, #1 on Humerus
Condyle	Dual rounded ends of a bone that articulate with the next bone	#11, #12 on Femur
Epicondyle	A place on a long bone just above the condyle	#9, #10 on Femur, #6, #7 on Humerus
Foramen	A hole in a bone: Vessels, nerves or other structures pass through the hole	#2 on Vertebra



Samples of Bony Landmark Drawings

(see Chapter 2 for all bones)

Articular System – The Joints

A **joint** (also called an **articulation**) is the point of contact between two bones, between a cartilage structure and a bone, or between teeth and bones. Joints are the structures that allow the individual "rigid" bones of the skeleton to assemble into a freely moving body.

Throughout this book a special symbol ◄► is used to indicate the meeting point of the bones that make up a joint. For example, the tibiofemoral joint is the connection of the femur and the tibia at the knee. This could be represented by "femur ◄► tibia", or for greater detail, "condyles of femur ◄► condyles of tibia".

Broad Classifications of Joints - by Structure and Function

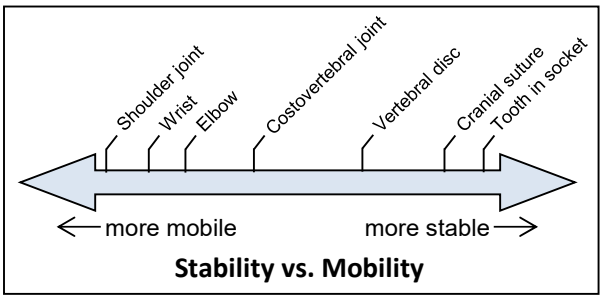
Joint structure determines function. The physical **structure of a joint** includes the shape of the articulating surfaces of the bones, how tightly they fit, and the types of tissue that hold the bones together. The **function of a joint** indicates how it moves (or doesn't move). There are three broad categories of joints:

Joints – Classified by Structure and Function

Function	Structure	Examples
Synarthrotic (immovable)	Fibrous	Cranial sutures, Teeth in sockets, 1st rib ◄► sternum
Amphiarthrotic (slightly moveable)	Cartilagenous	Intervertebral discs, Pubic symphysis, Manubrium of sternum ◄► Body of sternum
Diarthrotic (freely moveable)	Synovial	Most joints in the body. Synovial joints are described in detail below.

Stability vs. Mobility Trade-off

Stability is the ability of the body to maintain its integrity and form and to resist injury. **Mobility** is the ability of the body to move freely as required for the activities of life. A joint may allow a great deal of motion, as in the shoulder, or very little motion as in the tibiofibular joint. All joints function within an inherent trade-off: Joints that are more moveable provide less stability, while joints that are more stable tend to have less movement ability.

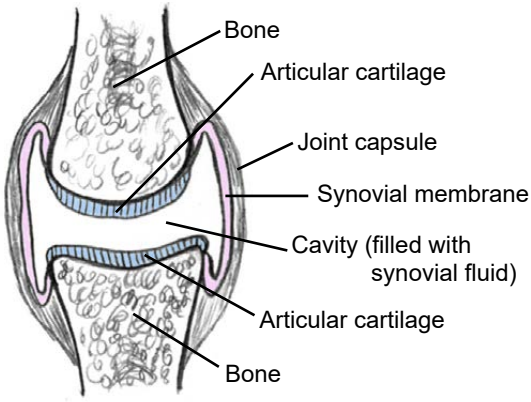


Stability vs. Mobility

Synovial Joints – Structure

Synovial joints are freely moveable (diarthrotic) because the bones are not securely connected by fibrous or cartilaginous tissue. Instead, there is a cavity that holds slippery synovial fluid between the bones. All synovial joints have the following structural components:

- Two bones that articulate
- Articular cartilage on each bone
- Joint capsule (fibrous outer shell, reinforced by ligaments)
- Synovial membrane (inner lining of capsule, secretes synovial fluid)
- Joint cavity
- Synovial fluid (in the cavity)



Structure of a Typical Synovial Joint

Accessory Structures for Synovial Joints

In addition to the basic joint capsule, synovial joints may be supported by one or more **accessory structures**. These structures include ligaments, cartilage pads, bursae, and fat pad "packing material".

Ligaments – Strong connective tissue bands that connect bone to bone and provide protection against the joint moving too far and becoming damaged. Most ligaments are outside the joint capsule (extracapsular ligaments) and span the bones that make up the joint. In addition, ligaments can be embedded within the fibrous material of the joint capsule itself, or can be completely inside the joint cavity (intracapsular ligaments).

Cartilage pads (small disc, meniscus, labrum) – Extra padding, protection, shaping, and containment inside the synovial cavity.

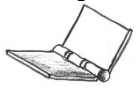
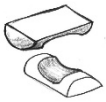
Bursae – A bursa (plural is bursae) is a sac containing synovial fluid. The composition of the sac is similar to a joint capsule, i.e., thin fibrous connective tissue lined with a synovial membrane that secretes synovial fluid. These fluid-filled sacs serve as shock absorbers or reduce friction between moving structures, and are primarily located where a muscle or tendon may rub on a bone.

Six Types of Synovial Joints

There are six types of synovial joints, based on commonality of bone shapes and supporting structures. Each type has a characteristic bone-shape/capsule/ligament arrangement that allows a certain set of actions. The joints of the body and their types are shown on a skeleton on page 17.

A mnemonic that may help you remember the six types is BS-PHEGS.

The Six Types of Synovial Joints

	Joint Type	Description	# of Axes	Action Pairs	Examples
BS	Ball & Socket 	A rounded end on one bone fits into a cupped socket on the other bone	Triaxial	Flexion, Extension Abduction, Adduction Medial & Lateral Rotation	Glenohumeral joint (shoulder joint), Coxal joint (hip joint)
P	Pivot 	A rounded projection on one bone fits into a ring formed by bone and ligament	Uniaxial	Rotation (Medial and Lateral Rotation, or Right and Left Rotation)	Radioulnar joint, Atlantoaxial joint (dens part)
H	Hinge 	Cylindrical surfaces fit together like a door hinge	Uniaxial	Flexion, Extension	Humeroulnar joint, Interphalangeal joint
E	Ellipsoid or Condyloid 	A shallow rounded end on one bone meets an oval depression on another bone	Biaxial	Flexion, Extension Abduction, Adduction (Ellipsoid is more oval shaped, condyloid is more spherical)	Radiocarpal joint, Atlanto-occipital joint, Metacarpophalangeal joint
G	Gliding or Plane 	Flat or slightly curved surfaces allow sliding in all directions	Non-axial	Gliding	Intervertebral facet joints, Intercarpal joints Intertarsal joints Acromioclavicular joint
S	Saddle 	Surfaces resemble saddles – convex one way and concave the other	Biaxial+	Flexion, Extension Abduction, Adduction, Opposition (facilitated by a specialized type of rotation)	Carpometacarpal joint #1 (base of thumb near the wrist)

Mastering Muscles & Movement

Demonstration Copy

Chapter 1 does not include pages 16-34.

Chapter 2

Bones, Bony Landmarks, Joints, and Ligaments

Introduction

Chapter 2 – Bones, Bony Landmarks, Joints, and Ligaments provides a central location in this book where all terminology on bones and joints is collected. This information is centralized in one location because you will need to refer to it frequently as you study the muscles in Chapters 4 through 6. This chapter includes an atlas of the **bones** of the body with **bony landmarks** labeled on them. Also included are full skeleton illustrations and tables and figures with summary information about **joints** and **ligaments**.

To fully learn the bones and bony landmarks, you should be able to recall the information from both **verbal** and **visual** directions. That is, when you *read* the name of a landmark you can visualize where it is on the bone, and conversely, when you *see* a place on a bone you can recall its bony landmark name.

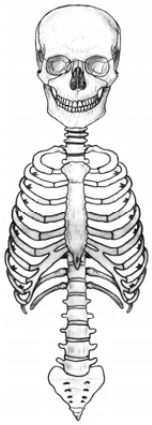
Each page of bone drawings is arranged with the bones on one side of the page and a list of bone names, bony landmarks, and joints on the other side of the page. This arrangement allows you to cover the list of names to hide it, and then use the labels on the drawings to test yourself as you memorize the names. This facilitates learning the landmarks from a *visual* direction. To study the information from a *verbal* direction, you need the opposite arrangement. That is, remove the labels on the bone drawings, and then read each bony landmark name in the list and try to visualize where it is on the bone.

The Mastering Muscles & Movement support website (studymuscles.com) has downloadable pages of bony landmark drawings with labels removed to facilitate studying from both the visual and verbal directions.

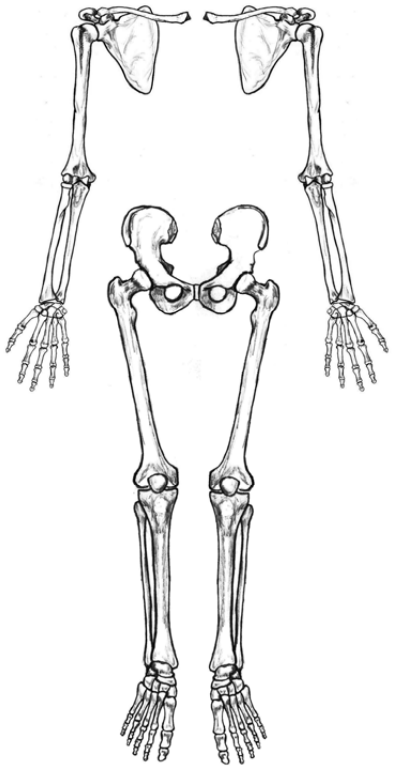
Bones of the Human Body

Axial Skeleton	Appendicular Skeleton
Skull (22) Cranial Bones (8) – Frontal (1), Parietal (2), Temporal (2), Occiput (1), Sphenoid (1), Ethmoid (1) Facial Bones (14) – Mandible (1), Zygomatic (2), Maxilla (2), Palatine (2), Nasal (2), Lacrimal (2), Vomer (1), Inferior Nasal Concha (2) Hyoid (1) Spine (26) – Cervical Vertebrae (7) Thoracic Vertebrae (12) Lumbar Vertebrae (5) Sacrum (5 V. fused) Coccyx (2-4 V. fused) Ribs (12 each side = 24) – 7 true ribs (have direct connection to sternum) 5 false ribs └— 3 connected to cartilage of rib 7 └— 2 floating Sternum (1)	**Upper Extremity:** Clavicle Scapula Humerus Ulna Radius Carpal bones (8) – Scaphoid, Lunate, Triquetrum, Pisiform, Trapezium, Trapezoid, Capitate, Hamate Metacarpal bones (5) Phalanges of the Hand (14) – Digit #1 – Thumb (Pollux) has 2 phalanges Digits #2-5 – Fingers, have 3 phalanges each Sesamoid bones of the hand **Lower Extremity:** Hip Bone (Ilium, Ischium and Pubis fused) Femur Patella Tibia Fibula Tarsal bones (7) – Talus, Calcaneus, Cuboid, Navicular, 1st, 2nd and 3rd Cuneiforms Metatarsal bones (5) Phalanges of the Foot (14) – Digit #1 – Big toe (Hallux), has 2 phalanges Digits #2-5 – Toes, have 3 phalanges each Sesamoid bones of the foot

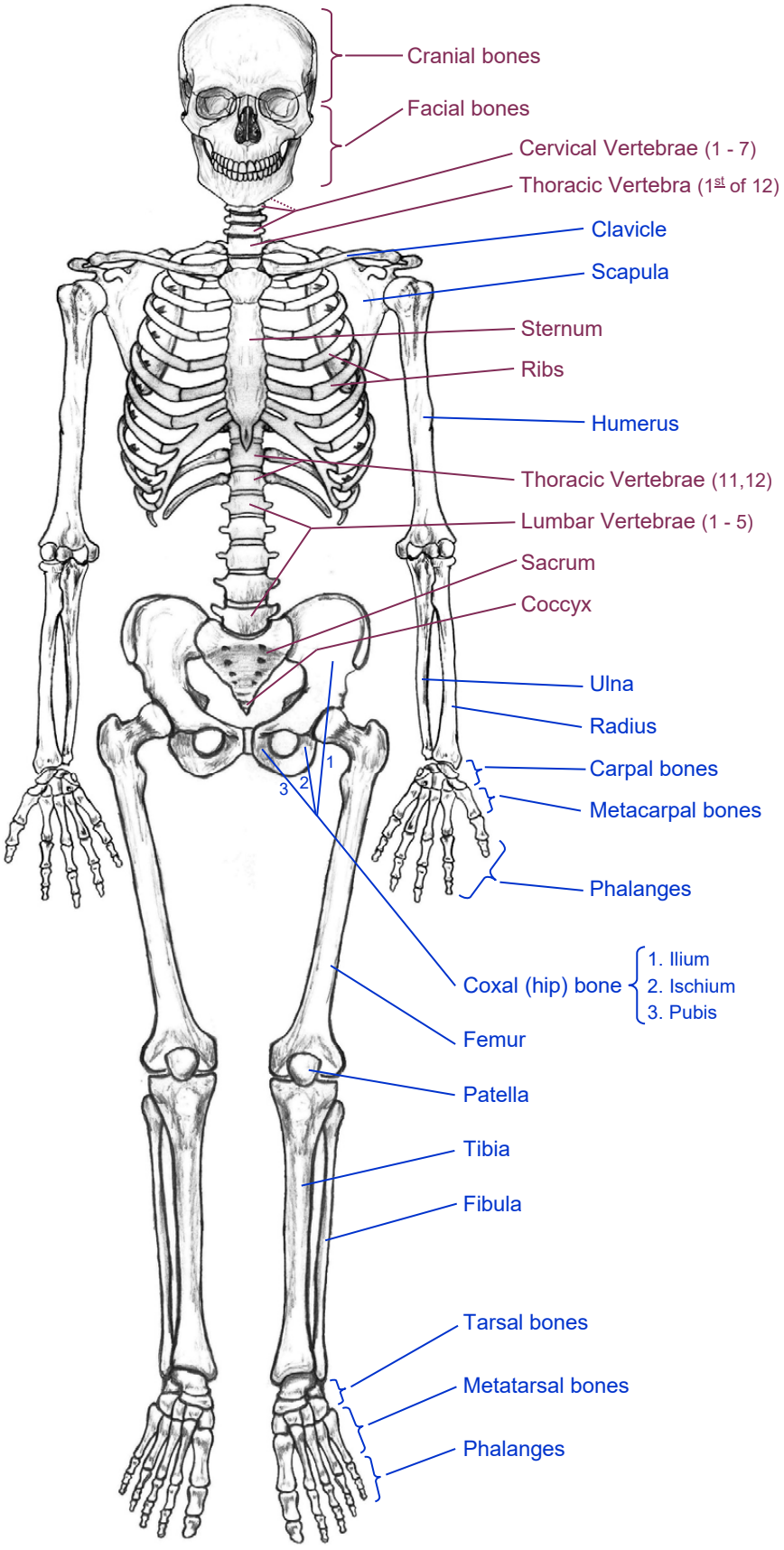
The Skeletal System



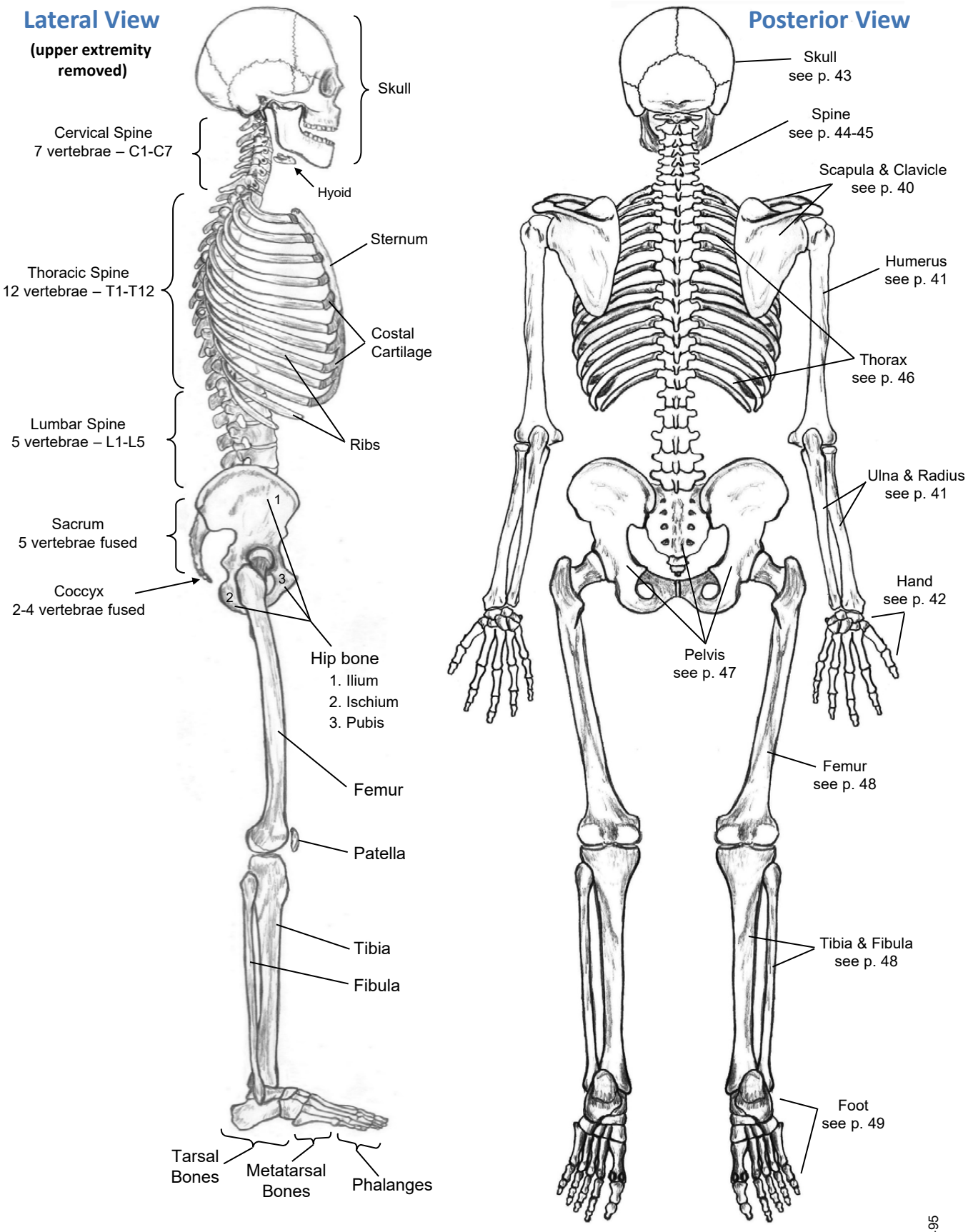
Axial Skeleton



Appendicular Skeleton

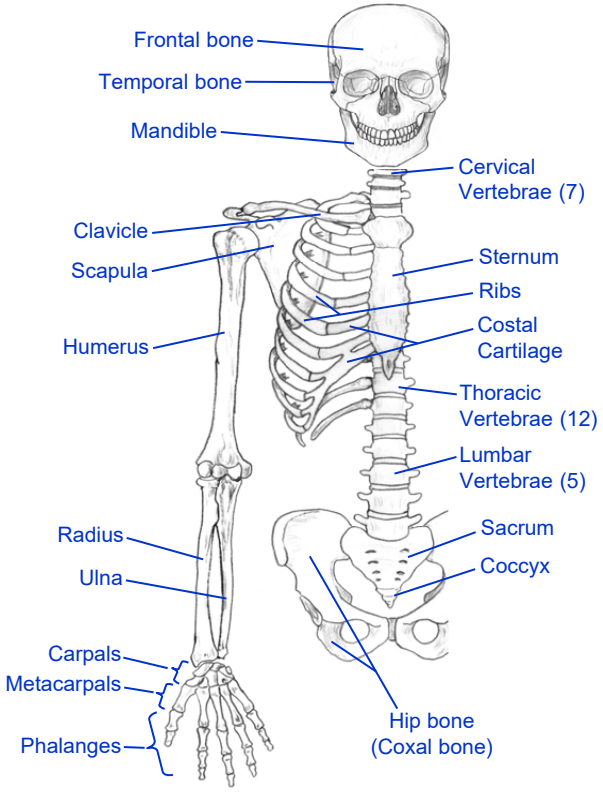


The Skeletal System

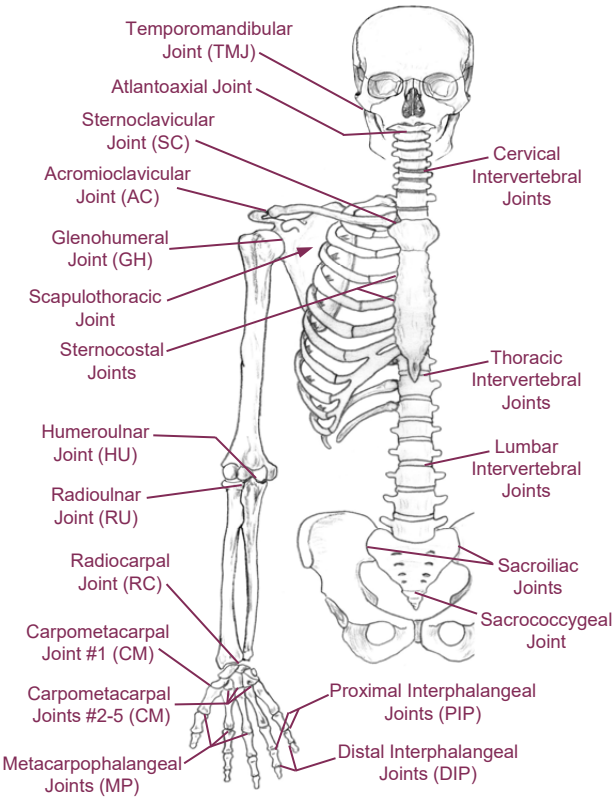


Comparison of Bone and Joint Names

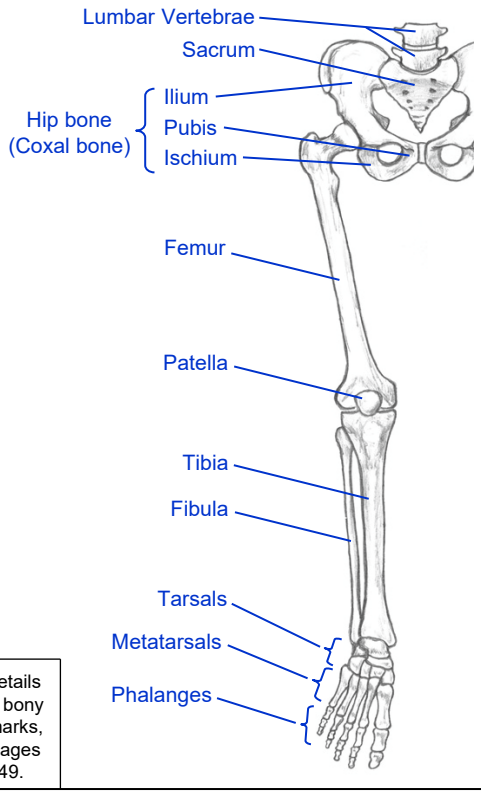
Upper Body – Bones



Upper Body – Joints

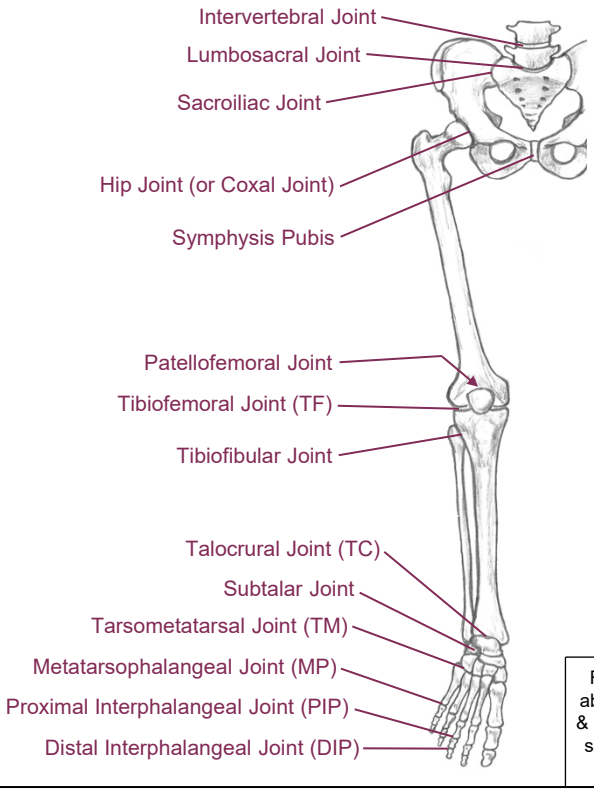


Lower Body – Bones

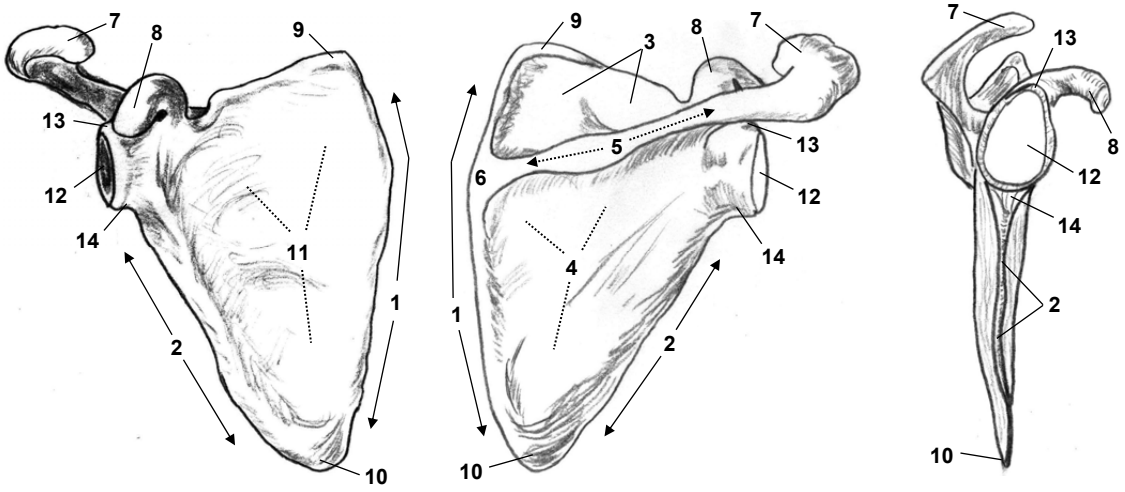


For details about bony landmarks, see pages 40-49.

Lower Body – Joints



For more about joints & ligaments, see pages 50-53.

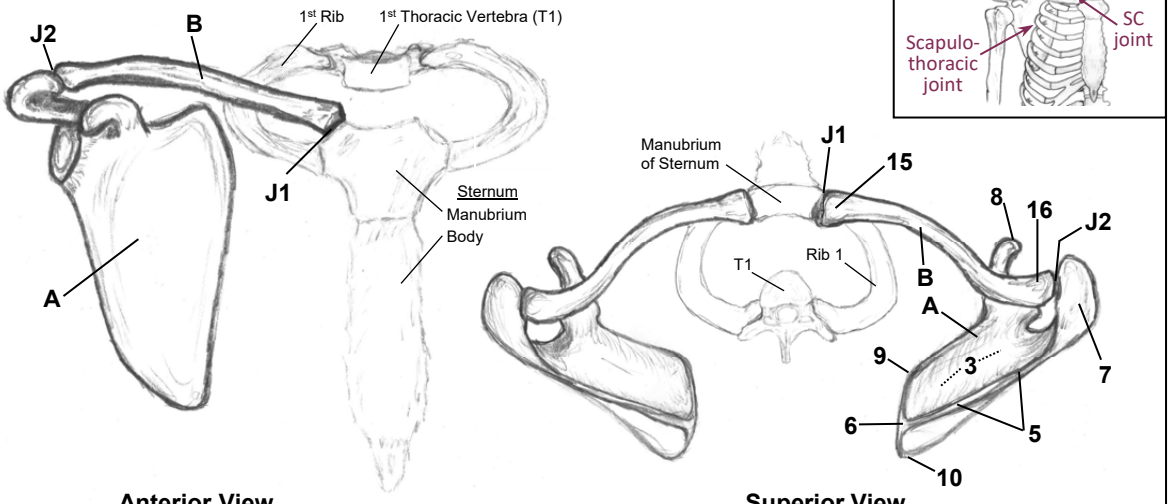


Anterior **Posterior** **Lateral**

Right Scapula

1. Medial (vertebral) border
2. Lateral (axillary) border
3. Supraspinous fossa
4. Infraspinous fossa
5. Spine
6. Root of spine
7. Acromion
8. Coracoid process
9. Superior angle
10. Inferior angle
11. Subscapular fossa
12. Glenoid fossa (Glenoid cavity)
13. Supraglenoid tubercle
14. Infraglenoid tubercle

Scapula



Anterior View **Superior View**

Shoulder Girdle (= Scapula + Clavicle)

A. Scapula

3. Supraspinous fossa
5. Spine of scapula
6. Root of spine
7. Acromion
8. Coracoid process
9. Superior angle
10. Inferior angle

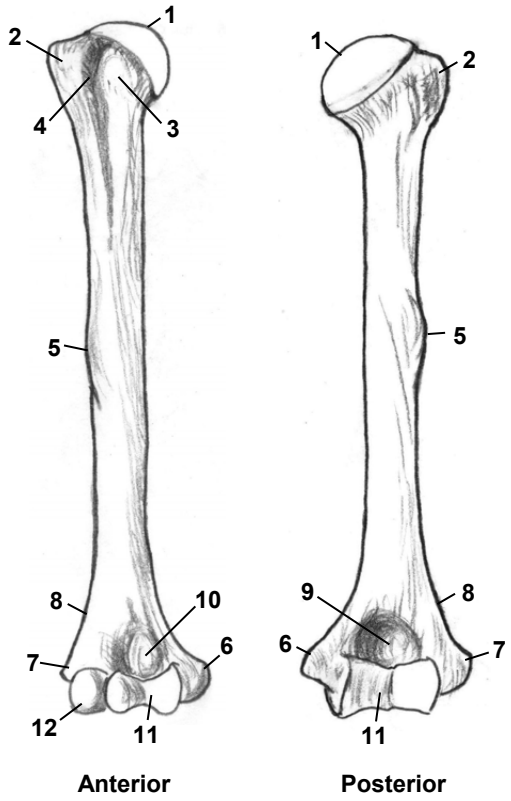
B. Clavicle

15. Sternal (medial) end
16. Acromial (lateral) end

Joints

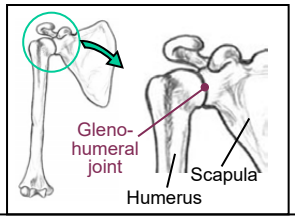
J1. Sternoclavicular joint (SC)
J2. Acromioclavicular joint (AC)

Shoulder Girdle

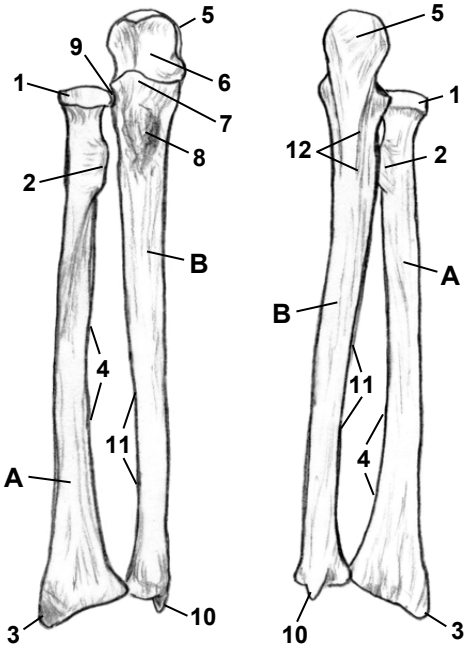


Right Humerus

1. Head
2. Greater tubercle
3. Lesser tubercle
4. Intertubercular groove (Bicipital groove)
5. Deltoid tuberosity
6. Medial epicondyle
7. Lateral epicondyle
8. Lateral supracondylar ridge
9. Olecranon fossa
10. Coronoid fossa
11. Trochlea
12. Capitulum



Upper Arm



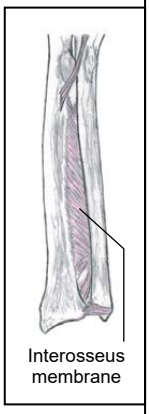
Right Radius & Ulna

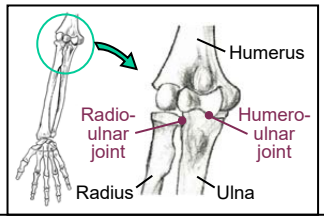
A. Radius

1. Head of radius
2. Radial tuberosity
3. Styloid process
4. Interosseus border

B. Ulna

5. Olecranon process
6. Trochlear notch
7. Coronoid process
8. Ulnar tuberosity
9. Radial notch
10. Styloid process
11. Interosseus border
12. Supinator crest





Forearm

Mastering Muscles & Movement

Demonstration Copy

Chapter 2 does not include pages 42-54.

Chapter 3

Using the Brain-Friendly System to Optimize Your Learning

Introduction

Chapter 3 – Using the Brain-Friendly System to Optimize Your Learning provides an orientation before you begin learning all the muscles described in the following chapters (4, 5, and 6). You will learn how to use the tables and figures in Chapters 4 – 6 and how to get the most out of studying the muscles.

Because this book is for the study of kinesiology (i.e., movement of the body), the muscles are organized into groups based on the bones and joints they move as they contract. For example, all muscles whose primary action is to move the humerus around an axis at the shoulder joint are presented in "Muscle Group 2 – Movement of the Shoulder Joint". This arrangement makes it easier to recall the information when you are looking at the body from a movement perspective.

Thirteen **muscle groups** are presented in Chapters 4, 5 and 6 based on major body divisions:

Chap. 4	Muscles That Move the Upper Extremity
Group 1:	Movement of the Scapula/Clavicle
Group 2:	Movement of the Shoulder Joint
Group 3:	Movement of the Elbow, Forearm
Group 4:	Movement of the Wrist, Hand, Fingers
Group 5:	Movement of the Thumb
Chap. 5	**Muscles That Move the Axial Skeleton**
Group 6:	Movement of the Face and Jaw
Group 7:	Movement of the Neck and Head
Group 8:	Movement of the Spine
Group 9:	Movement of Thorax, Abdomen, Breathing
Chap. 6	**Muscles That Move the Lower Extremity**
Group 10:	Movement of the Hip Joint (Part 1)
Group 11:	Movement of the Hip Joint (Part 2)
Group 12:	Movement of the Knee (& Hip Joint, Part 3)
Group 13:	Movement of the Ankle, Foot and Toes

In addition, concise **bonus muscle groups** have been added at the end of each chapter (they do not use the full 8-page format described next).

At the end of:	Bonus Muscle Groups
Chapter 4	Intrinsic Muscles of the Hand
Chapter 5	Muscles of the Pelvic Floor
Chapter 6	Intrinsic Muscles of the Foot

8-Page Format

A consistent **8-page format** is used to present each group of muscles. The repetitive format supports the brain-friendly philosophy of this book. A diagram of this 8-page format is shown on the next page. The following organization is used:

General Information –
The first three pages include a list of the muscles in the group, a description of the joints and actions involved, a list of the associated bones and bony landmarks, and overview drawings showing all the muscles and their attachments in place on the skeleton. Please see pages 58-59 for details.

The "A" Table and Figure –
The 4th and 5th pages provide text and drawings about the structure and function of the muscles in the group (see pages 60-61 for more information).

Table (A) – Origins, Insertions, Actions
A table presenting the descriptive information for the muscles.

Figure (A) – Muscle Attachments
Bone drawings with red and blue areas showing origins and insertions of the muscles.

The "B" Table and Figure –
The 6th and 7th pages allow further analysis of muscle actions, show innervation, and give full size illustrations of the muscles (see pages 62-63).

Table (B) – Synergists & Antagonists
A special table to study and compare muscle **actions.** This table also includes the **innervation** for each muscle.

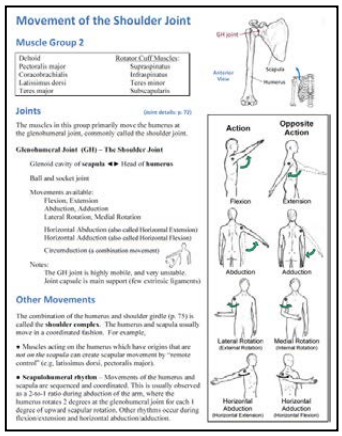
Figure (B) – Muscle Pictures
Illustrations of the muscles, to encourage looking at muscle shapes and fiber directions while analyzing actions.

Note-Taking Page (or Bonus Muscle Group) –
The final (8th) page for a group has small pictures of the muscles with blank areas for writing notes. (Note that this 8th page is sometimes used to show a bonus muscle group).

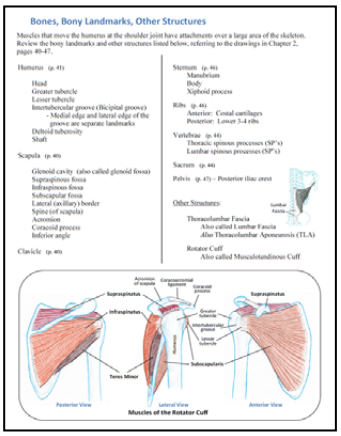
8-Page Format For Each Group of Muscles

General info about the Group (3 pages)

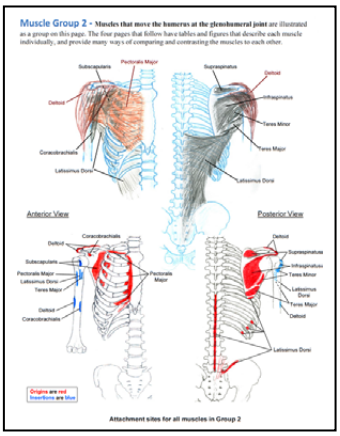
See page 58 for details



1. Descriptions of Joint(s), Actions and General Information



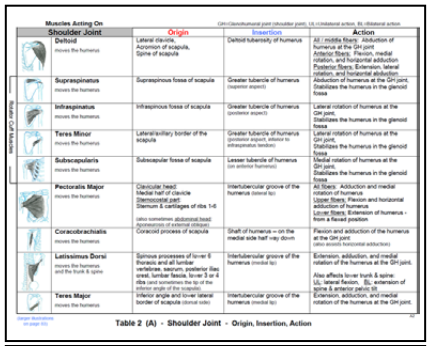
2. Bones, Landmarks, Structures and Note-Taking Area



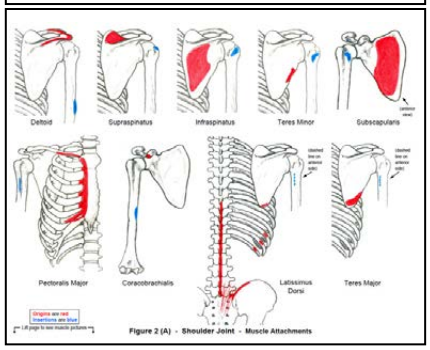
3. All muscles shown together and all origins & insertions together

"A" Table

See page 60 for details



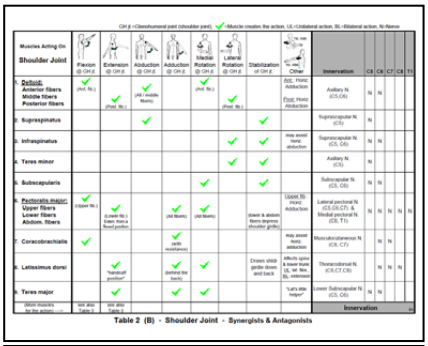
"A" Figure



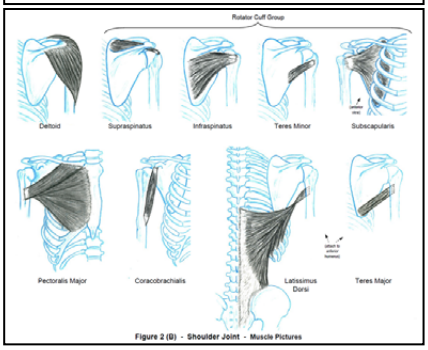
4. and **5.** Verbal Data: Origins, Insertions, Actions
Visual depictions of the verbal data

"B" Table

See page 62 for details

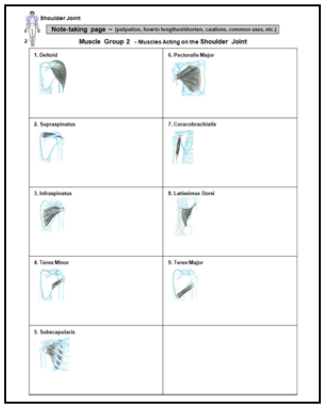


"B" Figure



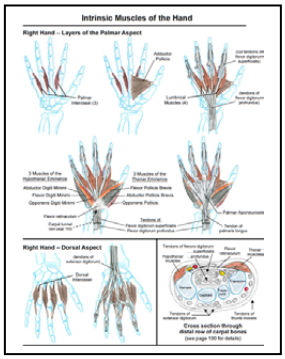
6. and **7.** Relational Tables for Actions & Innervation
Drawings of the muscles on same scale

Notes Page



8. Page for writing notes about muscles

– OR –



The **Notes** page is sometimes replaced with a **Bonus Muscle Group** like this.

How to Use the General Information Pages

Each group of muscles in chapters 4, 5, and 6 begins with three pages of general information. This overview of the group includes summaries of the joint(s) involved, the actions that are possible, and the bones, landmarks and other structures that are muscle attachments or are significantly involved in some other way. The General Information pages have the following components:

- A list of the muscles in the group
- Descriptions of the joint(s) moved by the muscles
- Movements available at those joints
- Action drawings
- Bony landmarks and other structures to preview before studying the individual muscles
- Overview drawings of the muscles and their attachments

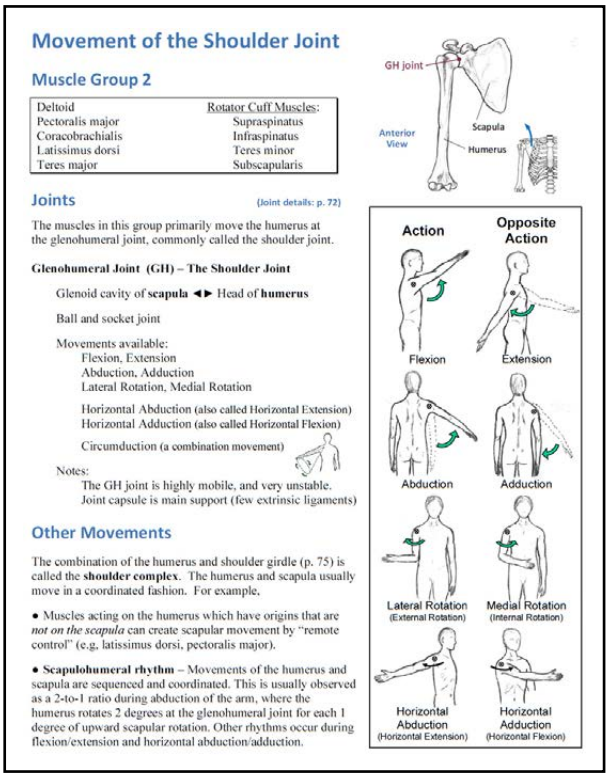
Joints and Actions

(1st page of the 8-page format)

The main joint or joints that are moved by the muscle group are given first, and other joints that are secondarily involved are listed second. A special symbol ◄► is used to indicate the meeting point (articulation) of the bones that make up the joint. Also included are the type of joint, the movements available at the joint, and other pertinent information.

Action Pair Drawings

For each muscle group, illustrations show the actions available for the main joints or structures moved when the muscles contract. These illustrations are organized in pairs to show how different actions oppose each other (opposite actions are done by antagonist muscles). The precise point where the joint in question is moving around its axis is indicated with a symbol " ⊗ ", and the direction the body part is moving is indicated with an arrow. Examples of action pairs are shown in the figure to the right.



Movement of the Shoulder Joint

Muscle Group 2

	Rotator Cuff Muscles:
Deltoid	Supraspinatus
Pectoralis major	Infraspinatus
Coracobrachialis	Teres minor
Latissimus dorsi	Subscapularis
Teres major	

Joints (Joint details: p. 72)

The muscles in this group primarily move the humerus at the glenohumeral joint, commonly called the shoulder joint.

Glenohumeral Joint (GH) – The Shoulder Joint

Glenoid cavity of **scapula** ◄► Head of **humerus**

Ball and socket joint

Movements available:
Flexion, Extension
Abduction, Adduction
Lateral Rotation, Medial Rotation

Horizontal Abduction (also called Horizontal Extension)
Horizontal Adduction (also called Horizontal Flexion)

Circumduction (a combination movement)

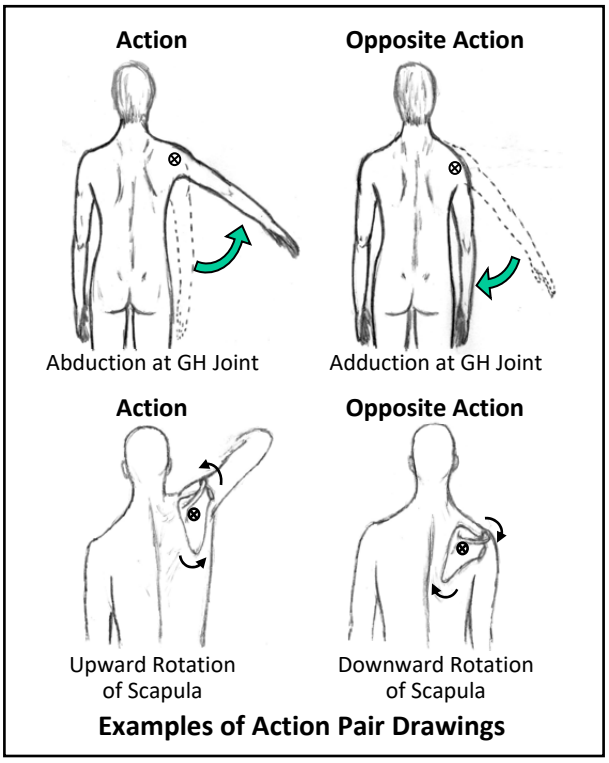
Notes:
The GH joint is highly mobile, and very unstable.
Joint capsule is main support (few extrinsic ligaments)

Other Movements

The combination of the humerus and shoulder girdle (p. 75) is called the **shoulder complex**. The humerus and scapula usually move in a coordinated fashion. For example,

- Muscles acting on the humerus which have origins that are *not on the scapula* can create scapular movement by "remote control" (e.g, latissimus dorsi, pectoralis major).
- **Scapulohumeral rhythm** – Movements of the humerus and scapula are sequenced and coordinated. This is usually observed as a 2-to-1 ratio during abduction of the arm, where the humerus rotates 2 degrees at the glenohumeral joint for each 1 degree of upward scapular rotation. Other rhythms occur during flexion/extension and horizontal abduction/adduction.

Joints and Actions (see p. 83 for full size page)



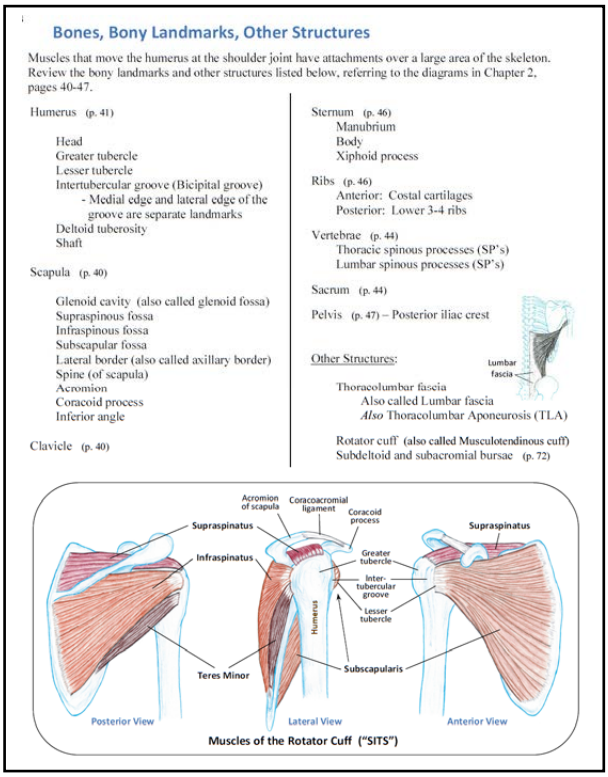
Examples of Action Pair Drawings

Bones, Bony Landmarks, Other Structures – Preview List

(2nd page of the 8-page format)

This page lists the bones, bony landmarks, and other body structures that are attachments for the muscles in the group. Also listed are other structures that are significantly involved with the use of the muscles. It is a good idea to preview the bony landmarks listed on this page before you begin studying the origins and insertions of the muscles (all bony landmark drawings are centralized in Chapter 2 of this book). Then, as you read and memorize each muscle, the names of landmarks will be familiar.

The bottom of this page often provides additional illustrations and information to highlight special features and terminology related to the muscle group. This may include special groupings within the group, cross-sections, or brief descriptions of smaller muscles that are not included in the main "**A**" and "**B**" tables for the muscle group.



Bones, Bony Landmarks, etc. (see p. 84 for full size page)

Muscle Overview Drawings

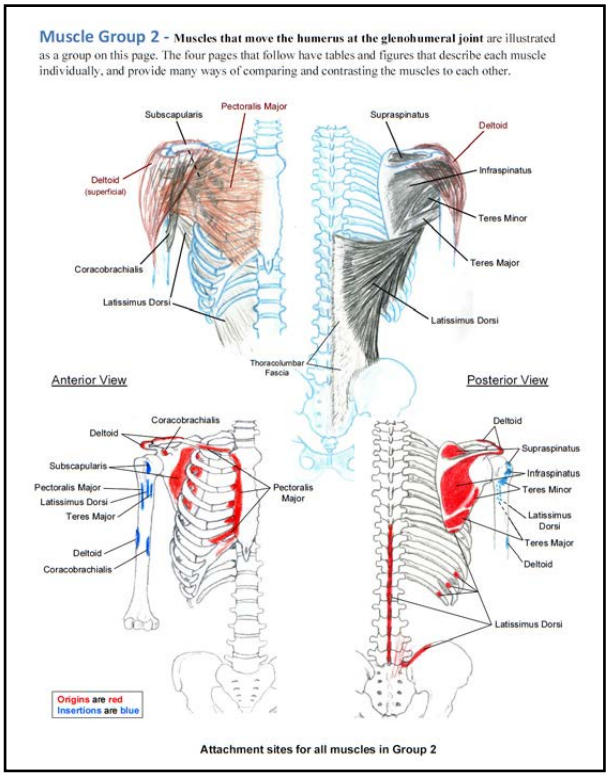
(3rd page of the 8-page format)

Overview drawings provide a "big picture" for the muscle group to give an overall sense of the group before going on to study the individual muscles. Two types of drawings are provided:

1. All muscles shown together in place on the skeleton.
2. Skeleton pictures with all origins in red and insertions in blue.

Use these drawings to look for patterns to help you understand how the muscles in the group work together. For example, Muscle Group 2 has muscles that move the humerus at the glenohumeral joint. You can see that all the insertions (shown in blue) are gathered on the humerus, while the origins (shown in red) are spread over a large area on many other bones of the body.

These illustrations are also useful to begin understanding which of the muscles in the group reside in different layers.



Overview Drawings (see p. 85 for full size page)

How to Use the Tables and Figures

Each group of muscles is presented in a consistent manner. Once you get used to this organization, you will find it easy to study and interrelate the information, as well as quickly look up individual muscles.

Each of the 13 groups of muscles is presented with two pairs of tables and figures: The "**A**" table and figure, and the "**B**" table and figure. All tables and figures for a given muscle group are enumerated with the group number, for example,

Muscle Group **1**: Table **1**(A), Figure **1**(A), Table **1**(B), Figure **1**(B)
Muscle Group **2**: Table **2**(A), Figure **2**(A), Table **2**(B), Figure **2**(B)
•
•
•
Muscle Group **13**: Table **13**(A), Figure **13**(A), Table **13**(B), Figure **13**(B)

The "A" Table and Figure

(4th and 5th pages of the 8-page format)

An "**A**" Table and "**A**" Figure for a muscle group are shown on pages facing each other, so you can easily refer back and forth as you study them. The example on the following page shows Table 2 (A) and Figure 2 (A), which are from Muscle Group 2, the muscles that move the humerus at the shoulder joint (glenohumeral joint).

Table 2 (A) – Origin, Insertion, Action

The **"A" Table** contains verbal descriptions of the origins, insertions, and actions for each muscle. As you study the muscles, occasionally look up and down each column to compare and contrast which muscles have similar attachments and actions, and which muscles differ. By continually looking for word patterns as you learn the information, you will help anchor the words in your brain and make them easier to recall later.

As you read the **Origins** and **Insertions** for each muscle, look down to the facing page (Figure 2 (A)), and observe the red and blue spots drawn on the bones. This will help relate the words in the Table to an image of exactly what the words mean. It will be easier to do this if you have *previewed* the bony landmarks listed a few pages prior.

As you read the **Actions**, move your body, or that of a partner, to relate the words to actual movements. Also, remember all the actions named in the right hand column of this "A" table have been gathered, sorted out, and re-listed across the top of the "B" table for further study (see next section).

Note that sometimes portions of text in the tables are in smaller print and enclosed in parentheses. These parenthetical phrases add extra detail to the basic information in a table cell. The idea is to have a concise description of origin, insertion, and action that is sufficient for most readers, and then provide more details for those readers who require advanced information.

Figure 2 (A) – Muscle Attachments

The **"A" Figure** illustrates the places where the muscles attach to the bones. **Red** indicates **origin** and **blue** indicates **insertion**. Visualize lines of force (e.g., puppet strings, ropes,…) connecting the red area to the blue area and think about what happens when the blue point on the more moveable bone is pulled toward the red area on the more stable bone.

Relate the movement you visualize to the words in the **Action** column of Table 2 (A), keeping in mind any constraints imposed by the bone shapes, joint type, etc. (see "Real-time Factors that Affect a Muscle's Actions" on page 67).

Comparing O/I Pictures to Muscle Pictures

Note that you can lift the "A" Figure page to see pictures of the individual muscles to go with each of the origin/insertion bone drawings. The **"B" Figure – Muscle Pictures** page is always two pages after the "A" Figure, so the muscle pictures lie directly under the bone attachment drawings.

Example of an "A" Table and Figure

Each **row** gives all information for a single muscle. For example, row 2 gives Origin, Insertion & Action for the Supraspinatus muscle.

Each **column** gives a single feature for all muscles. For example, column 3 gives the Insertions for all the muscles.

Muscles Acting On GH=Glenohumeral joint (shoulder joint), UL=Unilateral action, BL=Bilateral action

Shoulder Joint	Origin	Insertion	Action
Rotator Cuff Muscles			
Deltoid moves the humerus	Lateral clavicle, Acromion of scapula, Spine of scapula	Deltoid tuberosity of humerus	All / middle fibers: Abduction of humerus at the GH joint Anterior fibers: Flexion, medial rotation, and horizontal adduction Posterior fibers: Extension, lateral rotation, and horizontal abduction
Supraspinatus moves the humerus	Supraspinous fossa of scapula	Greater tubercle of humerus (superior aspect)	Abduction of humerus at the GH joint, Stabilizes the humerus in the glenoid fossa
Infraspinatus moves the humerus	Infraspinous fossa of scapula	Greater tubercle of humerus (posterior aspect)	Lateral rotation of humerus at the GH joint, Stabilizes the humerus in the glenoid fossa
Teres Minor moves the humerus	Lateral/axillary border of the scapula	Greater tubercle of humerus (posterior aspect, inferior to infraspinatus tendon)	Lateral rotation of humerus at the GH joint, Stabilizes the humerus in the glenoid fossa
Subscapularis moves the humerus	Subscapular fossa of scapula	Lesser tubercle of humerus (on anterior humerus)	Medial rotation of humerus at the GH joint, Stabilizes the humerus in the glenoid fossa
Pectoralis Major moves the humerus	Clavicular head: Medial half of clavicle Sternocostal part: Sternum & cartilages of ribs 1-6 (also sometimes abdominal head: Aponeurosis of external oblique)	Intertubercular groove of the humerus (lateral lip)	All fibers: Adduction and medial rotation of humerus Upper fibers: Flexion and horizontal adduction of humerus Lower fibers: Extension of humerus - from a flexed position
Coracobrachialis moves the humerus	Coracoid process of scapula	Shaft of humerus -- on the medial side half way down	Flexion and adduction of the humerus at the GH joint (also assists horizontal adduction)
Latissimus Dorsi moves the humerus and the trunk & spine	Spinous processes of lower 6 thoracic and all lumbar vertebrae, sacrum, posterior iliac crest, lumbar fascia, lower 3 or 4 ribs (and sometimes the tip of the inferior angle of the scapula)	Intertubercular groove of the humerus (medial lip)	Extension, adduction, and medial rotation of the humerus at the GH joint. Also affects lower trunk & spine: UL: lateral flexion, BL: extension of spine & anterior pelvic tilt
Teres Major moves the humerus	Inferior angle and lower lateral border of scapula (dorsal side)	Intertubercular groove of the humerus (medial lip)	Extension, adduction, and medial rotation of the humerus at the GH joint.

A2

(larger illustrations on page 83)

Table 2 (A) - Shoulder Joint - Origin, Insertion, Action

See page 86 for full size Table 2 (A)

Compare the words in the **A** Table above to the pictures in the **A** Figure below.

Origins: Shown in **Red**
Insertions: Shown in **Blue**
Actions: Visualize the blue being pulled toward the red

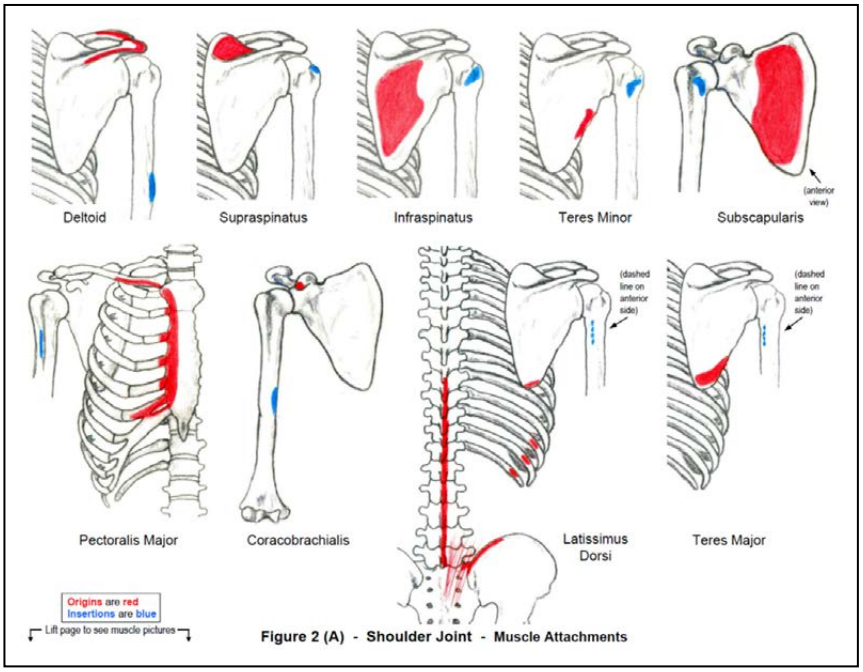
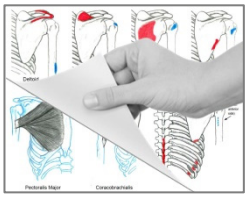


Figure 2 (A) - Shoulder Joint - Muscle Attachments

See page 87 for full size Figure 2 (A)

Lift this "A" Figure page to see the associated "B" Figure



Each row of pictures is sized and oriented for easy comparison of muscle attachments.

A dashed line indicates a muscle attachment on the opposite side of the bone from the side you are viewing.

The "B" Table and Figure

(6th and 7th pages of the 8-page format)

The "**B**" Table and "**B**" Figure are on pages facing each other so you can easily refer back and forth as you study them. The example on the following page shows Table 2 (B) and Figure 2 (B), which are from Muscle Group 2, the muscles that move the humerus at the shoulder joint.

Table 2 (B) – Synergists & Antagonists

The **B Table** has muscle names listed down the left-hand side. Across the top are all actions that are possible for the joint(s) of that muscle group. This creates a grid format where each muscle is represented by a row and each action by a column.

	Action 1	Action 2	Action 3	Action 4	Action 5
Muscle 1		✓	✓		
Muscle 2					✓
Muscle 3	✓				✓
Muscle 4		✓			

Each **row** shows all the Actions created by that Muscle

	Action 1	Action 2	Action 3	Action 4	Action 5
Muscle 1		✓	✓		
Muscle 2					✓
Muscle 3	✓				✓
Muscle 4		✓			

Each **column** shows all the Muscles that create that Action

In the cells of this grid are ✓ marks or other symbols that indicate how the muscle (the row) is involved with the action (the column). The following table describes all symbols that are used in the cells.

The arrangement of the **B** table is particularly suitable for learning the relationships of muscles that work together to perform a given action (synergists), as well as which muscles oppose that action (antagonists).

Symbols used in the B Tables

Symbol	Meaning
✓	The muscle creates the action (agonist, prime mover)
✓assist	The muscle assists the action but is not a prime mover
may assist	May assist, depending on strength requirements or relative bone angles
"__ fibers"	A muscle *portion* creates the action (e.g., "anterior fibers" or "upper fibers")
UL	Unilateral contraction creates the action (applies to axial skeleton, see p. 121)
BL	Bilateral contraction creates the action (applies to axial skeleton, see p. 121)
☐	(empty cell) The muscle *does not* contribute to the action

More Features of the B tables:

- Pairs of actions that are opposites are placed in adjacent columns. This allows looking down one column to see the synergists for an action, and then looking at the adjacent column to see the antagonists for the action. (ref. page 31)
- The **B** table also has an area on the right hand side that gives the **Innervation** for each muscle. The names of the nerve(s) that supply each muscle are listed, and the spinal segments are indicated in table format. (ref. page 24)
- The bottom row, with title "More muscles for the action --->", indicates when muscles in other muscle groups also contribute to the action indicated in a column. If so, the words "see also Group #" are in the cell.

Figure 2 (B) – Muscle Pictures

The **B Figure** contains pictures of the muscles for comparison. For example, Figure 2 (B) is located on a page facing Table 2 (B) so you can look back and forth to relate the actions in the table with muscle positions, shapes, and fiber directions.

Note that the **B** Figure is on a page directly under the **A** Figure two pages prior, so you can easily compare the muscle shape with the red and blue origins and insertions shown in the **A** Figure.

Example of a "B" Table and Figure

Each **row** shows ✓'s for the actions created by a single muscle. For example, row 2 indicates that the Supraspinatus muscle creates abduction and stabilizes the GH joint.

Each **column** shows ✓'s for all muscles that create an action. For example, Lateral Rotation at the GH joint is created by the Deltoid (posterior fibers), Infraspinatus, and Teres Minor muscles.

Group 2: GH jt.=Glenohumeral joint (shoulder joint), ✓=Muscle creates the action, UL=Unilateral action, BL=Bilateral action, N=Nerve

Muscles Acting On Shoulder Joint	Flexion @ GH jt.	Extension @ GH jt.	Abduction @ GH jt.	Adduction @ GH jt.	Medial Rotation @ GH jt.	Lateral Rotation @ GH jt.	Stabilization of GH jt.	Other	Innervation	C5	C6	C7	C8	T1
1. Deltoid: Anterior fibers Middle fibers Posterior fibers	✓ (Ant. fib.)	✓ (Post. fib.)	✓ (All / middle fibers)		✓ (Ant. fib.)	✓ (Post. fib.)		Ant.: Horiz. Adduction Post: Horiz. Abduction	Axillary N. (C5,C6)	N	N			
2. Supraspinatus			✓				✓		Suprascapular N. (C5)	N				
3. Infraspinatus						✓	✓	may assist horiz. abduction	Suprascapular N. (C5, C6)	N	N			
4. Teres Minor						✓	✓		Axillary N. (C5)	N				
5. Subscapularis					✓		✓		Subscapular N. (C5, C6)	N	N			
6. Pectoralis Major: Upper fibers Lower fibers Abdom. fibers	✓ (Upper fib.)	✓ (Lower fib.) Exten. from a flexed position		✓ (All fibers)	✓ (All fibers)		(lower & abdom fibers depress shoulder girdle)	Upper fib.: Horiz. Adduction	Lateral pectoral N. (C5,C6,C7) & Medial pectoral N. (C8, T1)	N	N	N	N	N
7. Coracobrachialis	✓			✓ (with resistance)				may assist horiz. adduction	Musculocutaneous N. (C6, C7)		N	N		
8. Latissimus Dorsi		✓ "handcuff position"		✓ (behind the back)	✓		Draws shldr girdle down and back	Affects spine & lower trunk. UL: lat. flex., BL: extension	Thoracodorsal N. (C6,C7,C8)		N	N	N	
9. Teres Major		✓		✓	✓			"Lat's little helper"	Lower Subscapular N. (C5, C6)	N	N			
(More muscles for the action) ---->	see also Group 3	see also Group 3							Innervation					B3

Nerve name
Spinal segments

Right-hand portion of Table shows nerves that supply each muscle (Innervations)

See page 88 for full size Table 2 (B)

Table 2 (B) - Shoulder Joint - Synergists & Antagonists

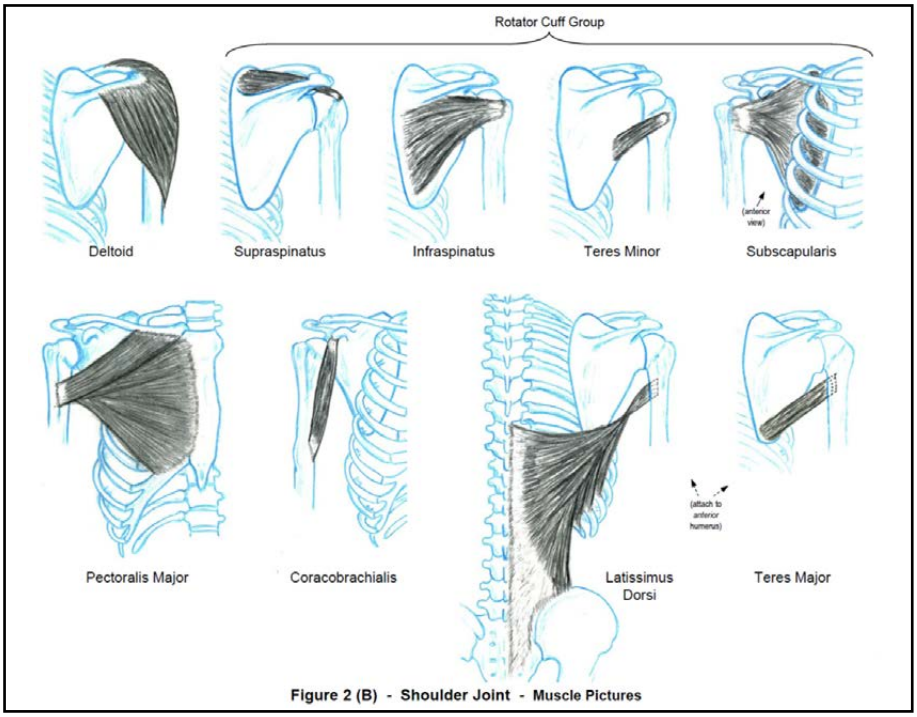
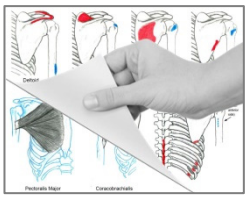


Figure 2 (B) - Shoulder Joint - Muscle Pictures

See page 89 for full size Figure 2 (B)

Lift previous page "A" Figure to see this "B" Figure



Each row of pictures is sized and oriented for easy comparison of muscles.

Dashed lines indicate that part of a muscle is on the opposite side of the bone from the side you are viewing.

An Example: Learning the Deltoid Muscle

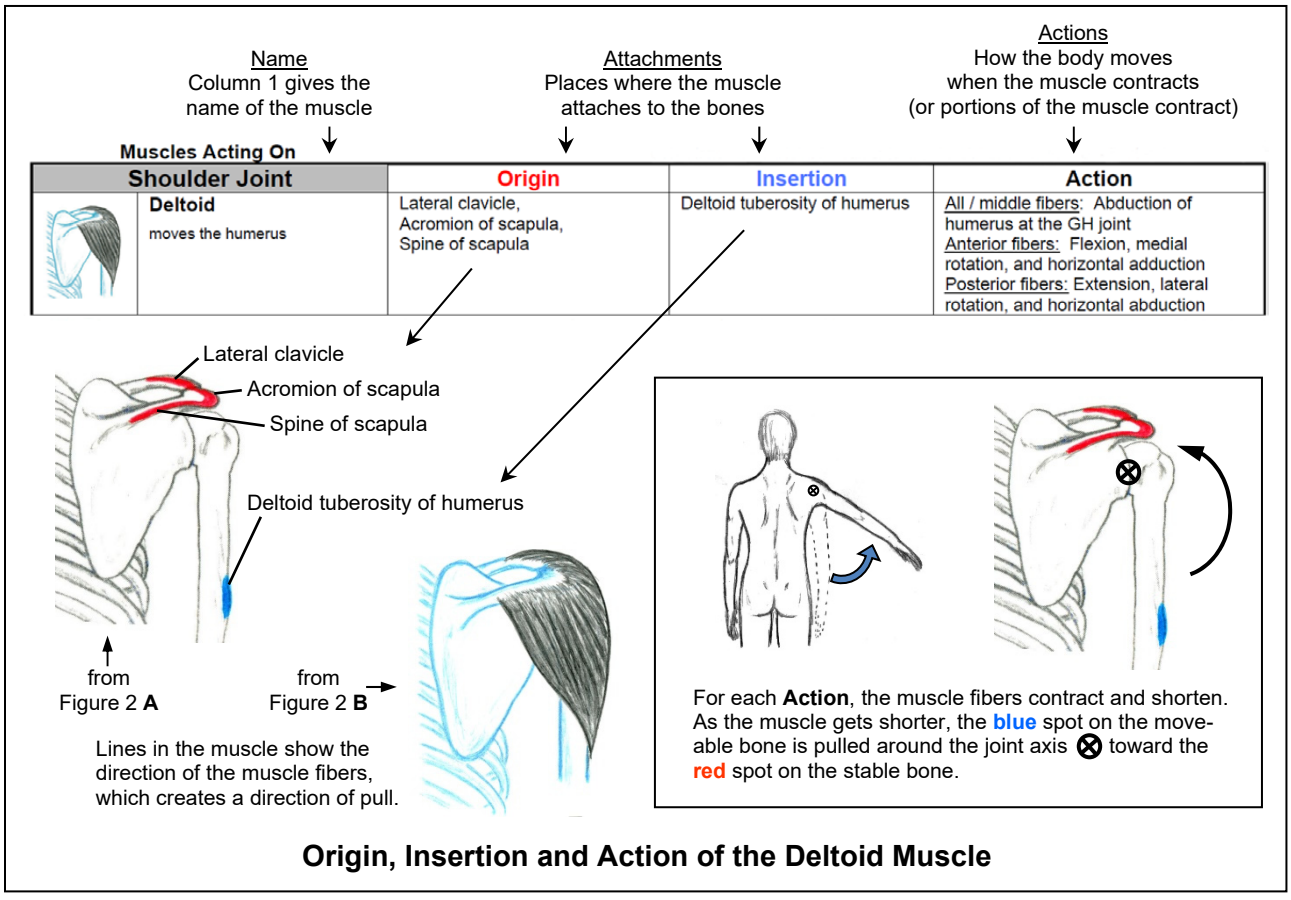
This section demonstrates how to use the tables and figures to study the Deltoid muscle and compare and contrast it to other muscles in its group. The components of this example are taken from the section "Muscle Group 2 – Movement of the Shoulder Joint" on pages 86-89, in Chapter 4 – Muscles That Move the Upper Extremity.

The figure below shows the **Deltoid** muscle portions from Table 2(A), Figure 2(A), and Figure 2(B). This demonstrates how to tie together the information and optimize your study time by learning from both the verbal and visual directions.

As you *read* the words describing Origin and Insertion in the table, *visually* identify those landmarks on the bone picture on the facing page (they are labeled in the figure below). Next, to strengthen your understanding, start by looking at the bone picture and see if you can *name* the bony locations that have red and blue marks. Then, read the words in the table and see if you were correct.

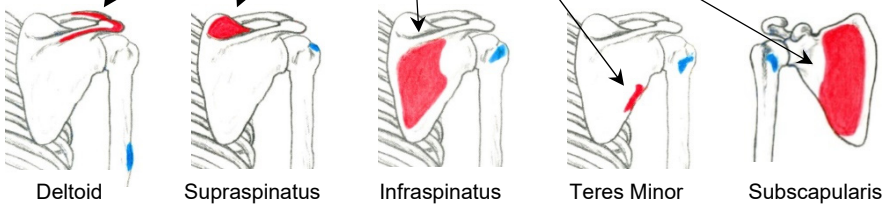
As you study other muscles in the table, you can further help your brain anchor the information by comparing and contrasting both words and pictures. For example, compare the origins of the deltoid with its neighboring muscles (see figure on page 65). Do this *verbally* by comparing the words in the Origin column of the table, and *visually* by comparing the red markings on the bone drawings. Do the same for the insertions. Now, view the muscle drawings in Figure 2(B) with clarity about where beneath the muscle fibers each muscle attaches to the bones.

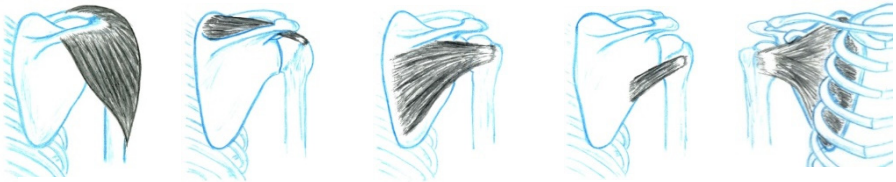
Finally, if possible, move and touch your body or that of a partner. Experience touching the bones, landmarks and muscles. Demonstrate the actions the agonist muscles are creating (or resisting if playing the role of antagonist).



Origin, Insertion and Action of the Deltoid Muscle

Shoulder Joint	Origin	Insertion	Action
Deltoid moves the humerus	Lateral clavicle, Acromion of scapula, Spine of scapula	Deltoid tuberosity of humerus	All / middle fibers: Abduction of humerus at the GH joint Anterior fibers: Flexion, medial rotation, and horizontal adduction Posterior fibers: Extension, lateral rotation, and horizontal abduction
Supraspinatus moves the humerus	Supraspinous fossa of scapula	Greater tubercle of humerus (superior aspect)	Abduction of humerus at the GH jo Stabi fossa
Infraspinatus moves the humerus	Infraspinous fossa of scapula	Greater tubercle of humerus (posterior aspect)	Later GH jo Stabi fossa
Teres Minor moves the humerus	Lateral/axillary border of the scapula	Greater tubercle of humerus (posterior aspect, inferior to infraspinatus tendon)	Later GH joint, Stabilizes the humerus in the glen fossa
Subscapularis moves the humerus	Subscapular fossa of scapula	Lesser tubercle of humerus (on anterior humerus)	Medial rotation of humerus at the GH joint, Stabilizes the humerus in the glen fossa





Verbal

Compare words going down each column

Visual

Compare red areas going across each row

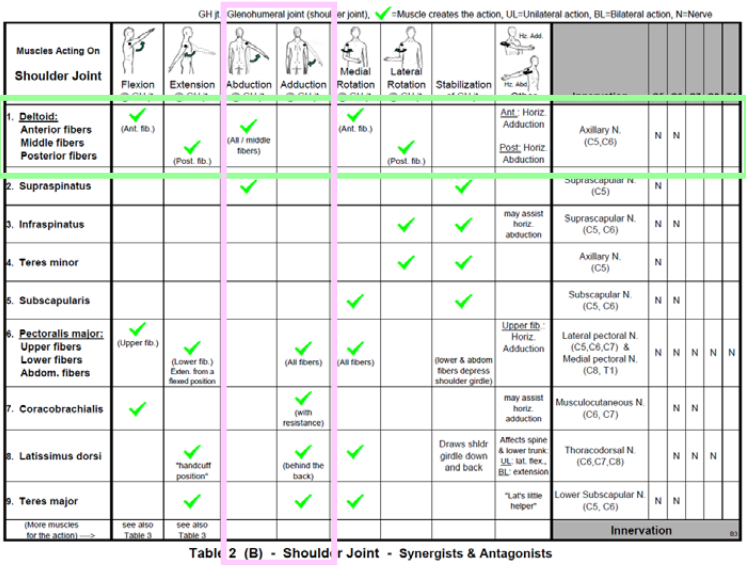
Movement

Compare fiber directions and visualize the muscles pulling on the bones

Comparing and Contrasting Origins of Muscles (do the same for Insertions)

Once you have studied the physical attributes of the deltoid and compared and contrasted it with its neighbors, you can study its actions with the other muscles in the group using the "B" table.

- Scan across its row in the "B" table, observe its fiber direction(s) and think about the fibers shortening to create the actions marked with a green ✓.
- For each of its actions marked with a ✓, scan down the action column to learn other muscles that are synergists with the deltoid for that action.
- Also look at the adjacent column (that shows the opposite action) to learn antagonists for that deltoid action.



GH jt. Glenohumeral joint (shoul er joint), ✓=Muscle creates the action, UL=Unilateral action, BL=Bilateral action, N=Nerve

Muscles Acting On Shoulder Joint	Flexion	Extension	Abduction	Adduction	Medial Rotation	Lateral Rotation	Stabilization	Hz. Add. / Hz. Abd.	Innervation					
1. Deltoid: Anterior fibers Middle fibers Posterior fibers	✓ (Ant. fib.)	✓ (Post. fib.)	✓ (All / middle fibers)		✓ (Ant. fib.)	✓ (Post. fib.)		Ant.: Horiz. Adduction Post: Horiz. Abduction	Axillary N. (C5,C6)	N	N			
2. Supraspinatus			✓				✓		Suprascapular N. (C5)	N				
3. Infraspinatus						✓	✓	may assist horiz. abduction	Suprascapular N. (C5, C6)	N	N			
4. Teres minor						✓	✓		Axillary N. (C5)	N				
5. Subscapularis					✓		✓		Subscapular N. (C5, C6)	N	N			
6. Pectoralis major: Upper fibers Lower fibers Abdom. fibers	✓ (Upper fib.)	✓ (Lower fib.) Exten. from a flexed position		✓ (All fibers)	✓ (All fibers)		(lower & abdom fibers depress shoulder girdle)	Upper fib.: Horiz. Adduction	Lateral pectoral N. (C5,C6,C7) & Medial pectoral N. (C8, T1)	N	N	N	N	N
7. Coracobrachialis	✓			✓ (with resistance)				may assist horiz. adduction	Musculocutaneous N. (C6, C7)		N	N		
8. Latissimus dorsi		✓ "handcuff position"		✓ (behind the back)	✓		Draws shldr girdle down and back	Affects spine & lower trunk. UL: lat. flex., BL: extension	Thoracodorsal N. (C6,C7,C8)		N	N	N	
9. Teres major		✓		✓	✓			"Lat's little helper"	Lower Subscapular N. (C5, C6)	N	N			
(More muscles for the action) --->	see also Table 3	see also Table 3							Innervation					

Table 2 (B) - Shoulder Joint - Synergists & Antagonists

Using the "B" Table to Study Actions

About Mastering the Muscles

As you study each group of muscles, you will be building a *foundation* of basic knowledge that will enable you to apply and communicate anatomical and movement information in a clear and efficient way. A few situations where this may be useful are:

- Assessing and working with clients
- Communicating with other health professionals (verbally and written)
- Reading books and magazine/journal articles
- Attending or teaching continuing education classes relevant to your specialty

In order to be fluent in the language of muscles and movement, you will need to learn a basic set of information about each muscle. Then, you will need to be able to communicate and apply that information in a variety of ways.

What to Learn About Each Muscle

Use the table below as a guide to what you need to know about each muscle to master it.

Items 1 through 6 describe the basic knowledge needed to "know" the muscle you are learning.

Items 7 and 8 list further knowledge that relates to physically using the muscle in daily life. These skills are developed by applying the basic facts about the muscle in different situations.

Note that this list is *not* about learning everything for one muscle before you move on to the next. Rather, the list is a framework to be filled in over time as you study and practice with all the muscles in a muscle group.

What to Learn About Each Muscle

Basic Knowledge	Practical Applications
1. Name and palpate the origin(s).	7. For the muscle's main action (or actions): • Passively shorten it • Passively lengthen it • Instruct client to actively shorten it (concentric contraction) • Instruct client to actively lengthen it (the antagonist is working) • Provide correct resistance to test strength of the muscle • Name one or more synergists - (must indicate the *action* that is being "synergized") • Name one or more antagonists - (must indicate the *action* that is being "antagonized")
2. Name and palpate the insertion(s).	
3. Trace the shape of the entire muscle on the body. • Palpate the muscle • Know where the tendon is vs. the muscle belly	
4. Know and touch the joint(s) the muscle acts on. • More than one joint may be involved	8. Know something about the muscle as it applies to the daily life of a person: • Activities and exercises that use this muscle - (as agonist, antagonist, and stabilizer) • Movements where the muscle contracts concentrically • Movements where the muscle contracts eccentrically • Problems or pathologies that may apply to this muscle
5. Indicate the fiber arrangement. • Show shape and fiber direction on a body • Describe it, draw a diagram showing it	
6. Name and demonstrate the actions of the muscle.	

Real-time Factors that Affect a Muscle's Actions

The table below provides a summary of the influences involved when a movement is created by the contraction of a muscle.

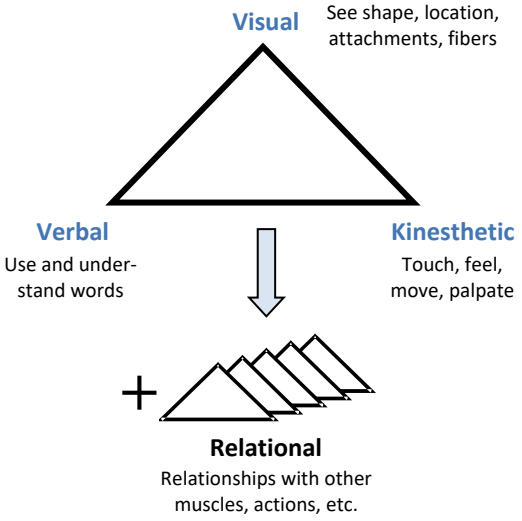
Factors Affecting How a Movement Occurs

The movement that occurs when a muscle contracts can be summarized as the sum of six factors:

1. Direction and arrangement of its fibers
   +
2. Locations of its attachment sites (and their positions relative to the joint axis)
   +
3. The mechanical capability and limitations of the joint(s) being moved
   +
4. Stuff in the way (muscle tissue, fascia, bones, ligaments, skin, fat, organs, etc.)
   +
5. What other muscles are doing at the same time (opposing, stabilizing, etc.)
   +
6. Which bones are most moveable at the moment (what is weight bearing, current direction of gravity, what is held in place by outside forces like a wall, table, another person, etc.)

How You Will Use the Information You've Learned

There are many ways that you will use your knowledge of a muscle. You may have to recall or communicate the information from any of three main directions: **verbal**, **visual**, or **kinesthetic**. The triangle in the figure illustrates this concept. In any given situation, you may need to recall your knowledge from one of the corners of the triangle. In addition, you may need to think **relationally**, i.e., for a muscle or action, be able to think of related muscles or actions.



Recalling and Using Muscle Knowledge

You then need to be able to connect to the types of information represented by the other corners of the triangle as you pursue the requirements of the situation at hand. The table below gives a few examples.

Using the Types of Muscle Knowledge

Legs of △	If this happens:	Can you:
Verbal to Visual	You hear or read the name of a muscle.	Visualize where it is on the body and what it looks like.
Visual to Verbal to Kinesthetic	Your client points to a place on their body that hurts.	Recall the name of a muscle there, and have client perform an action to test it.
Kinesthetic to Verbal to Relational	Your client moves a body part and says it is "stiff" and they can't move it very far.	Name the joint and movement involved, and identify which muscles are shortening (agonists), and which muscles are lengthen-ing (antagonists)

Generalizations

The list below gives some general rules of thumb to use while you are learning the muscles in Chapters 4, 5 and 6. Keeping these in mind will help you stay oriented, see useful patterns, and reduce the amount of rote memorization you have to do.

- Muscles on the anterior body usually create flexion (except at knee and below).
- Muscles on the posterior body usually create extension (except at knee and below).
- Muscles that have an oblique (diagonal) angle usually create or control rotations.
- Muscles that insert on the lateral side of limbs create abduction.
- Muscles that insert on the medial side of limbs create adduction.
- For muscles of the axial skeleton, an antagonist for a *unilateral* action is the same muscle on the other side of the body (see Chapter 5, page 121).
- Muscles are strongest at their resting or neutral position (see "mid-range" on pages 18-19). When moved into a substantially shortened state, the muscle has reduced pulling force. The muscle's power is also reduced when it is put in a markedly lengthened position.

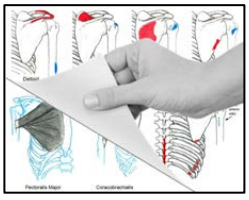
Palpation Techniques

The list below provides some ideas to consider when you are palpating the body to identify, assess, or treat muscles.

- Steps to palpate a specific structure: Locate, isolate, engage, palpate, observe cautions
- Be aware of the tactile: Touch, pressure, texture.
- Find landmarks to locate the full length of the muscle.
- Try to feel different depths, being aware of changes in fiber direction and knowing that layers of fascia separate muscles that lie at different depths.
- Use movement (passive, active) to help locate muscles.
- Consider main movements vs. secondary (or assist) movements.
- Provide correct contact point and direction of resistance to engage or activate a muscle.
- Remember gravity is always there to provide resistance (position the body so the muscle has to work against gravity).
- To palpate on yourself, look for a way to "self-engage" the muscle – press against a table, wall, chair, or a place on your own body.
- A muscle is easier to feel upon initial muscle activation rather than full-out contraction – have your partner initiate the action and then release it repeatedly to help isolate the muscle.

Brain-Friendly Conventions Used in Chapters 4 - 6

- All illustrations of muscles and bones are shown on the **right side of the body**. This allows easy comparison of images within each group and from group to group. Once learned and well-organized in memory, the brain can easily "mirror-image" the information to the left side of the body in practice.
- Wherever possible, related illustrations are shown at the **same size and angle of view**. This helps the brain draw comparisons and contrasts without having to translate/flip/resize before observing the features to compare.
- For verbal learners: Note that in the A tables (described on page 60), **related words are lined up** so a visual scan down a column can reveal similarities and differences in the attachments and actions of the different muscles.
- When viewing the side-by-side muscle illustrations (the A Figures and B Figures described on pages 60-63), the origin/insertion pictures and the corresponding muscle pictures are sized and lined up so you can simply **lift the page** to directly study each muscle with its underlying attachments on the bones.



Chapter 4

Muscles That Move the Upper Extremity

Group 1 – Scapula / Clavicle

p. 75-82

Trapezius
Levator scapula
Rhomboid major & minor
Serratus anterior
Pectoralis minor
Subclavius

Group 2 – Shoulder Joint

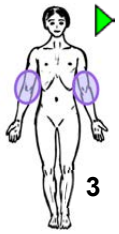
p. 83-90

Deltoid
Supraspinatus
Infraspinatus
Teres minor
Subscapularis
Pectoralis major
Coracobrachialis
Latissimus dorsi
Teres major

Group 3 – Elbow, Forearm

p. 91-98

Biceps brachii
Brachialis
Brachioradialis
Pronator teres
Pronator quadratus
Triceps brachii
Anconeus
Supinator



Group 4 – Wrist, Hand, Fingers

p. 99-106

Flexor carpi radialis
Palmaris longus
Flexor carpi ulnaris
Flexor digitorum superficialis
Flexor digitorum profundus
Extensor carpi radialis longus
Extensor carpi radialis brevis
Extensor carpi ulnaris
Extensor digitorum
Extensor indicis

Group 5 – Thumb

p. 107-113

Flexor pollicis longus
Flexor pollicis brevis
Opponens pollicis
Adductor pollicis
Abductor pollicis brevis
Abductor pollicis longus
Extensor pollicis longus
Extensor pollicis brevis

Bonus Group

p. 114-115

Intrinsic Muscles
of the Hand

Mastering Muscles & Movement

Demonstration Copy

Chapter 4 – Upper Extremity,
pages 70-116 are not included.

(only Chapter 6 - Lower Extremity
muscle groups are included)

Chapter 5

Muscles That Move the Axial Skeleton

Group 6 – Face, Jaw

p. 127-134

Masseter
Temporalis
Lateral pterygoid
Medial pterygoid
Occipitofrontalis
Platysma
Suprahyoids group
- Geniohyoid, Mylohyoid, Stylohyoid, Digastric

Infrahyoids group
- Sternohyoid, Sternothyroid, Omohyoid, Thyrohyoid

Muscles of facial expression

Group 7 – Neck, Head

p. 135-142

Sternocleidomastoid
Scalenes group
Longus capitis & longus colli
Suboccipital group
- Rectus capitis posterior major
- Rectus capitis posterior minor
- Oblique capitis superior
- Oblique capitis inferior

Splenius capitis
Splenius cervicis
Semispinalis capitis
Levator scapula*
Trapezius, upper fibers*

*(revisited for reversed O/I actions)

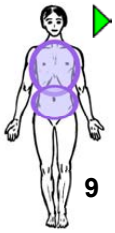
Group 8 – Spine

p. 143-150

Spinalis
Longissimus
Iliocostalis
Semispinalis
Multifidus
Rotatores
Quadratus lumborum
Interspinales & Intertransversarii

Group 9 – Thorax, Abdomen, Breathing

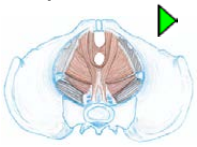
p. 151-157



Rectus abdominis
External oblique
Internal oblique
Transverse abdominis
Diaphragm
External intercostals
Internal intercostals
Serratus posterior superior
Serratus posterior inferior
Levator costae
Transversus thoracis

Bonus Group

p. 158-159



Muscles of the
Pelvic Floor and Perineum

Mastering Muscles & Movement

Demonstration Copy

Chapter 5 – Axial Skeleton,
pages 118-160 are not included.

(only Chapter 6 - Lower Extremity
muscle groups are included)

Chapter 6

Muscles That Move the Lower Extremity

Group 10 – Hip Joint (Part 1)

p. 167-174

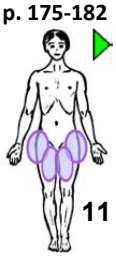
Gluteus maximus
Gluteus medius
Gluteus minimus
Piriformis (1st lateral rotator)
The other 5 lateral rotators
- Gemellus superior
- Obturator internus
- Gemellus inferior
- Obturator externus
- Quadratus femoris

Iliopsoas
- (Iliacus & Psoas major)

Group 11 – Hip Joint (Part 2)

p. 175-182

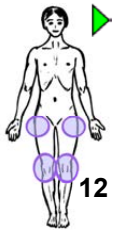
Sartorius
Tensor fascia latae
Pectineus
Adductor brevis
Adductor longus
Adductor magnus
Gracilis



Group 12 – Knee (& Hip Joint, Part 3)

p. 183-190

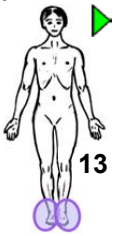
Rectus femoris
Vastus lateralis
Vastus intermedius
Vastus medialis
Biceps femoris
Semitendinosus
Semimembranosus
Popliteus



Group 13 – Ankle, Foot, Toes

p. 191-197

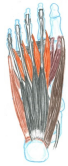
Gastrocnemius
Plantaris
Soleus
Tibialis posterior
Flexor digitorum longus
Flexor hallucis longus
Fibularis longus (peroneus)
Fibularis brevis (peroneus)
Tibialis anterior
Extensor digitorum longus
Extensor hallucis longus



Bonus Group

p. 198-199

Intrinsic Muscles
of the Foot



Introduction

The **lower extremity** is the lower-body portion of the appendicular skeleton (see page 37), and includes the hip bone, thigh, leg, and foot. The sacroiliac joints, where the hip bones articulate with the sacrum, are the joints connecting the lower extremities to the trunk.

This chapter describes the muscles that move the various joints within the lower extremity. The muscles are separated into four functional groups, with some overlap of function between groups for muscles that cross multiple joints:

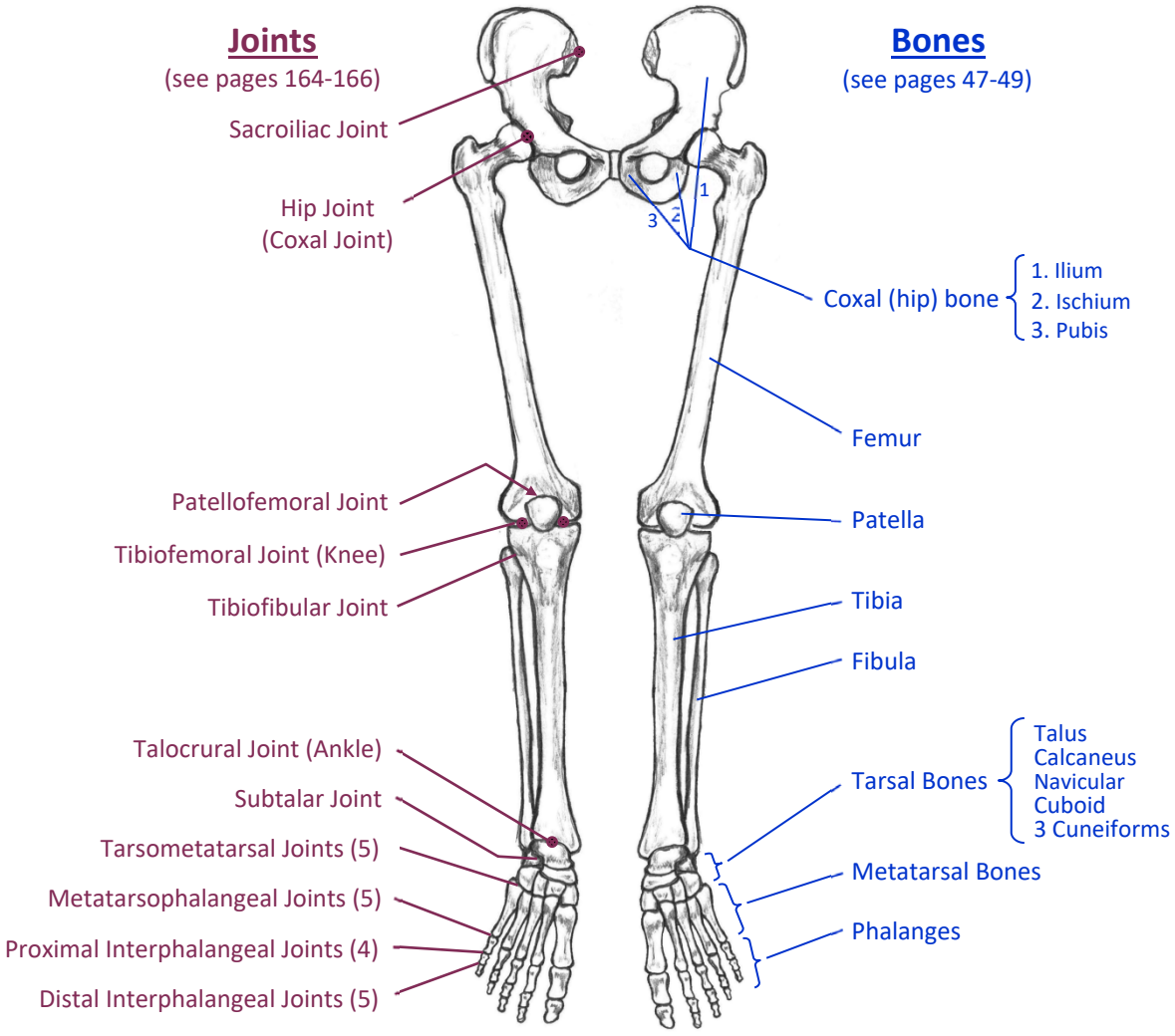
Group 10: Movement of the hip – part 1, which are the "shorter" muscles that move the femur at the hip joint

Group 11: Movement of the hip – part 2, which are the "longer" muscles that move the femur at the hip joint

Group 12: Movement of the knee (which includes multiple-joint muscles that also move the femur at the hip)

Group 13: Movement of the ankle, foot, and toes

At the end of the chapter, a bonus muscle group presents the intrinsic muscles of the foot.

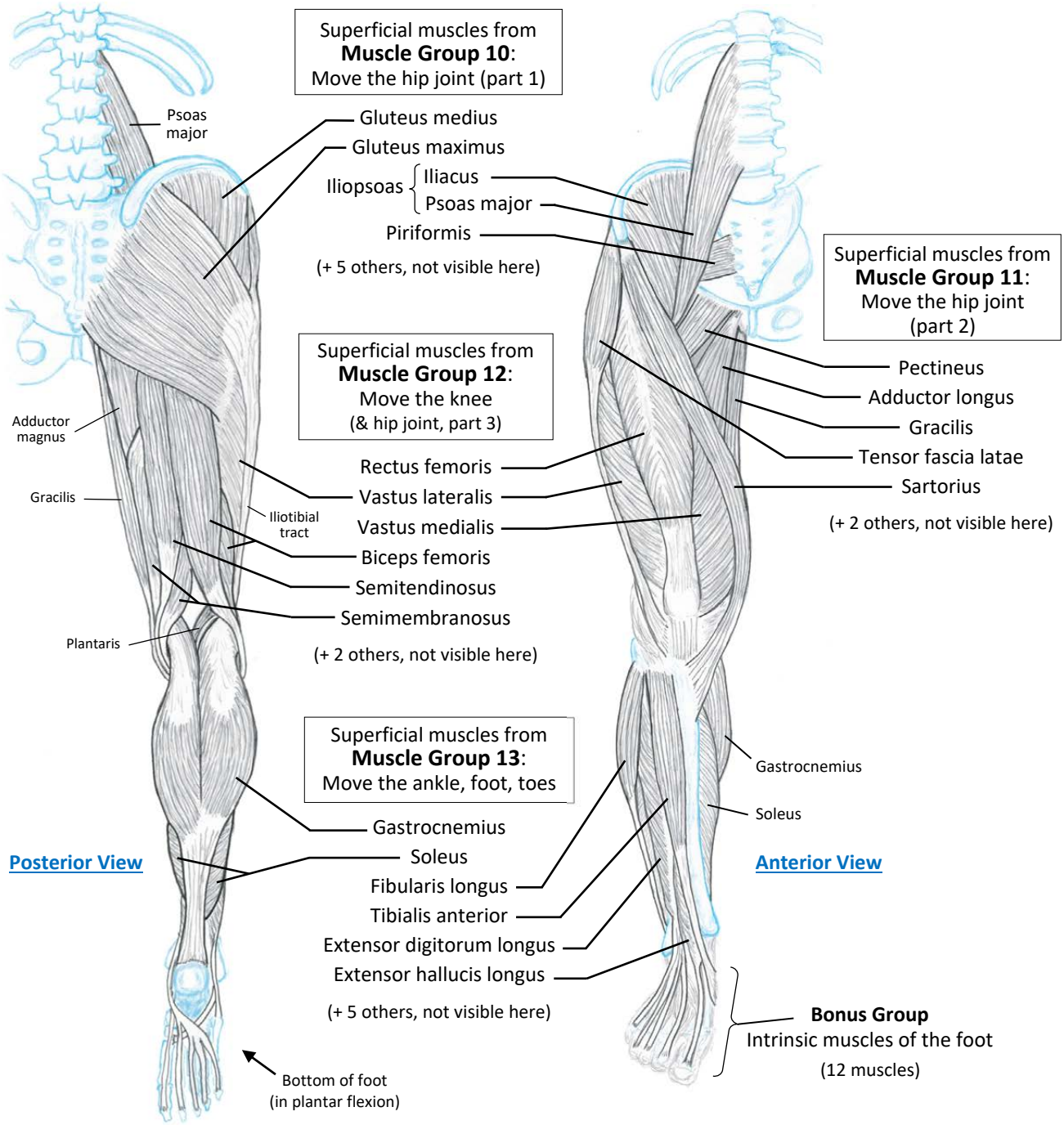


Overview of Muscles

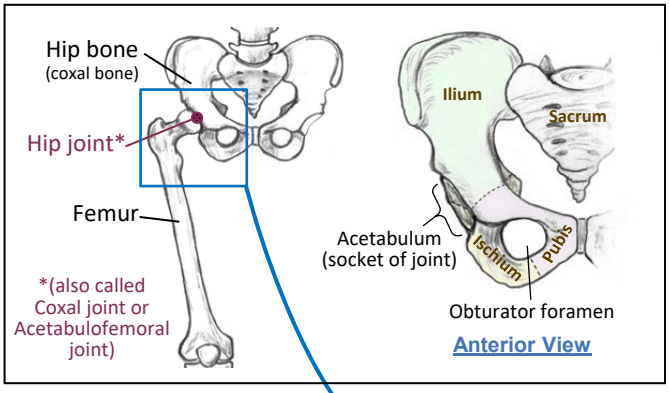
The illustration below shows posterior and anterior views of the superficial muscles from groups 10-13. This gives an idea about the overall organization of muscles involved with moving the lower extremity. Note that only muscles that have superficial exposure can be seen. There are also many other muscles at deeper layers that are hidden beneath the superficial muscles.

Joint Details and Ligaments

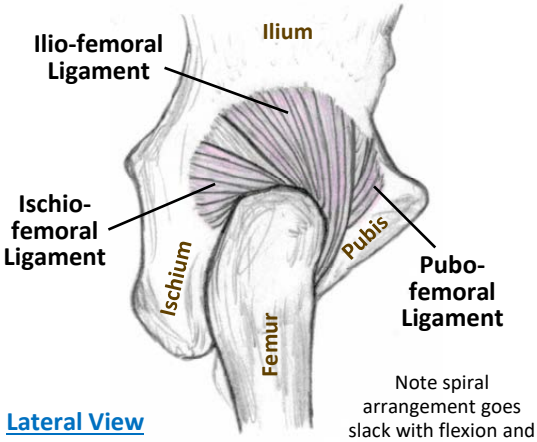
The joints of the lower extremity begin proximally with the sacroiliac joint, which is the connection of the lower extremity to the sacrum of the axial skeleton. Progressing distally, there are numerous joints at the hip, knee, ankle, and foot. The details and ligaments of these joints are described on the following three pages. Also, see page 126 for ligaments of the pelvis.



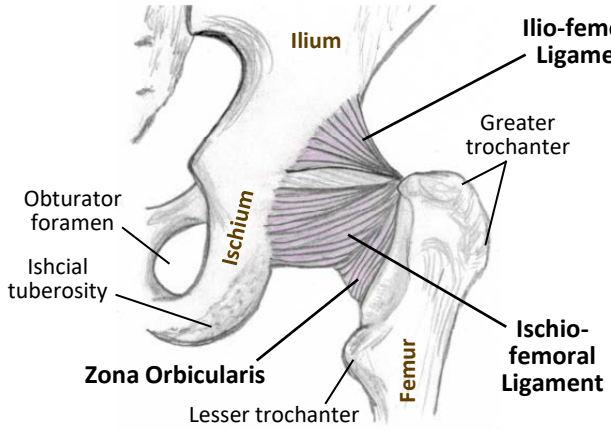
Hip – Joints and Ligaments

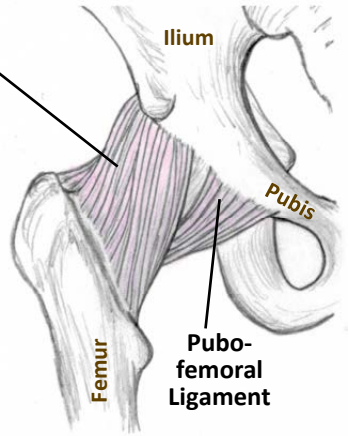


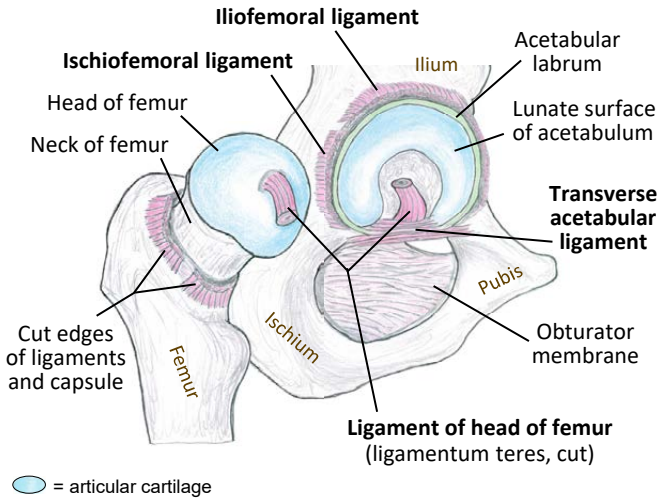
Right Hip



Note spiral arrangement goes slack with flexion and taut with extension.



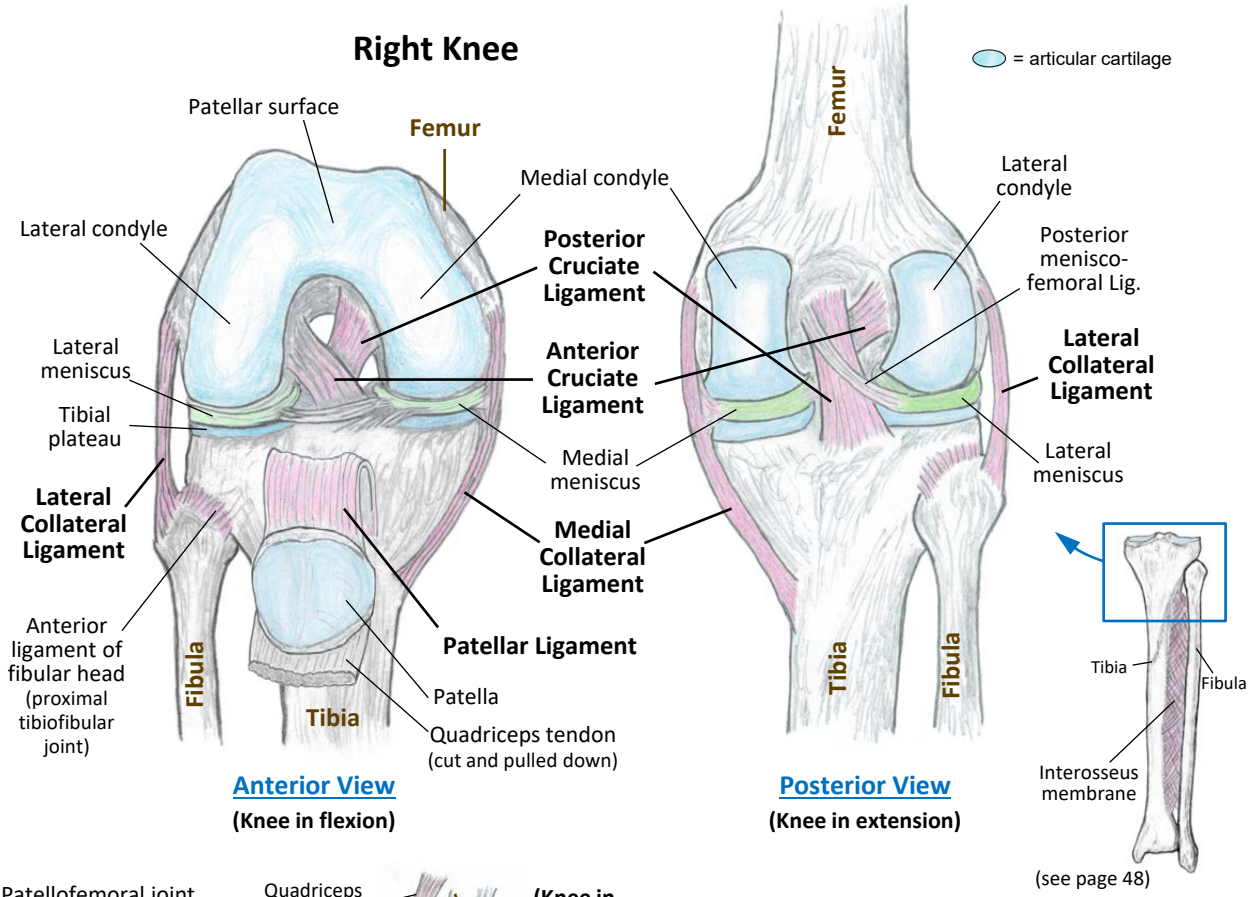


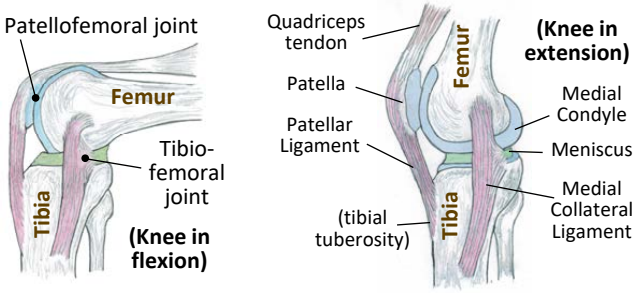


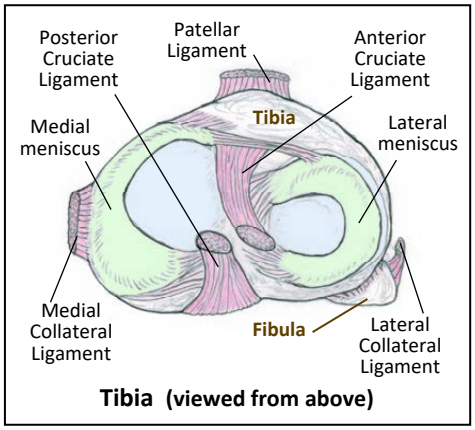
(Femur removed to expose acetabulum)

Hip Joint	
Ligament	**Function**
Iliofemoral Lig.	Limits extension and lateral rotation.
Ischiofemoral Lig.	Limits extension and medial rotation.
Pubofemoral Lig.	Limits extension and abduction.
Zona Orbicularis	Wraps around neck of femur, resists pulling head of femur away from socket.
Ligament of head of femur	Loosely connects head of femur into the acetabulum, carries blood vessel.
Transverse acetabular Lig.	Completes the acetabular labrum ring, and creates a foramen for vessels to enter the joint.

Knee – Joints and Ligaments

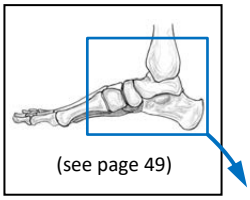






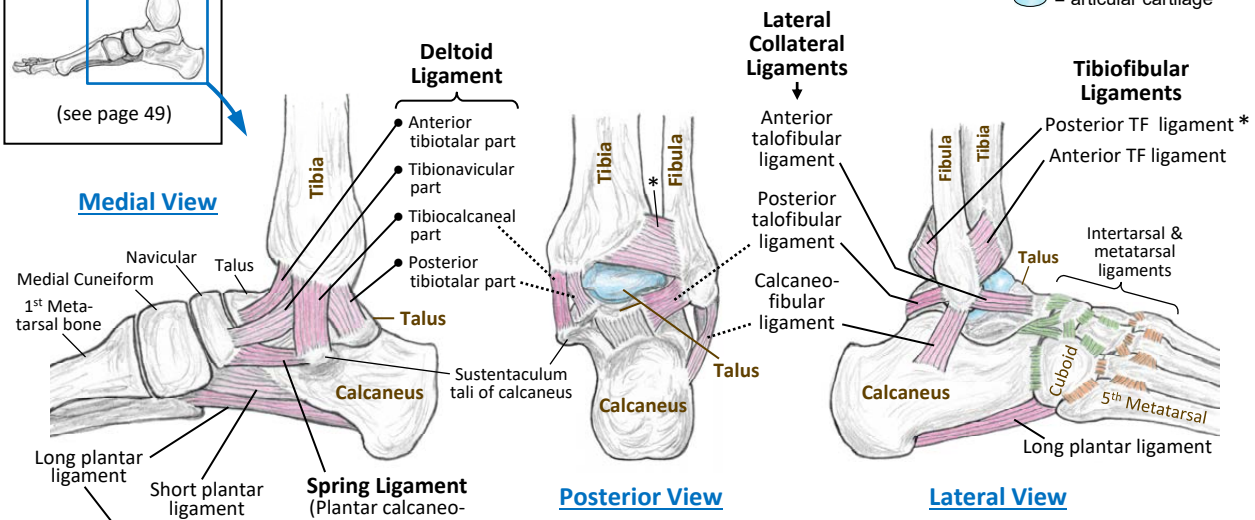
Knee: Tibiofemoral Joint & Patellofemoral Joint	
Ligament	**Function**
Medial (Tibial) Collateral Lig. (MCL)	Medial stabilizer, resists valgus forces. Taut when knee is in full extension.
Lateral (Fibular) Collateral Lig. (LCL)	Lateral stabilizer, resists varus forces. Taut when knee is in full extension.
Anterior Cruciate Lig. (ACL)	Prevents anterior displacement of tibia on femur.* Resists hyper-extension and medial rotation. Most frequently injured knee ligament.
Posterior Cruciate Lig. (PCL)	Prevents posterior displacement of tibia on femur.* Resists extreme flexion of knee.
The cruciate ligaments keep the condyles of the femur aligned on the tibial plateau while the knee is flexing and extending. *Note: *Anterior* displacement of the tibia on the femur is equivalent to *posterior* displacement of the femur on the tibia.	
Patellar Lig.	Connects patella to tibia, completing the pulley structure to extend the knee

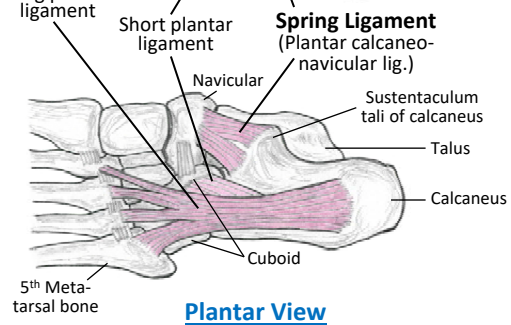
Ankle and Foot – Joints and Ligaments



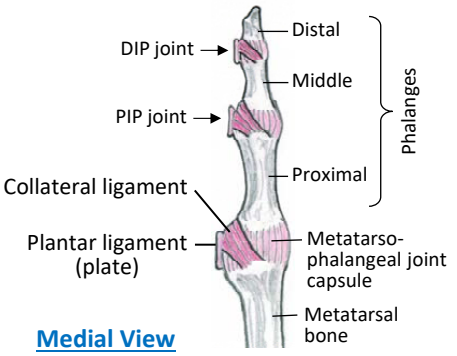
Right Foot

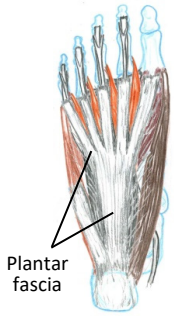
= articular cartilage



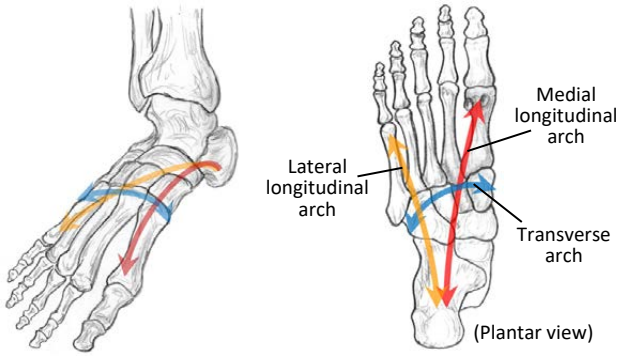


Ankle: Talocrural Joint & Subtalar Joint	
Ligament	**Function**
Tibiofibular Ligs.	Stabilize the distal tibiofibular joint (a fibrous synarthrotic joint)
Deltoid Lig. Has 4 parts {	Medial stabilizer, limits eversion, resists valgus forces on the ankle ● Anterior tibiotalar ● Tibiocalcaneal ● Tibionavicular ● Posterior tibiotalar
Anterior Talofibular Lig. (ATFL)	Lateral stabilizer, limits inversion and plantarflexion, resists varus forces (most frequently injured ligament)
Posterior Talofibular Lig.	Lateral stabilizer, limits inversion and dorsiflexion, resists varus stress
Calcaneo-fibular Lig.	Lateral stabilizer, limits inversion and dorsiflexion, resists varus stress

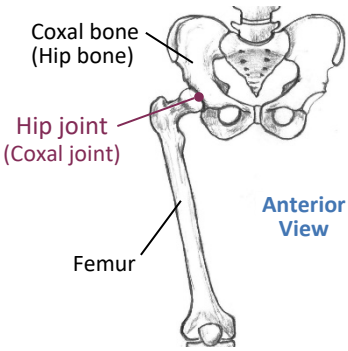




Foot: Tarsal, Metatarsal and Phalangeal Joints (and arches of the foot)	
Ligament	**Function**
Plantar Fascia (Plantar Aponeurosis)	Supports longitudinal arches of foot
Long Plantar Lig.	Supports longitudinal arches of foot
Spring Lig. (Plantar calcaneo-navicular Lig.)	Supports medial longitudinal arch of foot. Forms a floor under talonavicular joint, keeping talus from "falling down".
Calcaneocuboid (Short Plantar) Lig.	Supports longitudinal arches deep within the foot, especially the lateral arch
Metatarso-phalangeal, PIP, DIP Ligs.	Collateral ligs, Plantar ligs (plates) (Similar to ligaments in the hand – see page 74)



Movement of the Hip Joint (Part 1)



Muscle Group 10

Gluteus maximus	Piriformis (deep lateral rotator #1 of 6)
Gluteus medius	The other 5 lateral rotators:
Gluteus minimus	Gemellus superior, Obturator internus
Iliopsoas: Iliacus & Psoas Major	Gemellus inferior, Obturator externus
	Quadratus femoris

Joints

(Joint details: p. 164)

This is the first of three groups of muscles that primarily move the femur at the hip joint (coxal joint). This group contains the "shorter" length muscles that mainly originate on the front or back of the ilium bone of the pelvis, and insert on the greater or lesser trochanter of the femur.

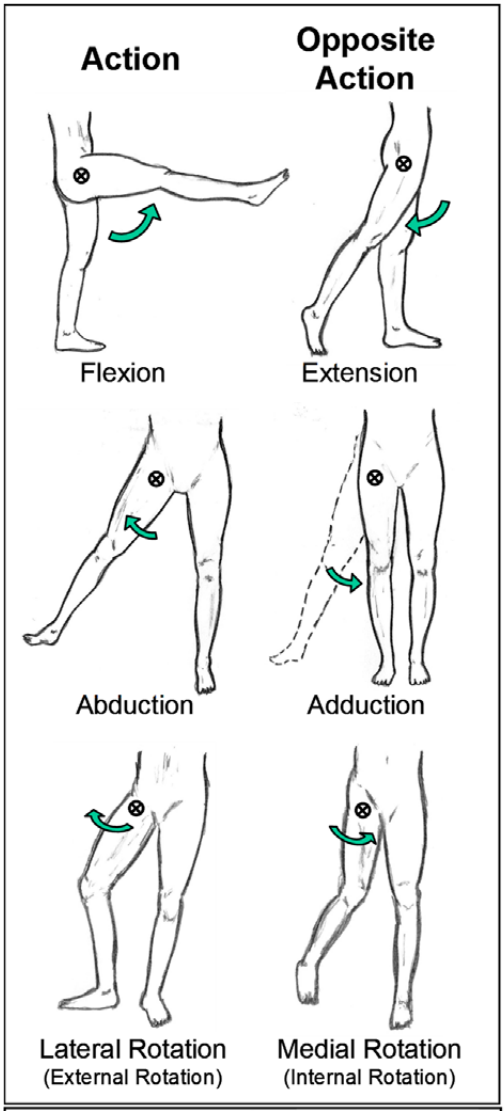
Hip Joint (Coxal Joint) (also called coxofemoral joint or acetabulofemoral joint)

Head of **Femur** ◄► Acetabulum of the **Hip Bone**

Ball and Socket Joint

Movements Available:

Flexion
Extension
Abduction
Adduction
Lateral Rotation (External Rotation)
Medial Rotation (Internal Rotation)



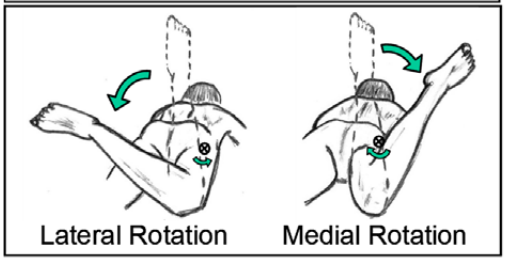
Other Joints

(Joint details: p. 124, 126)

Postural effects and small movements of the following joints are also created by the muscles in this group:

Sacroiliac Joint
Lateral **Sacrum** ◄► Posterior **Ilium**
Part gliding, part fibrocartilagenous
(affected by piriformis and iliopsoas in this muscle group)

Intervertebral Joints of lumbar vertebrae
Facets and discs
(affected by psoas major in this muscle group)



Hip Joint (Part 1)

10

Bones, Bony Landmarks, Other Structures

The "short" muscles that move the hip joint mainly have attachments on the pelvis and the femur. Review the bony landmarks and other structures listed below, referring to the diagrams in Chapter 2, pages 47-48.

Hip Bone (Coxal Bone, Os Coxae) (p. 47)

(Made up of 3 bones fused: Ilium, Ischium, Pubis)

- Landmarks on the Ilium:
  - Iliac Fossa
    - (anterior-medial surface of wing)
  - Iliac Crest
  - Posterior Superior Iliac Spine (PSIS)
  - Gluteal surface
    - (posterior-lateral surface of wing)
  - Anterior Gluteal Line
    - (a ridge on the gluteal surface, between the origins of gluteus medius and gluteus minimus)

- Acetabulum) (p. 164)
  - All 3 hip bones (ilium, ischium, pubis) intersect in the cavity of this socket

- Obturator foramen
  - Hole encircled by pubis and ischium

Femur (p. 48)

- Head
- Neck
- Greater trochanter
- Lesser trochanter
- Gluteal tuberosity

Sacrum (p. 45)

- Muscles attach on both the posterior and anterior surfaces.

Lumbar vertebrae L1-L5, and thoracic T12 (p. 44)

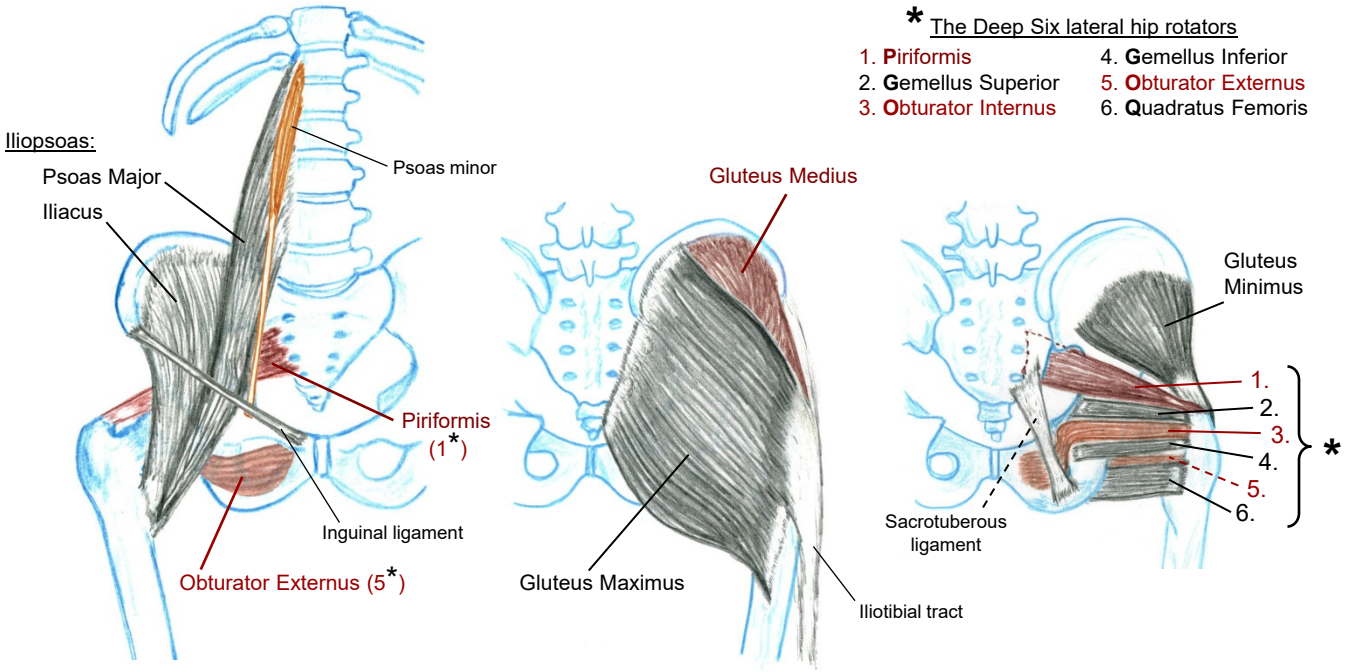
- Anterior bodies and TVP's – (for psoas major)

Other Structures

- Sacrotuberous Ligament (p. 126)
- Inguinal Ligament (p. 126)
- Iliotibial Tract / Iliotibial Band (ITB) (p. 177)

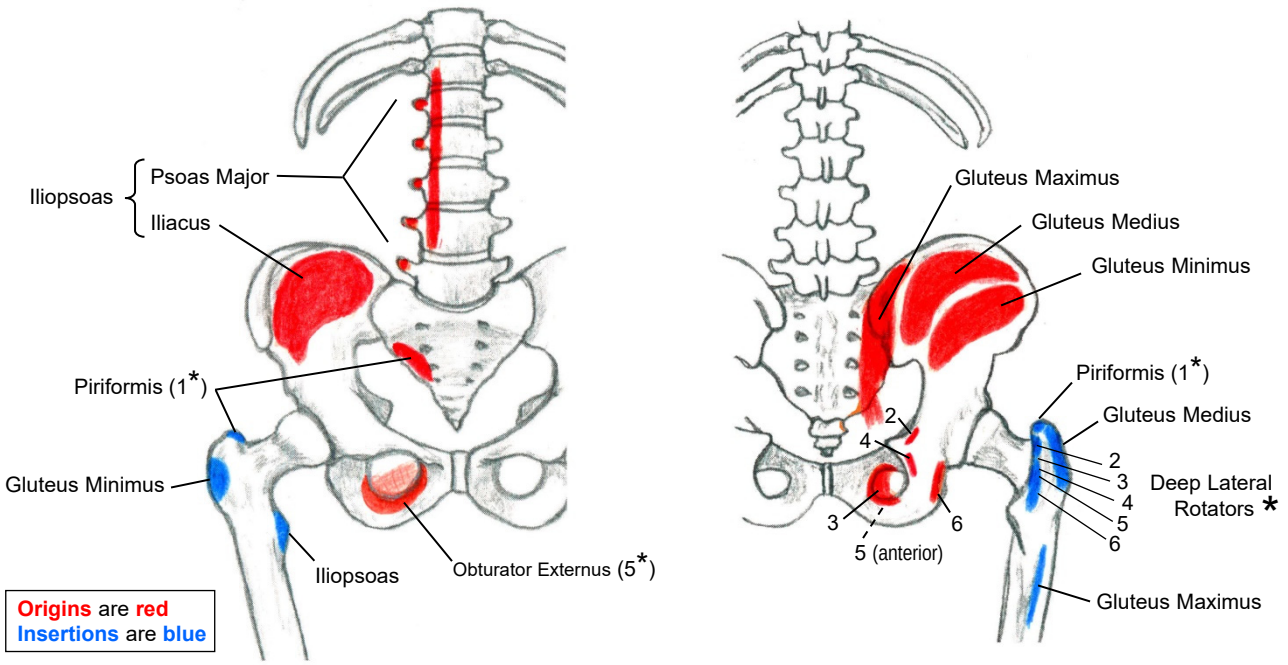
Notes

Muscle Group 10 - **The first of three groups of muscles that move the hip joint** are illustrated as a group on this page. The following four pages have tables and figures that describe each muscle individually, and provide many ways of comparing and contrasting the muscles to each other.



Anterior View

Posterior Views



Attachment sites for all muscles in Group 10

Click a muscle picture to view its Muscle Detail Card

Group 10: Muscles Acting On

TVP=Transverse process of vertebra, ITB=Iliotibial Band (another name for the iliotibial tract)

Hip Joint (Part 1)	Origin	Insertion	Action
 **Gluteus Maximus** moves the hip joint	Posterior iliac crest, ilium, and sacrum (also lateral coccyx and sacrotuberous ligament)	Gluteal tuberosity of femur, and the iliotibial tract (ITB)	Extension and lateral rotation at the hip joint (also lower fibers assist adduction, and upper fibers may assist abduction)
 **Gluteus Medius** moves the hip joint	Upper lateral surface of the ilium (upper half of the wing of the ilium, starting just below the iliac crest)	Greater trochanter of femur (lateral aspect)	All fibers: Abduction at the hip joint. Ant. fibers: Assist flexion and medial rotation Post. fibers: Assist extension and lateral rotation
 **Gluteus Minimus** moves the hip joint	Lower lateral surface of the ilium (lower half of the wing of the ilium, inferior to the origin of gluteus medius)	Greater trochanter of femur (anterior aspect)	Abduction and medial rotation at the hip joint. (Also may assist flexion)
 **Piriformis** (Deep Lateral Rotator #1) moves the hip joint	Anterior surface of sacrum	Greater trochanter of femur (superior aspect)	Lateral rotation at the hip joint
 **The Other 5 Deep Lateral Rotators** (#2 - #6) **G**emellus superior **O**bturator internus **G**emellus inferior **O**bturator externus **Q**uadratus femoris	Gemelli & Quad.Fem.: Ischium Obturators: Obturator foramen (ischium & pubis) All Deep 6 Collective: Sacrum, Ischium, and Pubis	Greater trochanter of femur (posterior-medial aspect)	Lateral rotation at the hip joint
 **Iliopsoas:** **Iliacus** and **Psoas Major** Moves the hip joint and the spine	Iliacus: Anterior iliac fossa Psoas Major: Bodies & TVP's of T12 and L1-L5	Both: Lesser trochanter of the femur	Flexion at the hip joint. (May assist lateral rotation at the hip joint) If the femur is fixed (in a standing position): Pulls on lumbar spine, increasing lordosis and anterior pelvic tilt.

(larger illustrations on page 173)

Table 10 (A) - Hip Joint (Part 1) - Origin, Insertion, Action

Side-by-Side

Note

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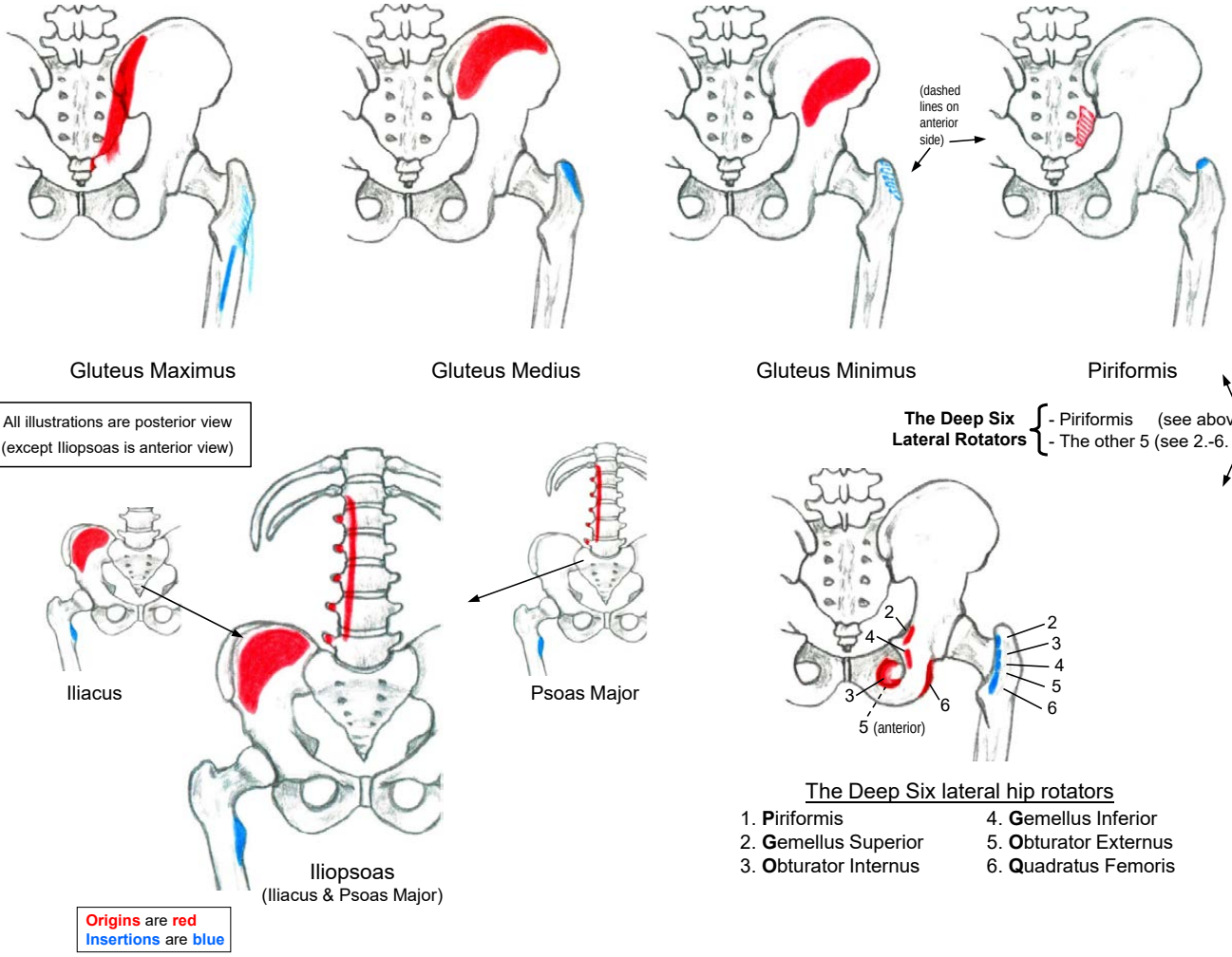

Figure 10 (A) - Hip Joint (Part 1) - Muscle Attachments

171

Note

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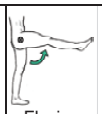
Click an Action picture to view ***all*** of its synergists & antagonists

Group 10: Hip joint (coxal joint) = Head of femur seated in acetabulum of the hip bone (coxal bone), ✓=Muscle creates the action, N=Nerve

Muscles Acting On **Hip Joint (Part 1)**	 Flexion @ Hip jt.	 Extension @ Hip jt.	 Abduction @ Hip jt.	 Adduction @ Hip jt.	 Medial Rotation @ Hip jt.	 Lateral Rotation @ Hip jt.	 Stabilization of Hip jt.	Other	Innervation	L2	L3	L4	L5	S1	S2
1. Gluteus Maximus		✓	✓ assist (upper fibers)	✓ assist (lower fibers)		✓			Inferior gluteal N. (L5, S1, S2)				N	N	N
2. Gluteus Medius	✓ assist (anterior fibers)	✓ assist (posterior fibers)	✓ (all fibers)		✓ assist (anterior fibers)	✓ assist (post. fibers) when hip is extended	✓ (main hip stabilizer)	This is the primary abductor	Superior gluteal N. (L4, L5, S1)			N	N	N	
3. Gluteus Minimus	✓ may assist		✓		✓		✓		Superior gluteal N. (L4, L5, S1)			N	N	N	
4. Piriformis **Deep lateral rotator #1**						✓			Sacral Plexus (S1, S2)					N	N
5. The Other 5 Deep Lateral Rotators **G**emellus Superior **O**bturator Internus **G**emellus Inferior **O**bturator Externus **Q**uadratus Femoris						✓			**GS:** SP- L5, S1, 2 **OI:** SP- L5, S1, 2 **GI:** SP- L4,5, S1 **OE:** Obturator,L3,4 **QF:** SP- L4,5, S1 (SP=Sacral Plexus)		N	N N N N N	N N N N N	N N N N	N N
Iliopsoas: **6. Iliacus** **7. Psoas Major**	✓					✓ may assist		Reverse O/I (femur fixed): increases lumbar lordosis, ant. pelvic tilt	**Iliacus**: Femoral N. (L2, L3) **Psoas Major**: Lumbar plexus (L2-L4)	N	N	N			
(More muscles for the action) ---->	see also Groups 11, 12	see also Groups 11, 12	see also Group 11	see also Group 11	see also Groups 11, 12	see also Groups 11, 12			**Innervation** B3						

Side-by-Side

Side-by-Side

Table 10 (B) - Hip Joint (Part 1) - Synergists & Antagonists

Note

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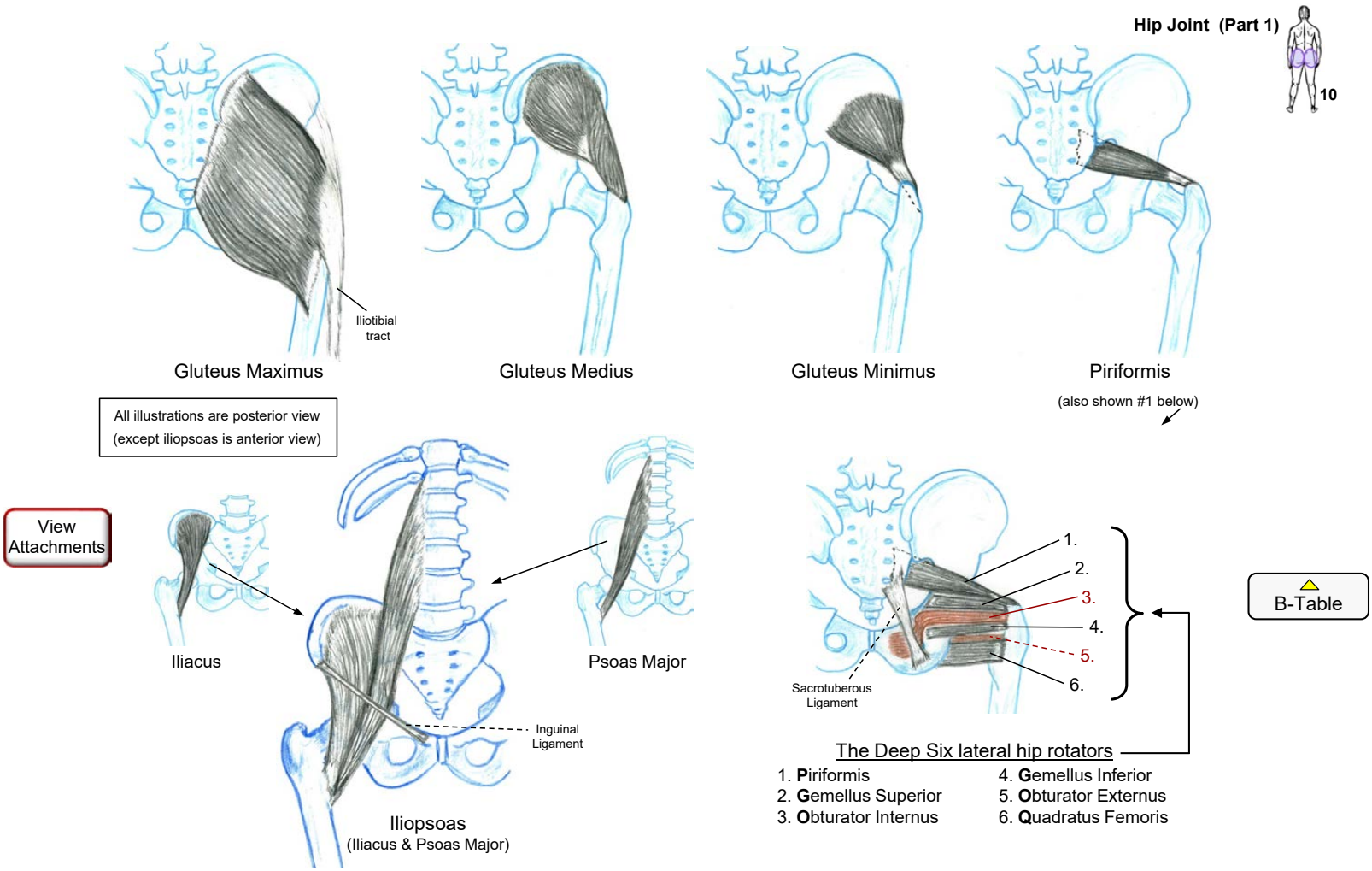

Figure 10 (B) - Hip Joint (Part 1) - Muscle Pictures

Note

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Note-taking page ~ (palpation, how to lengthen/shorten, cautions, common uses, etc.)

Muscle Group 10 - Muscles Acting on the Hip Joint (Part 1)

1. Gluteus Maximus

2. Gluteus Medius

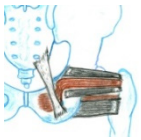
3. Gluteus Minimus

4. Piriformis

(Deep Lateral Rotator #1)

5. The Other 5 Deep Lateral Rotators

#2 - #6 *(Piriformis is lateral rotator #1)*



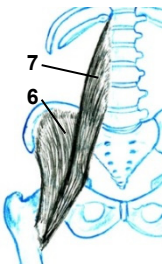
#2. Gemellus superior
#3. Obturator internus
#4. Gemellus inferior
#5. Obturator externus
#6. Quadratus femoris

6. Iliacus

7. Psoas Major

6. + 7. Iliopsoas

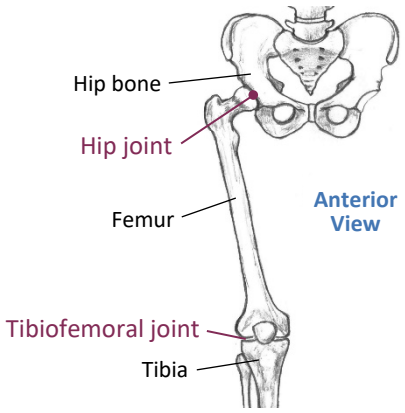
Iliacus + Psoas Major
(treated as one muscle)



Movement of the Hip Joint (Part 2)

Muscle Group 11

Superficial Long Muscles:	The Adductor Group:
Sartorius	Pectineus
Tensor fascia latae (TFL)	Adductor brevis
	Adductor longus
	Adductor magnus
	Gracilis



Joint

(Joint details: p. 164)

This is the second of three groups of muscles that move the femur at the hip joint (coxal joint). This group contains the "longer" length muscles that mainly originate on the iliac crest and pubic bone, and insert on the posterior shaft of the femur and the proximal end of the tibia.

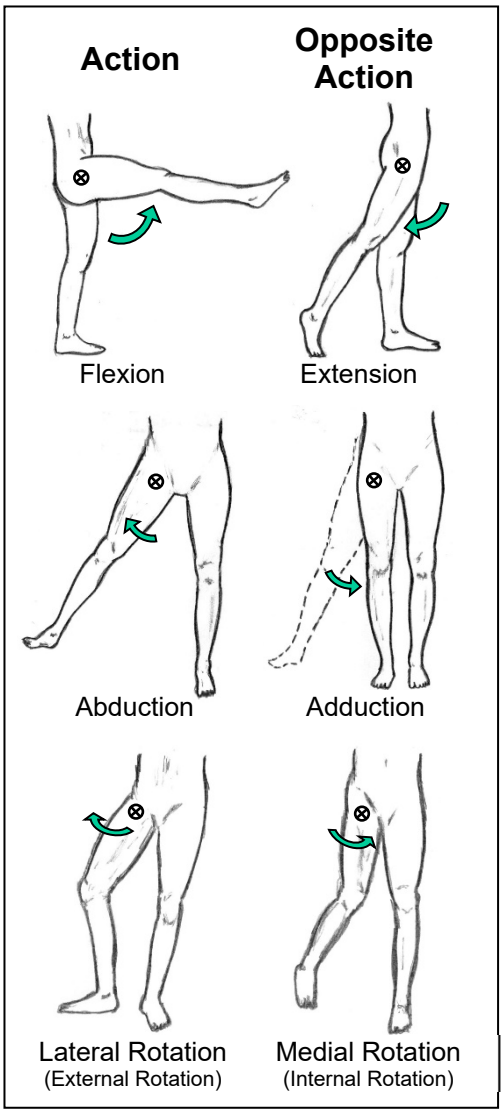
Hip Joint (Coxal Joint) (also called acetabulofemoral joint or coxofemoral joint)

Acetabulum of the **Hip Bone** ◄► Head of **Femur**

Ball and Socket Joint

Movements Available:

Flexion
Extension
Abduction
Adduction
Lateral Rotation (External Rotation)
Medial Rotation (Internal Rotation)



Other Joints

(Joint details: p. 165)

Three of the muscles in this group cross both the hip and the knee joints, and therefore also affect the knee (although the *main* knee movers are presented in the next section – Group 12: Movement of the Knee).

Tibiofemoral Joint (TF)

Condyles of **Femur** ◄► Condyles of **Tibia** (tibial plateau)
Modified Hinge Joint
Movements Available:
Flexion, Extension
Medial and Lateral Rotation (when the knee is flexed)

(Note: The TF joint is covered more fully in the next section – Group 12: Movement of the Knee)

Hip Joint (Part 2)

11

Bones, Bony Landmarks, Other Structures

The "long" muscles that move the hip joint have attachments on the hip bone, femur and tibia. Review the bony landmarks and other structures listed below, referring to the drawings in Chapter 2, pages 47-48.

Hip Bone (Coxal Bone, Os Coxae) (p. 47)

(Made up of 3 bones fused: Ilium, Ischium, Pubis)

Landmarks on the Ilium:
- Anterior superior iliac spine (ASIS)

Landmarks on the Ischium:
- Ischial tuberosity
- Ramus of ischium

Landmarks on the Pubis:
- Superior ramus of pubis
- Pubic crest
- Pubic tubercle
- Body of pubis
- Inferior ramus of pubis
- Symphysis pubis

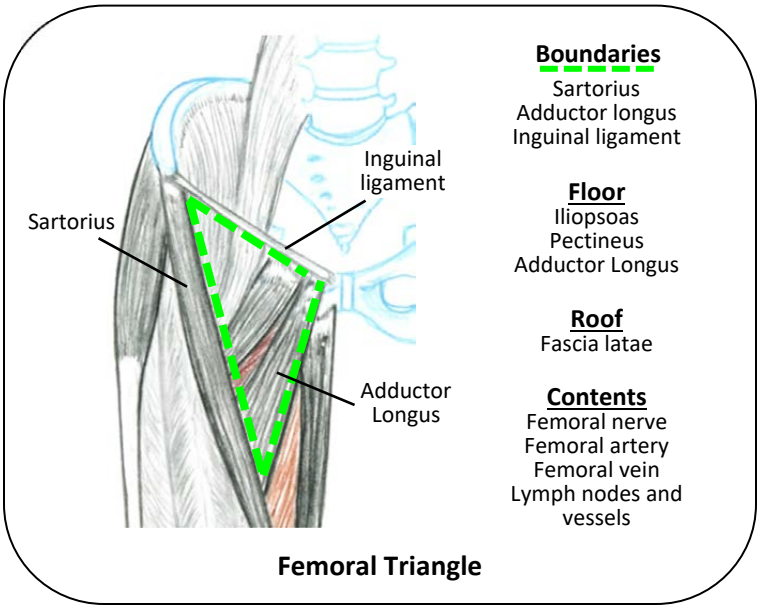
Note: The inferior pubic ramus and the ischial ramus together are called the ischiopubic ramus.

Femur (p. 48)
- Condyles
- Linea aspera
  - (medial lip, lateral lip)
- Pectineal line
- Adductor tubercle

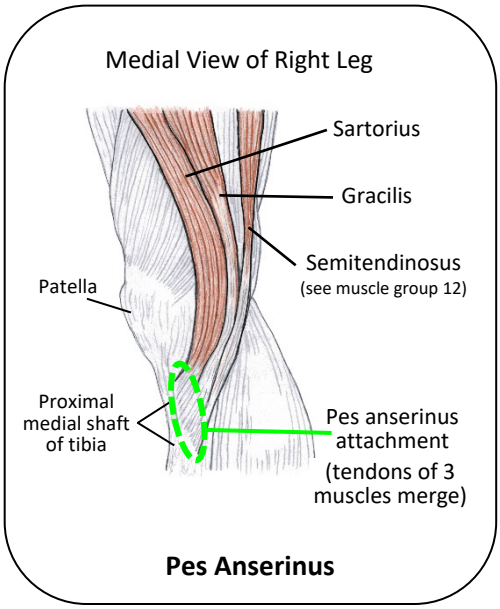
Tibia (p. 48)
- Proximal medial shaft (PMS)
- Condyles
- Lateral tibial tubercle (Gerdy's tubercle)

Other Structures

Fascia Latae	(p. 177)
Iliotibial tract / Iliotibial band (ITB)	"
Pes anserinus	(p. 176)
(on proximal medial shaft (PMS) of tibia)	
Femoral triangle	(p. 176)
Adductor canal	(p. 184)
Adductor hiatus	(p. 177)

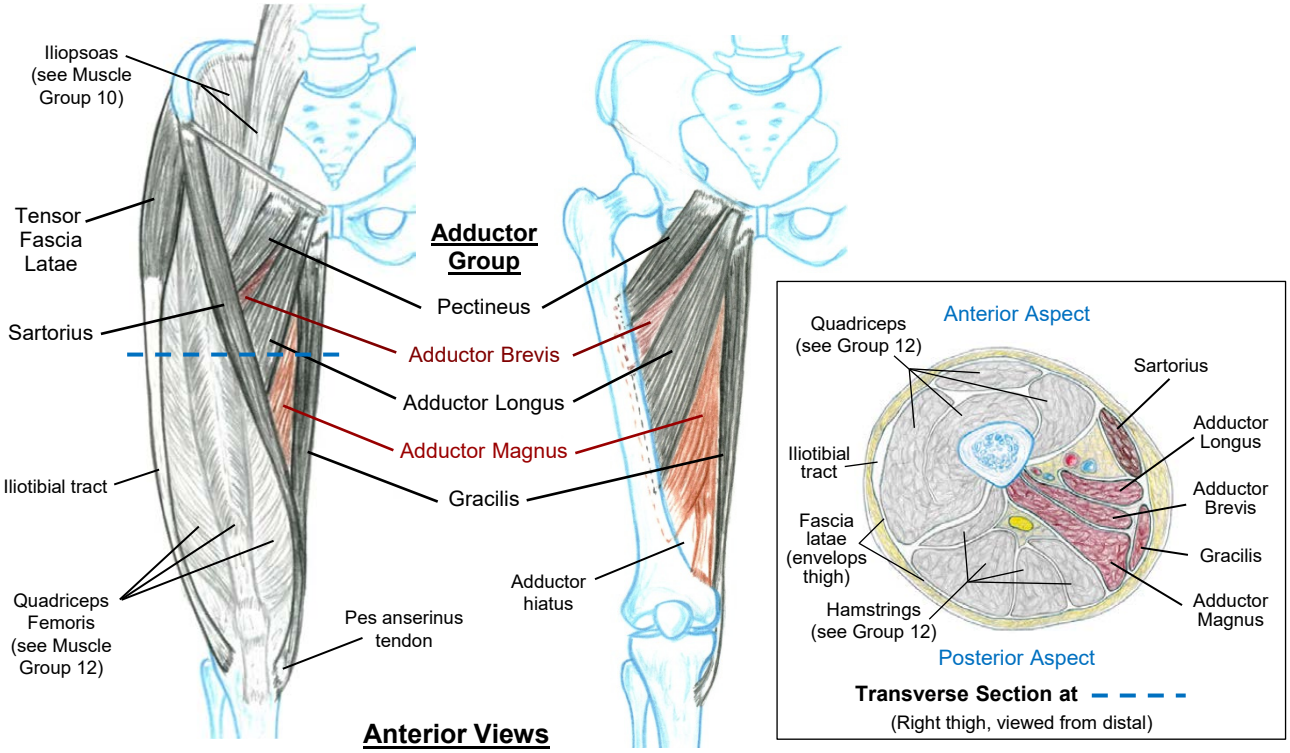


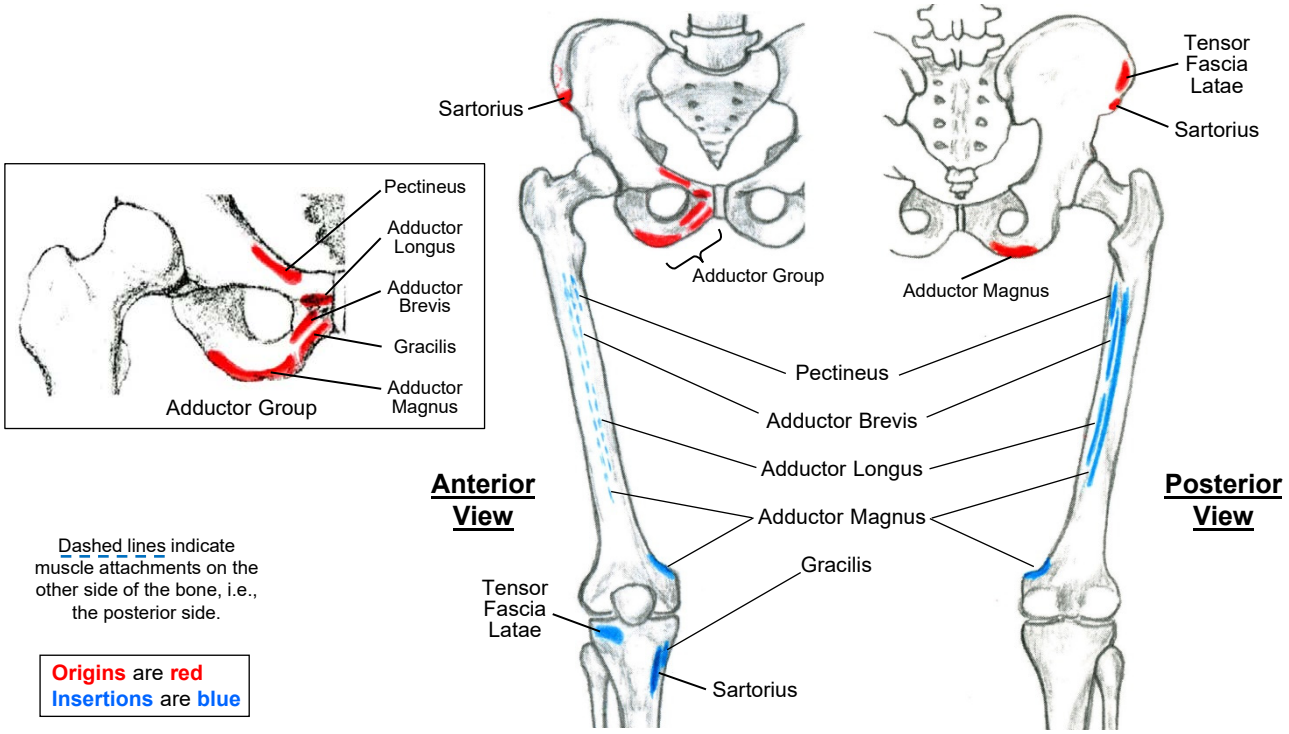
Femoral Triangle



Pes Anserinus

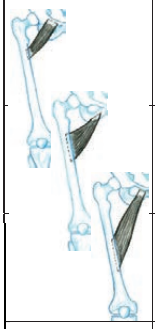
Muscle Group 11 - **The second of three groups that move the hip joint** are illustrated as a group on this page. The following four pages have tables and figures that describe each muscle individually, and provide many ways of comparing and contrasting the muscles to each other.





Attachment sites for all muscles in Group 11

Click a muscle picture to view its Muscle Detail Card

Hip Joint (Part 2)	Origin	Insertion	Action
 **Sartorius** moves the hip joint and knee	Anterior Superior Iliac Spine (ASIS) of the hip bone	Proximal medial shaft of tibia (by way of the pes anserinus tendon)	Flexion, abduction, and lateral rotation at the hip joint. Flexion of the knee and medial rotation of the tibia at the flexed knee.
Tensor Fascia Latae moves the hip joint and stabilizes the knee	Iliac crest, just posterior to the ASIS (i.e., next to the sartorius origin)	Iliotibial tract, which continues on to the lateral tubercle of the tibia (Gerdy's tubercle)	Flexion, abduction, and medial rotation at the hip joint Stabilizes the extended knee
 **Pectineus** moves the hip joint	Superior ramus of pubis	Pectineal line of femur (on posterior femur, proximal to linea aspera)	Adduction, flexion, and medial rotation at the hip joint
Adductor Brevis moves the hip joint	Inferior ramus of pubis (near the obturator foramen, lateral to the gracilis attachment)	Proximal linea aspera of femur	Adduction, flexion, and medial rotation at the hip joint
Adductor Longus moves the hip joint	Pubic tubercle	Mid linea aspera of femur	Adduction, flexion, and medial rotation at the hip joint
 **Adductor Magnus** moves the hip joint	Anterior: Inferior ramus of pubis, Posterior: Ramus of ischium, Ischiocondylar: Ischial tuberosity *Overall Description*: Ischio-pubic ramus & ischial tuberosity	Entire linea aspera, and adductor tubercle of femur (with hiatus in between for vessels to pass through)	All fibers: Adduction at the hip joint. Anterior fibers: Flexion and medial rotation at the hip joint. Posterior fibers: Extension at the hip joint
 **Gracilis** moves the hip joint and knee	Inferior ramus of pubis (medial edge of ramus, near the symphysis pubis)	Proximal medial shaft of tibia (by way of the pes anserinus tendon)	Adduction at the hip joint. Flexion of the knee and medial rotation of the tibia at the flexed knee (may assist flexion & medial rotation at the hip joint)

The Adductor Group

(larger illustrations on page 181)

Table 11 (A) - Hip Joint (Part 2) - Origin, Insertion, Action

Side-by-Side

178

Note

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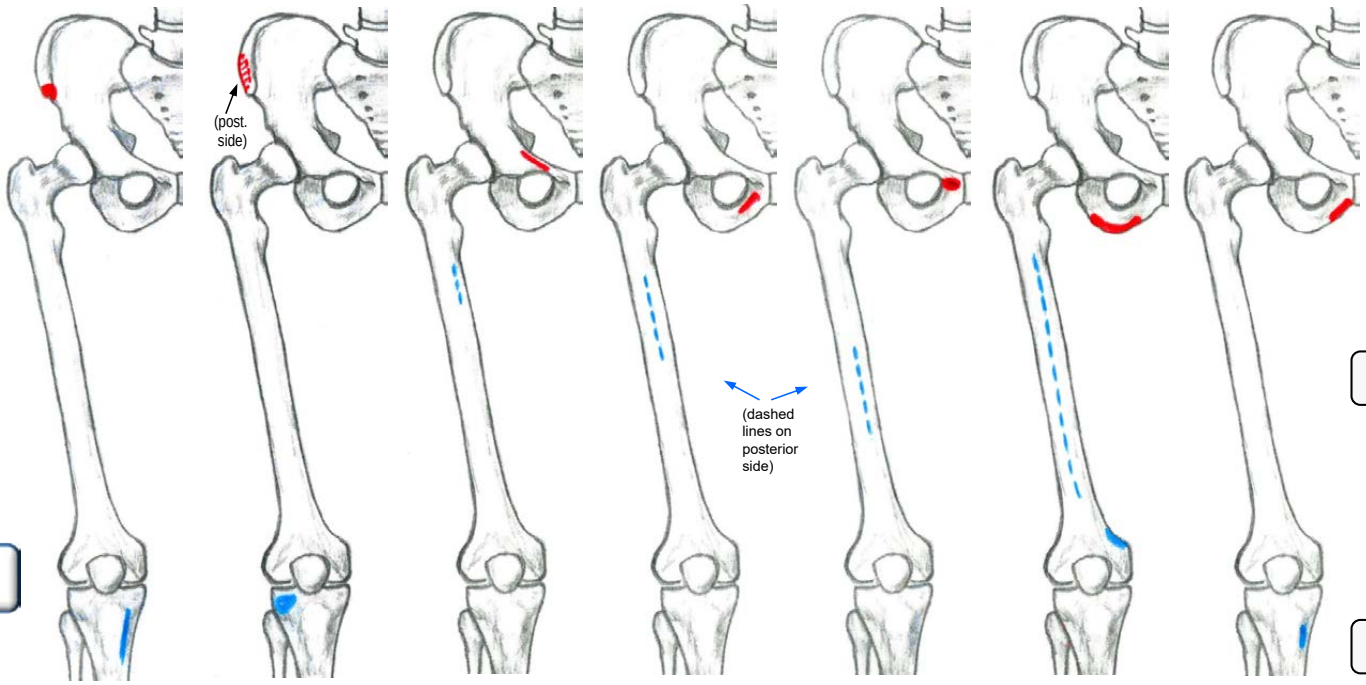

A-Table

View Muscles

B-Table

All illustrations are Anterior View

Adductor Group Origins (clockwise):

1. **P**ectineus (superior pubic ramus)
2. Add. **L**ongus (pubic tubercle)
3. Add. **B**revis (inferior pubic ramus – lateral to gracilis)
4. **G**racilis (inferior pubic ramus – medial edge)
5. Add. **M**agnus (inferior pubic ramus , ischial ramus & ischial tuberosity)

Origins are **red**
Insertions are **blue**

Figure 11 (A) - Hip Joint (Part 2) - Muscle Attachments

Note

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11

Group 11:

Click an Action picture to view ***all*** of its synergists & antagonists

Knee=Tibiofemoral joint (TF jt.), ✓=Muscle creates the action, N=Nerve

Muscles Acting On **Hip Joint (Part 2)**	Flexion @ Hip jt.	Extension @ Hip jt.	Abduction @ Hip jt.	Adduction @ Hip jt.	Medial Rotation @ Hip jt.	Lateral Rotation @ Hip jt.	Flexion @ Knee	Other	Innervation	L2	L3	L4	L5	S1	S2	S3
1. **Sartorius**	✓		✓			✓	✓	Medial rotation of tibia at flexed knee	Femoral N. (L2, L3)	N	N					
2. **Tensor Fascia Latae**	✓		✓		✓			Stabilizes the extended knee	Superiror Gluteal N. (L4, L5, S1)			N	N	N		
3. **Pectineus**	✓			✓	✓				Femoral N. (L2, L3) (& sometimes Obturator N.)	N	N					
4. **Adductor Brevis**	✓			✓	✓			(deep to adductor longus)	Obturator N. (L2, L3, L4)	N	N	N				
5. **Adductor Longus**	✓			✓	✓				Obturator N. (L2, L3, L4)	N	N	N				
6. **Adductor Magnus**	✓ Anterior fibers (which insert proximally)	✓ Posterior fibers (which insert distally)		✓ All fibers	✓ Anterior fibers			Can be an antagonist to itself (posterior vs. anterior fibers)	Anterior part: Obturator N. (L2,L3,L4) Posterior part: Sciatic N. (L4,L5, S1)	N	N	N	N	N		
7. **Gracilis**	✓ may assist			✓	✓ may assist		✓	Medial rotation of tibia at flexed knee	Obturator N. (L2, L3)	N	N					
(More muscles for the action) ---->	see also Groups 10,12	see also Groups 10,12	see also Group 10	see also Group 10	see also Groups 10,12	see also Groups 10,12	see also Groups 12,13		**Innervation** B3							

Side-by-Side

Side-by-Side

Table 11 (B) - Hip Joint (Part 2) - Synergists & Antagonists

180

Note

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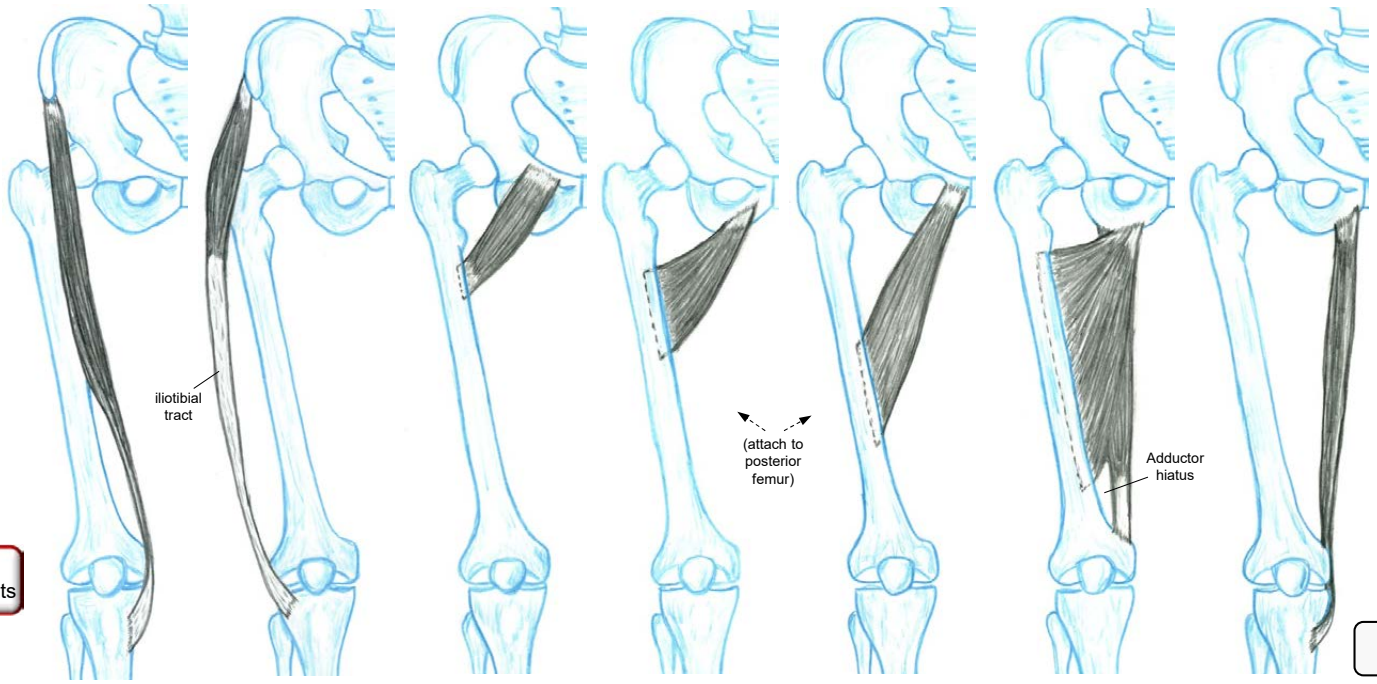
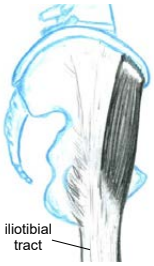


View Attachments

B-Table



TFL (side view)

All illustrations are Anterior View

Figure 11 (B) - Hip Joint (Part 2) - Muscle Pictures

Note

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11

Note-taking page ~ (palpation, how to lengthen/shorten, cautions, common uses, etc.)

Muscle Group 11 - Muscles Acting on the Hip Joint (Part 2)

1. Sartorius

2. Tensor Fascia Latae

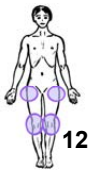
3. Pectineus

4. Adductor Brevis

5. Adductor Longus

6. Adductor Magnus

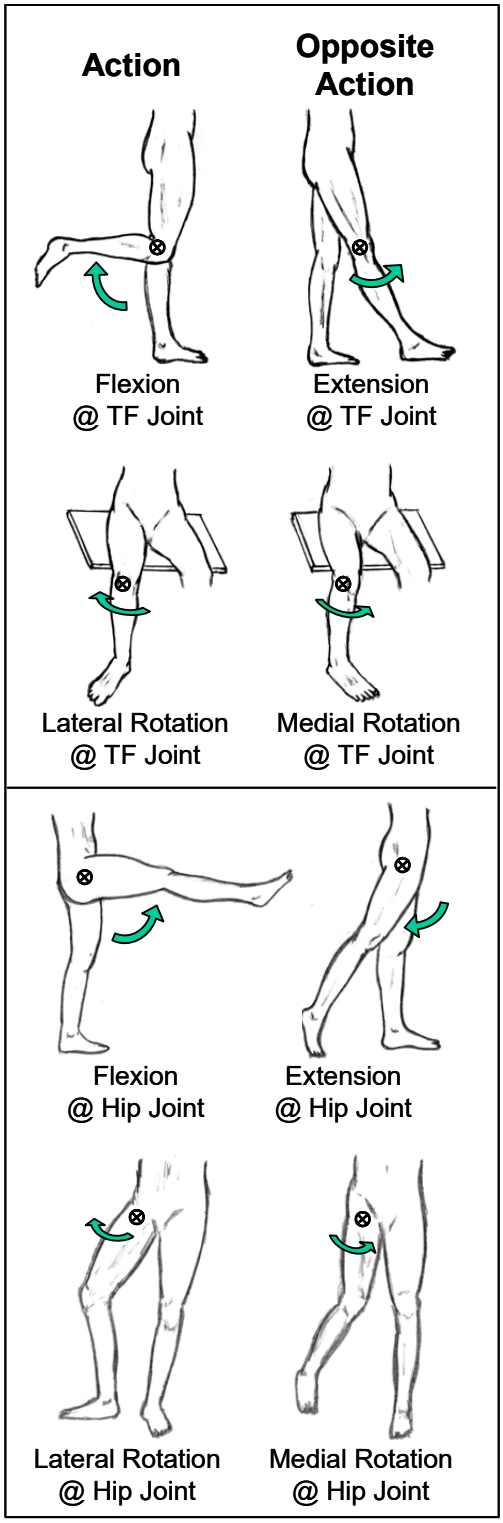
7. Gracilis



Movement of the Knee (& Hip Joint, Part 3)

Muscle Group 12

Quadriceps Group:	Hamstrings Group:
Rectus femoris	Biceps femoris
Vastus lateralis	Semimembranosus
Vastus intermedius	Semitendinosus
Vastus medialis	
	Other:
	Popliteus



Joints

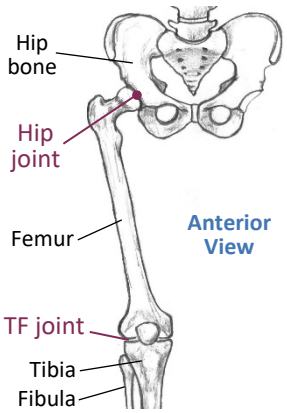
(Joint details: p. 164-165)

This group primarily moves the tibia/fibula at the knee. Many of the muscles are also strong movers of the femur at the hip joint, so this is *also* the third of the three groups of hip movers (along with Groups 10 and 11).

Tibiofemoral Joint (TF) – The Knee

Condyles of **Femur** ◄► Condyles of **Tibia** (tibial plateau)

Modified Hinge joint
Movements Available:
- Flexion, Extension
- Medial and Lateral Rotation (when the knee is flexed)



Hip Joint

(See previous section: Group 11: Hip Joint, Part 2)

Other Joints

These joints are also involved with movements of the knee:

Patellofemoral
- Posterior **Patella** ◄► Patellar surface of **Femur**
- Gliding joint
- Moves all directions, but primarily up & down

Proximal Tibiofibular
- Proximal lateral **Tibia** ◄► Head of **Fibula**
- Gliding joint
- Very slight movement (subluxation is possible)

12 Bones, Bony Landmarks, Other Structures

Muscles that move knee (and hip) have attachments on the hip bone, femur, patella, tibia and fibula. Review the bony landmarks and other structures listed below, referring to the illustrations in Chapter 2, pages 47-48.

Hip Bone (Coxal Bone, Os Coxae) (p. 47)

- Anterior Inferior Iliac Spine (AIIS)
- Ischial tuberosity

Femur (p. 48)

- Linea aspera
- Greater trochanter
- Lesser trochanter
- Lateral condyle
- Shaft
  - Anterior, Posterior, Lateral, Medial Surfaces
- Patellar Surface

Patella

Fibula (p. 48)

- Head

Tibia (p. 48)

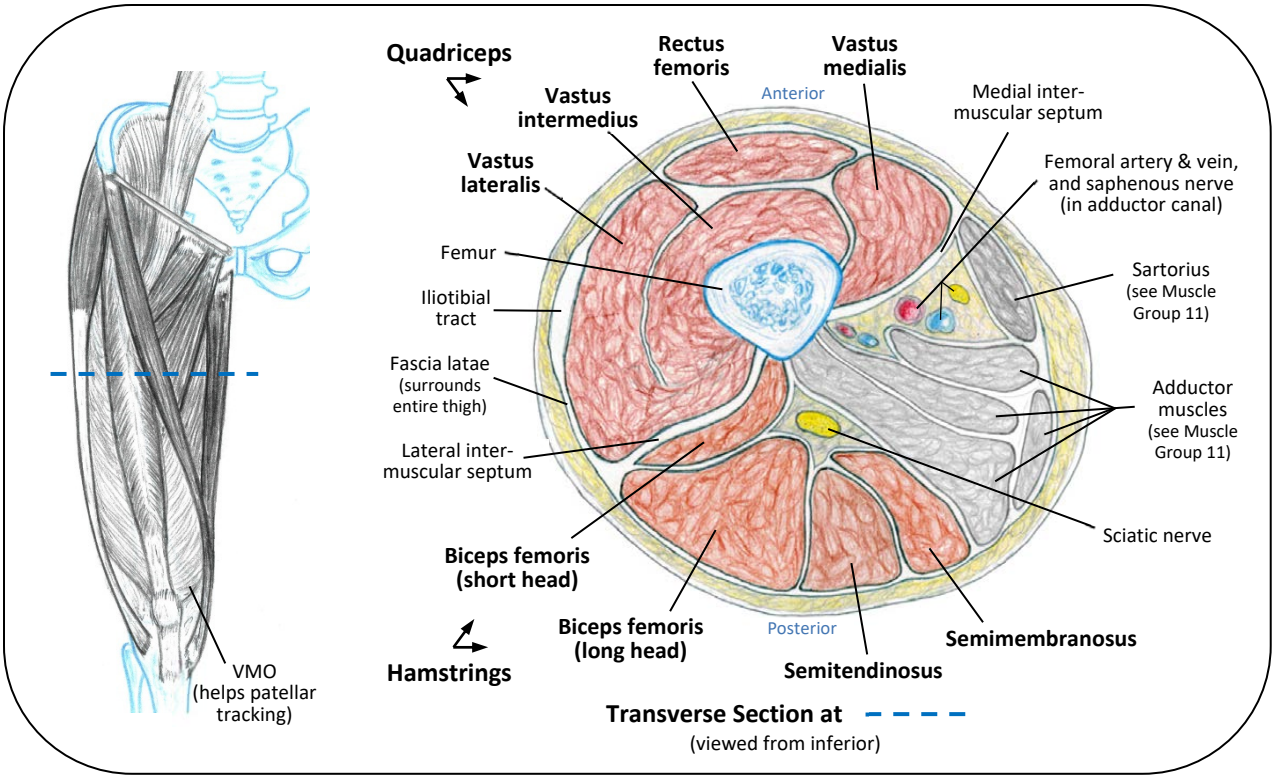
- Tibial tuberosity
- Lateral & Medial Condyles (tibial plateau)
- PMS – Proximal Medial Shaft
- Pes Anserinus attachment

Other Structures:

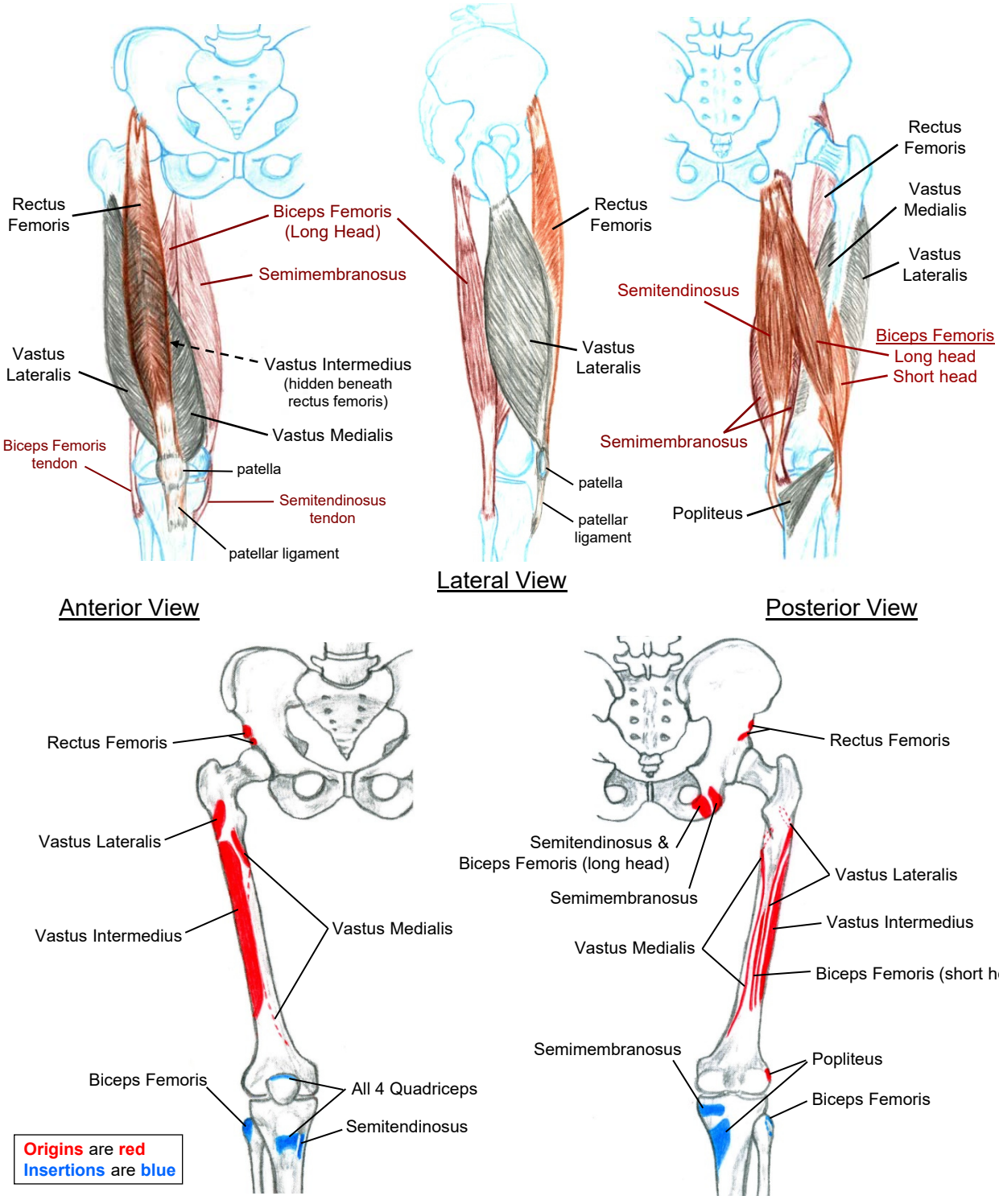
- Patellar ligament (patellar tendon) (p. 165)
- Knee ligaments & menisci (p. 165)
- Pes anserinus tendon (p. 176)
- Vastus medialis obliquus (VMO) (p. 184)
- Popliteal Fossa

Notes:

Note that the rectus femoris and all the hamstring muscles are multi-joint muscles, and they are excellent examples for exploring the concepts of active and passive insufficiency and the force-length relationship (see page 33).



Muscle Group 12 - **Muscles that move the knee** (and in many cases the hip) are illustrated as a group on this page. The next four pages have tables and figures that describe each muscle individually, and provide many ways of comparing and contrasting the muscles to each other.



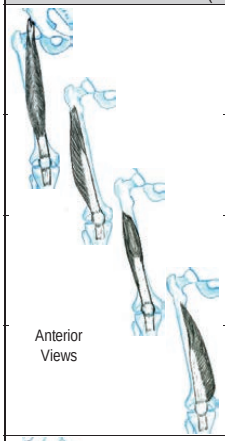
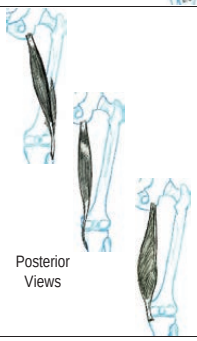
Attachment sites for all muscles in Group 12

Click a muscle picture to view its Muscle Detail Card

12

Group 12: Muscles Acting On

* The tibia is only capable of rotation (at the tibiofemoral joint) when the knee is in a flexed position.

Knee (& Hip Joint, Part 3)	Origin	Insertion	Action
 Anterior Views	**Rectus Femoris** (Quadricep) moves the knee and the hip joint	Anterior Inferior Iliac Spine (AIIS) of the hip bone (and superior margin of the acetabulum just below the AIIS)	Tibial tuberosity via the patellar ligament	Extension at the knee, Flexion at the hip joint
	Vastus Lateralis (Quadricep) moves the knee	Posterior lateral femur, lateral lip of linea aspera (and wraps to anterior at the base of the greater trochanter)	Tibial tuberosity via the patellar ligament	Extension at the knee
	Vastus Intermedius (Quadricep) moves the knee	Anterior and lateral shaft of femur (upper 2/3 of the shaft)	Tibial tuberosity via the patellar ligament	Extension at the knee
	Vastus Medialis (Quadricep) moves the knee	Posterior medial femur, medial lip of linea aspera (and wraps to anterior at the base of the lesser trochanter)	Tibial tuberosity via the patellar ligament	Extension at the knee (distal portion, the VMO, pulls patella medially so it tracks properly)
 Posterior Views	**Biceps Femoris** (Hamstring) moves the knee and the hip joint	Long head: Ischial tuberosity Short head: Lateral lip of linea aspera (distal half)	Head of fibula	*Both* heads: Flexion and lateral rotation* at the knee Long head: Extension and lateral rotation at the hip joint.
	Semitendinosus (Hamstring) moves the knee and the hip joint	Ischial tuberosity	Proximal medial shaft of tibia (by way of the pes anserinus tendon)	Flexion and medial rotation* at the knee, Extension and medial rotation at the hip joint
	Semimembranosus (Hamstring) moves the knee and the hip joint	Ischial tuberosity	Posterior medial condyle of tibia	Flexion and medial rotation* at the knee, Extension and medial rotation at the hip joint
	**Popliteus** moves the knee	Lateral condyle of the femur	Proximal posterio-medial tibia	Medial rotation* at the knee, May assist flexion at the knee When weight bearing: Lateral rotation of femur, to unlock straightened knee

Side-by-Side

(larger illustrations on page 189)

Table 12 (A) - Knee (& Hip Joint, Part 3) **- Origin, Insertion, Action**

186

Note

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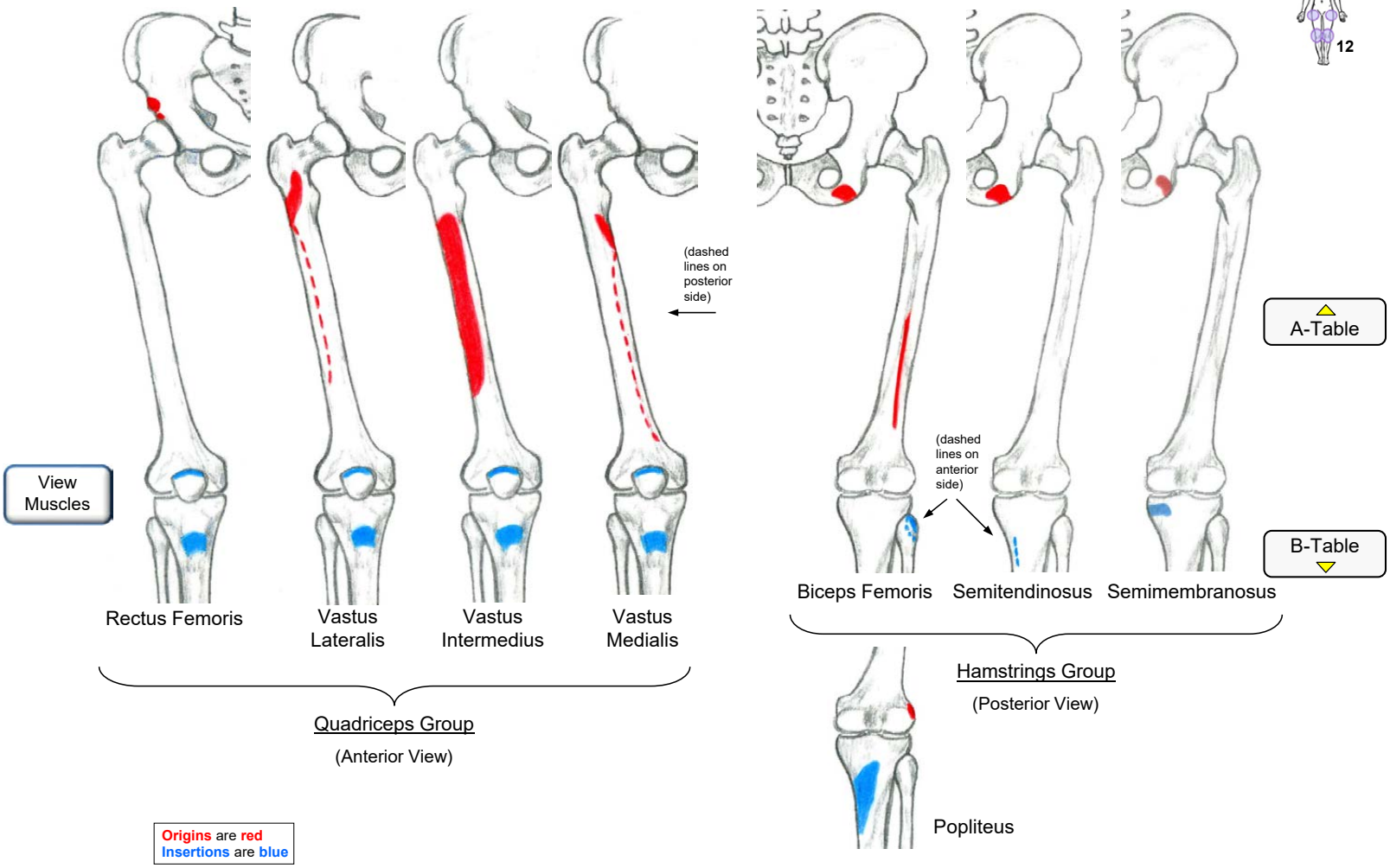

Figure 12 (A) - Knee (& Hip Joint, Part 3) **- Muscle Attachments**

Note

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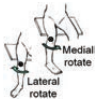
Click an Action picture to view ***all*** of its synergists & antagonists

Group 12:

Knee=Tibiofemoral joint (TF jt.), ✓=Muscle creates the action, N=Nerve

Muscles Acting On **Knee** (& Hip Joint, Part 3)	 Flexion @ Knee	 Extension @ Knee	 Rotation @ Knee	 Flexion @ Hip jt.	 Extension @ Hip jt.	 Medial Rotation @ Hip jt.	 Lateral Rotation @ Hip jt.	Other	Innervation	L2	L3	L4	L5	S1	S2	S3
1. **Rectus Femoris** (Quadricep)		✓		✓				Tight Rectus Femoris can cause anterior pelvic tilt.	Femoral N. (L2, L3, L4)	N	N	N				
2. **Vastus Lateralis** (Quadricep)		✓						Makes up all of the lateral thigh. It is deep to the iliotibial tract.	Femoral N. (L2, L3, L4)	N	N	N				
3. **Vastus Intermedius** (Quadricep)		✓						It is deep to the other 3 quads.	Femoral N. (L2, L3, L4)	N	N	N				
4. **Vastus Medialis** (Quadricep)		✓						Distal part (VMO) pulls patella medially so it tracks properly.	Femoral N. (L2, L3, L4)	N	N	N				
5. **Biceps Femoris** (Hamstring)	✓		✓ *(lateral rotation)*		✓ (long head)		✓ (long head)	This is the lateral hamstring. It has two heads (long & short).	Long head: Tibial part of sciatic N. (S1, S2, S3) Short hd: Peroneal part of sciatic N. (L5, S1, S2)				N	N	N	N
6. **Semitendinosus** (Hamstring)	✓		✓ *(medial rotation)*		✓	✓		Tight hamstrings can cause posterior pelvic tilt.	Tibial part of the sciatic nerve (L5, S1, S2)				N	N	N	
7. **Semimembranosus** (Hamstring)	✓		✓ *(medial rotation)*		✓	✓		Semimemb. is broad, flat, bipennate, deep to Semitend.	Tibial part of the sciatic nerve (L5, S1, S2)				N	N	N	
8. **Popliteus**	✓ may assist		✓ *(medial rotation)*					When weight bearing: Lateral rotation of femur, to unlock knee.	Tibial N. (L4, L5, S1)			N	N	N		
(More muscles for the action) ---->	see also Groups 11,13			see also Groups 10,11	see also Groups 10,11	see also Groups 10,11	see also Groups 10,11		**Innervation** B3							

Side-by-Side

Side-by-Side

Table 12 (B) - Knee (& Hip Joint, Part 3) - Synergists & Antagonists

188

Note

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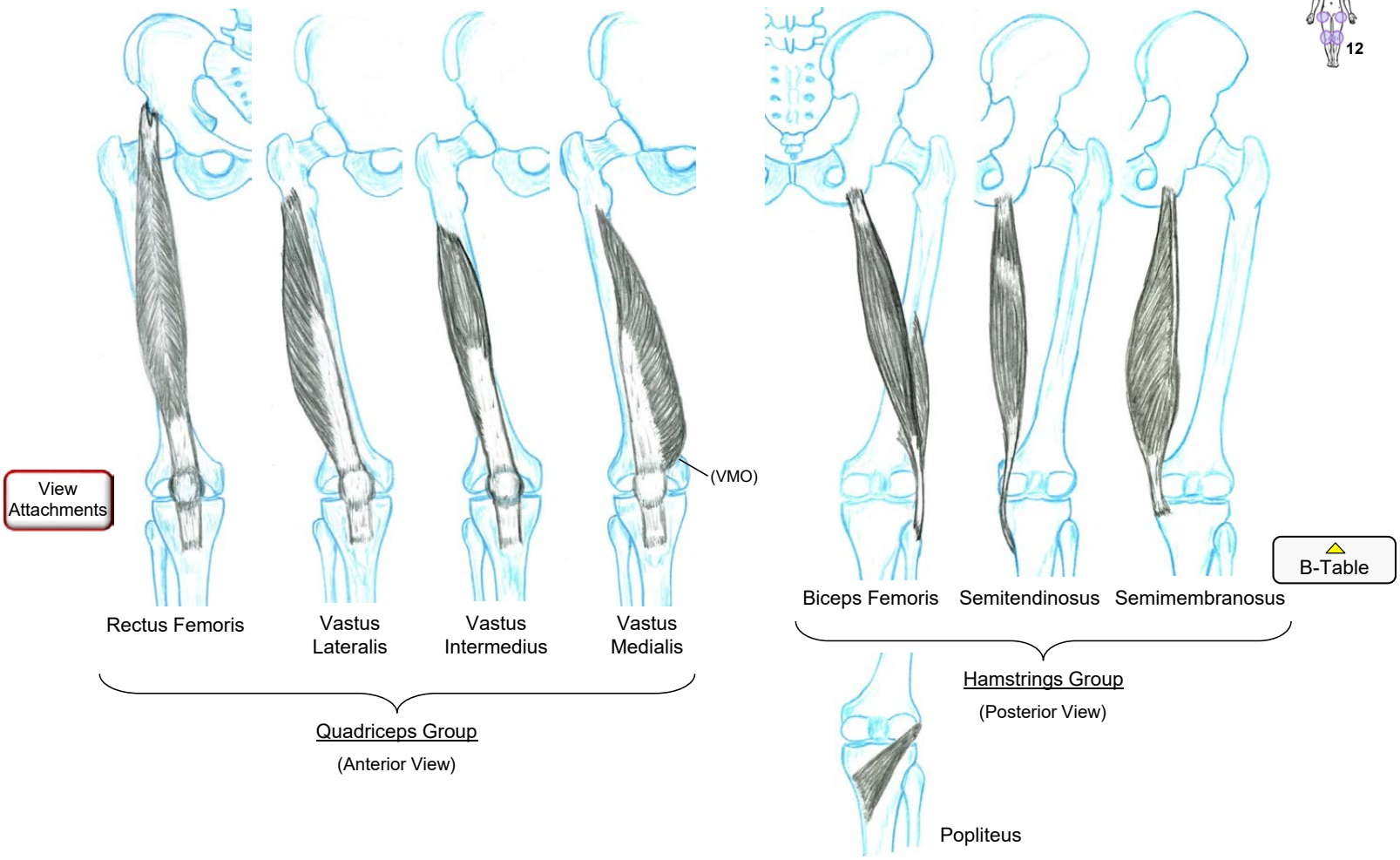

Figure 12 (B) - Knee (& Hip Joint, Part 3) **- Muscle Pictures**

189

Note

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12

Note-taking page ~ (palpation, how to lengthen/shorten, cautions, common uses, etc.)

Muscle Group 12 - Muscles Acting on the Knee (& Hip Joint, Part 3)

1. Rectus Femoris

2. Vastus Lateralis

3. Vastus Intermedius

4. Vastus Medialis

5. Biceps Femoris

6. Semitendinosus

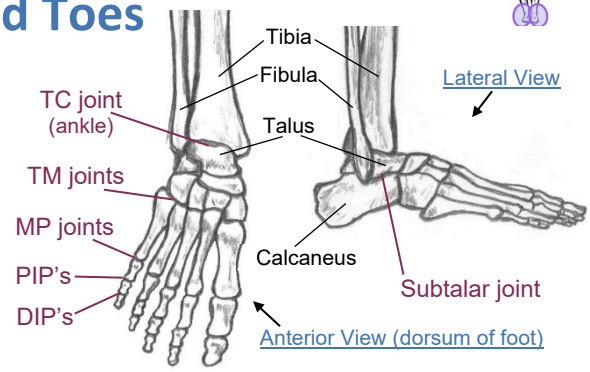
7. Semimembranosus

8. Popliteus

Movement of the Ankle, Foot, and Toes

Muscle Group 13

Gastrocnemius	Fibularis brevis (peroneus b.)
Soleus	Fibularis longus (peroneus l.)
Plantaris	
Tibialis posterior	Tibialis anterior
Flexor digitorum longus	Extensor digitorum longus
Flexor hallucis longus	Extensor hallucis longus



Joints

(Joint details: p. 166)

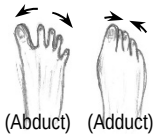
The muscles in this group move the ankle, foot, and toes. A couple of the muscles also cross the knee joint and therefore affect the knee. There are many joints involved, and it can be challenging to visualize which joints are in play with some of the more complex foot movements.

Talocrural Joint (TC) - Ankle
Distal **tibia** & distal **fibula** ◄► **Talus**
Hinge joint
Movements available: Plantar flexion
Dorsiflexion

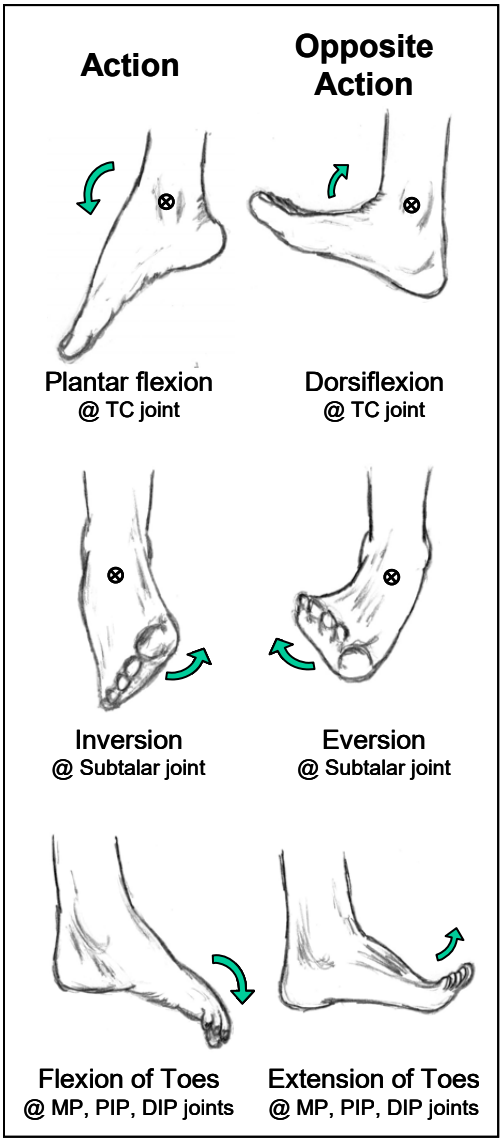
Subtalar Joint (Talocalcaneal Joint)
Inferior aspect of **Talus** ◄► Superior aspect of **Calcaneus**
Gliding joint
Movements available: Inversion (Supination)
Eversion (Pronation)

Tarsometatarsal Joints (TM or TMT) (#1-#5)
Distal row of **tarsals** ◄► Bases of **metatarsals**
Gliding joints

Metatarsophalangeal Joints (MP or MTP) (#1-#5)
Heads of **metatarsals** ◄► Bases of proximal **phalanges**
Condyloid joints
Movement of the toes: Flexion, Extension
Abduction, Adduction



Interphalangeal Joints (PIP and DIP) (#1-#5)
Joints between the **phalanges** of the toes
Hinge joints
Movement of the toes: Flexion, Extension

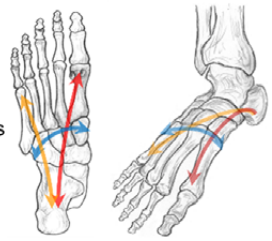


PIP = Proximal Interphalangeal (between the proximal phalanx and the middle phalanx)
DIP = Distal Interphalangeal (between the middle phalanx and the distal phalanx)
Note: The big toe (hallux) has only 2 phalanges, so has only an IP joint (no PIP or DIP)

Other Joints

The following joints are included here for completeness, but are not considered primary joints involved with ankle/foot/toe movements. They are special combinations of intertarsal joints (interfaces between tarsal bones) that are important when studying the arches and flexibility of the foot.

Transverse Tarsal Joint (also called the midtarsal joint) (p. 49)
Talocalcaneonavicular Joint (TCN)
Longitudinal and transverse arches of the foot (p. 166)



Bones, Bony Landmarks, Other Structures

Muscles that move the ankle, foot and toes have attachments on the bones of the leg, foot, and posterior knee. Review the bony landmarks and other structures listed below, referring to Chapter 2, pages 48-49.

Femur (p. 48)
- Medial and Lateral Condyles
- Medial and Lateral Epicondyles

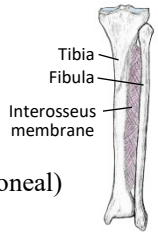
Tibia (p. 48)
- Medial and Lateral Condyles
- Soleal Line
- Medial malleolus
- Shaft
  - Posterior, Anterior, Medial, Lateral
  - Combination aspects, e.g., posteriolateral
  - Lengthwise positions, e.g., "proximal two-thirds", "middle one-half"

Fibula (p. 48)
- Head
- Lateral malleolus
- Shaft
  - Posterior, Anterior, combinations, lengthwise positions (as with tibia above)

Ankle & Foot Bones (p. 49)

- Tarsal Bones (7)
  - Talus, Calcaneus
  - Cuboid, Navicular
  - Cuneiforms (3)
    - (1st: medial, 2nd: middle, 3rd: lateral)
- Metatarsal Bones (5): 1st=medial to 5th=lateral
  - Tuberosity of the 5th metatarsal
  - Head, base, and shaft
- Phalanges (14)
  - Digit #1 = Hallux (big toe)
    - Proximal, Distal phalanges
  - Digits #2-#5 = toes medial to lateral
    - Proximal, Middle, Distal phalanges
  - Head, base, and shaft

Other Structures
- Interosseous membrane
- Calcaneal tendon (Achilles tendón)
- Plantar aponeurosis /plantar fascia
- Retinacula: (extensor, flexor, fibular/peroneal)



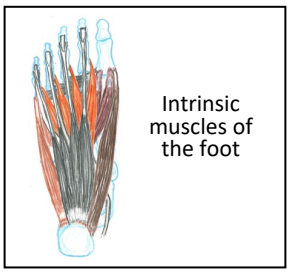
Tendon Arrangements and Compartments of the Leg (see pages 193 and 201)

Medial malleolus tendons:	Tibialis Posterior & two Flexor muscles (**T**P, F**D**L, F**H**L)
Dorsum of foot tendons:	Tibialis Anterior & two Extensor muscles (TA, EHL, EDL)
Lateral malleolus tendons:	Fibularis Longus & Fibularis Brevis (FL, FB)
Anatomical Stirrup:	Tendons of fibularis longus and tibialis anterior form "stirrup" under foot

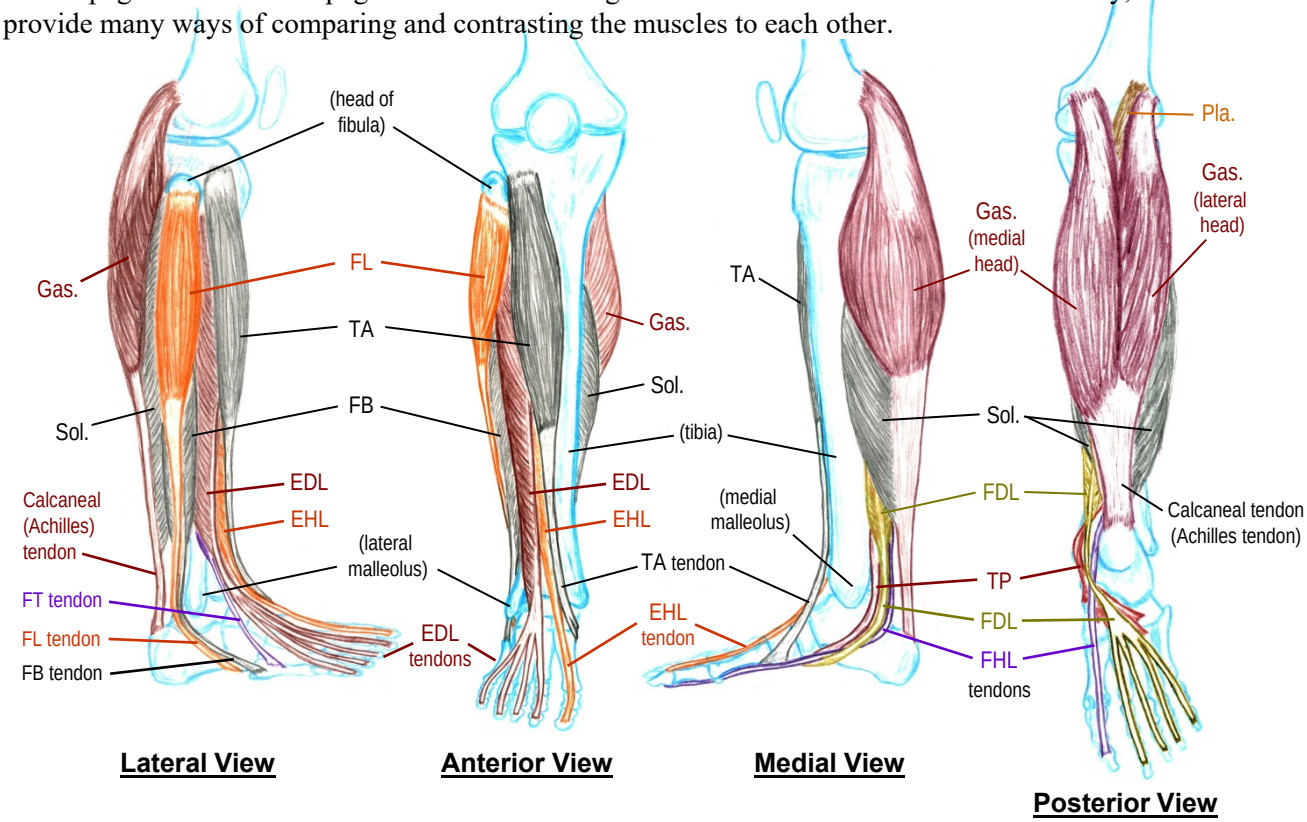
Four Leg Compartments: 1. Anterior, 2. Lateral, 3. Deep posterior, 4. Superficial posterior

Intrinsic Muscles of the Foot (see pages 198-199)

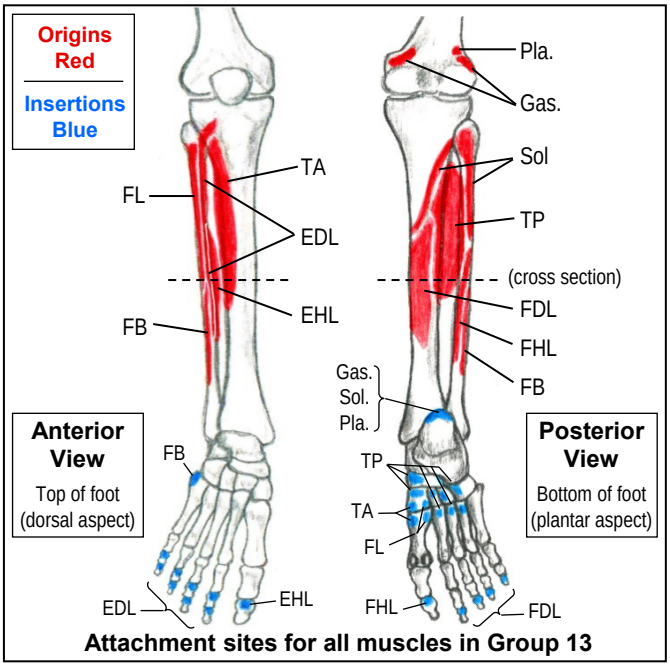
There are twelve muscles that reside within the structure of the foot itself. These *intrinsic* muscles of the foot are not included in the Group 13 tables, but a separate table and illustrations are presented as a Bonus Group on pages 198-199.

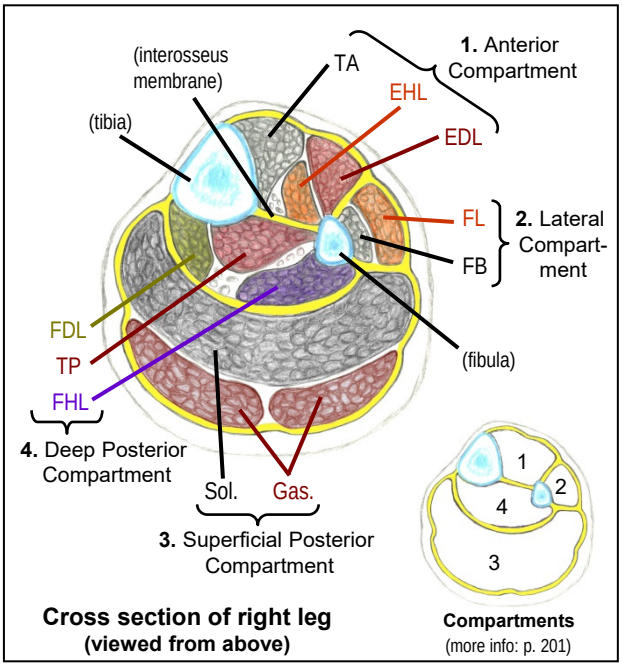


Muscle Group 13 - **Muscles that move the ankle, foot, and toes** are illustrated as a group on this page. The next four pages have tables and figures that describe each muscle individually, and provide many ways of comparing and contrasting the muscles to each other.



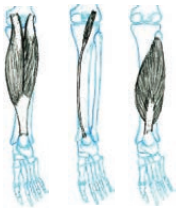
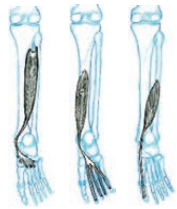
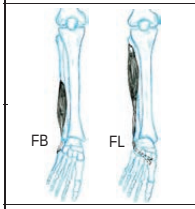
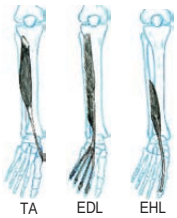
Gas. - Gastrocnemius	FL - Fibularis Longus (Peroneus)	TA - Tibialis Anterior	TP - Tibialis Posterior
Sol. - Soleus	FB - Fibularis Brevis (Peroneus)	EDL - Extensor Digitorum Longus	FDL - Flexor Digitorum Longus
Pla. - Plantaris	FT - Fibularis Tertius (Peroneus)	EHL - Extensor Hallucis Longus	FHL - Flexor Hallucis Longus





Click a muscle picture to view its Muscle Detail Card

Group 13: Muscles Acting On Joints: DIP & PIP=Distal & Proximal Interphalangeal, MP=Metatarsophalangeal, Toes #1-#5: 1=big toe, 5=little toe

Ankle, Foot, Toes	Origin	Insertion	Action
 Gas. Pla. Sol.	**Gastrocnemius** moves the ankle and knee	Posterior condyles of femur (lateral & medial)	Calcaneus via the achilles tendon	Plantar flexion of the ankle, Flexion of the knee (also stabilizes the knee in standing, walking, running)
	Plantaris moves the ankle and knee	Posterior lateral epicondyle of femur	Calcaneus via the achilles tendon (small spot on the medial side)	Weak plantar flexion of ankle, may assist with inversion of the foot and flexion of the knee
	Soleus moves the ankle	Proximal posterior shaft and head of fibula, Soleal line & middle medial edge of tibia	Calcaneus via the achilles tendon	Plantar flexion of the ankle
 TP FDL FHL	**Tibialis Posterior** moves the foot	Posterior lateral tibia, Posterior medial fibula, and interosseus membrane.	Plantar aspect of all tarsals except talus, and bases of metatarsals #2-4 (Tarsal attachments: calcaneus, navicular, cuboid, 3 cuneiforms)	Inversion of the foot, Plantar flexion of the ankle
	Flexor Digitorum Longus moves toes #2-5 and the foot	Posterior tibia (starts 1/3 of the way down)	Base of distal phalanges #2-5 (plantar aspect)	Flexion of toes #2-5, Inversion of foot, Plantar flexion of ankle
	Flexor Hallucis Longus moves toe #1 and the foot	Posterior fibula (starts 1/3 of the way down)	Base of distal phalanx of hallux - big toe (plantar aspect)	Flexion of toe #1 (hallux), Inversion of foot, Plantar flexion of ankle
 FB FL	**Fibularis Brevis** *(also called Peroneus Brevis)* moves the foot	Distal half of fibula (lateral aspect)	Tuberosity of the 5th metatarsal	Eversion of the foot, Assists plantar flexion of ankle
	Fibularis Longus *(also called Peroneus Longus)* moves the foot	Head and proximal two-thirds of fibula (lateral aspect)	Medial (1st) cuneiform and base of 1st metatarsal (plantar aspect)	Eversion of the foot, Assists plantar flexion of ankle
 TA EDL EHL	**Tibialis Anterior** moves the foot	Lateral condyle and proximal half of tibia (lateral aspect) (and interosseus membrane)	Medial (1st) cuneiform and base of 1st metatarsal (medial edge of plantar aspect)	Dorsiflexion of the ankle, Inversion of the foot
	Extensor Digitorum Longus moves toes #2-5 and the foot	Lateral condyle of tibia, and proximal 2/3 of fibula (anterior aspect)	Middle & distal phalanges #2-5 (dorsal aspect)	Extension of toes #2-5, Dorsiflexion of the ankle, Eversion of the foot
	Extensor Hallucis Longus moves toe #1 and the foot	Middle portion of fibula (anterior medial aspect) (and interosseus membrane)	Base of distal phalanx of hallux -big toe (dorsal aspect)	Extension of toe #1 (hallux), Dorsiflexion of the ankle (May assist inversion of foot)

(larger illustrations on page 197)

Side-by-Side

Table 13 (A) - Ankle, Foot, Toes - Origin, Insertion, Action

194

Note

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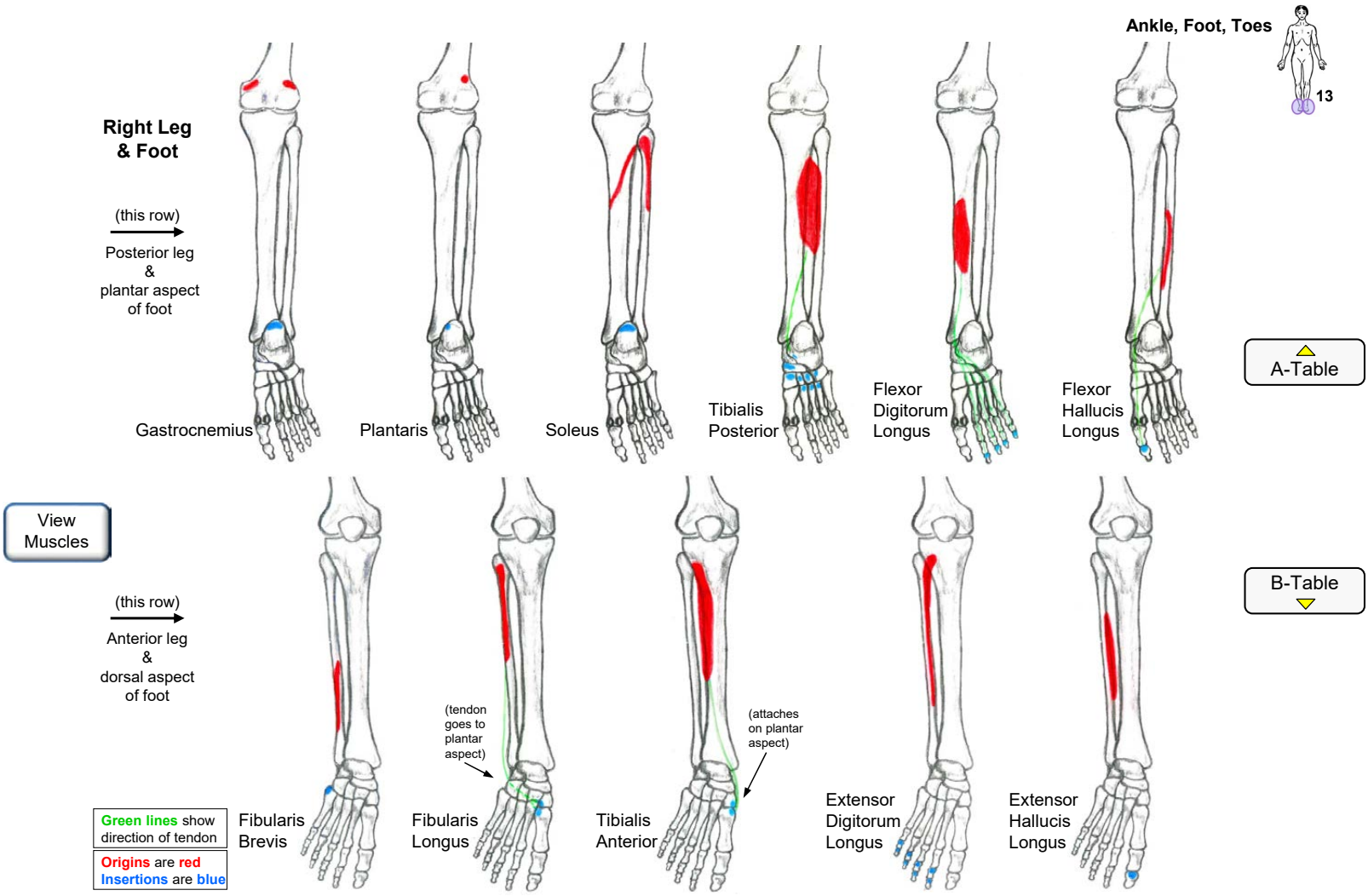

Figure 13 (A) - Ankle, Foot, Toes - Muscle Attachments

Note

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It should be viewed with the e-reader set to “Fit to width”.

Click an Action picture to view ***all*** of its synergists & antagonists

Group 13: #1-#5 toes (1=big toe, 5=little toe), Ankle=Talocrural joint (TC jt.), Knee=Tibiofemoral joint (TF jt.), ✓=Muscle creates the action, N=Nerve

Muscles Acting On **Ankle, Foot, Toes**	 Plantar flexion (=flexion) @ Ankle	 Dorsiflexion (=extension) @ Ankle	 Inversion (@ Subtalar joint)	 Eversion (@ Subtalar joint)	 Flexion of Toes	 Extension of Toes	 Flexion @ Knee	 Stabilization	Innervation	L4	L5	S1	S2
1. Gastrocnemius	✓						✓	Stabilizes knee	Tibial N. (S1, S2)			N	N
2. Plantaris	✓ may assist		✓ may assist				✓ may assist		Tibial N. (L4, L5, S1)	N	N	N	
3. Soleus	✓								Tibial N. (S1, S2)			N	N
4. Tibialis Posterior	✓		✓					Stabilizer of ankle/foot	Tibial N. (L5, S1)		N	N	
5. Flexor Digitorum Longus	✓		✓		✓ #2-5				Tibial N. (L5, S1)		N	N	
6. Flexor Hallucis Longus	✓		✓		✓ #1 (hallux)				Tibial N. (L5, S1, S2)		N	N	N
7. Fibularis Brevis (Peroneus Brevis)	✓ assist			✓				Helps stabilize foot	Superficial fibular N. * (L4, L5, S1)	N	N	N	
8. Fibularis Longus (Peroneus Longus)	✓ assist			✓				PL and TA form "Anatomical stirrup"…	Superficial fibular N. (L4, L5, S1)	N	N	N	
9. Tibialis Anterior		✓	✓					…helping to maintain balance & stabilize foot	Deep fibular N. (L4, L5, S1)	N	N	N	
10. Extensor Digitorum Longus		✓		✓		✓ #2-5			Deep fibular N. (L4, L5, S1)	N	N	N	
11. Extensor Hallucis Longus		✓	✓ may assist			✓ #1 (hallux)			Deep fibular N. (L4, L5, S1)	N	N	N	
(More muscles for the action) ---->							see also Groups 11,12		**Innervation** B4				

Side-by-Side

Side-by-Side

* fibular N. = peroneal N.

Table 13 (B) - Ankle, Foot, Toes - Synergists & Antagonists

196

Note

This was originally a landscape-oriented page.
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It should be viewed with the e-reader set to “Fit to width”.

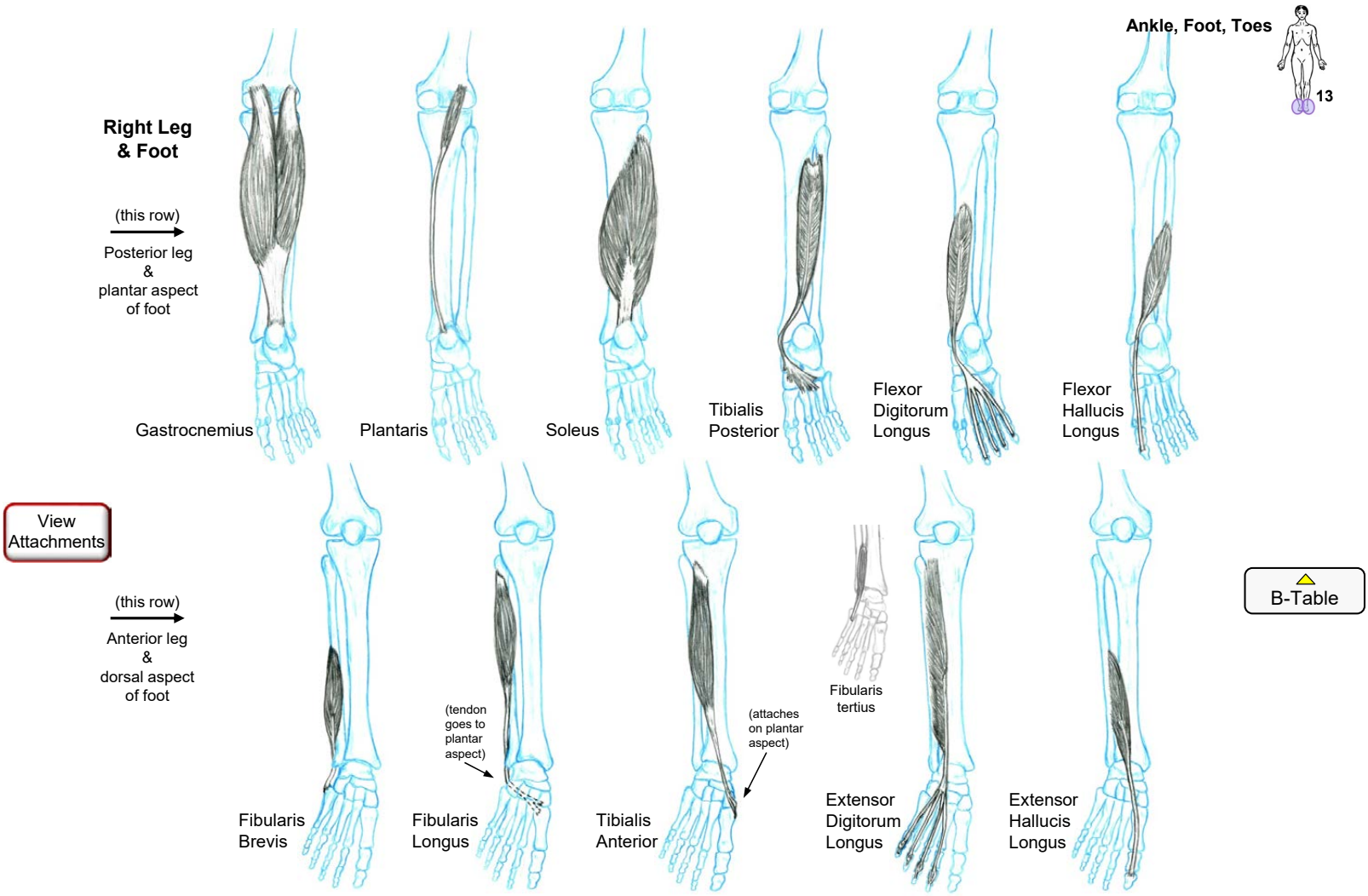


Figure 13 (B) - Ankle, Foot, Toes - Muscle Pictures

Note

This was originally a landscape-oriented page.
It has been converted to portrait for the e-book.

It should be viewed with the e-reader set to “Fit to width”.

Foot – Intrinsic
(Bonus Group)

13b

Intrinsic Muscles of the Foot – Plantar Aspect

Muscle	Origin	Insertion	Action	Innervation
Plantar Layer #1 (superficial)				
Abductor Digiti Minimi	Tuberosity of the calcaneus	Proximal phalanx of the little toe (lateral base)	Abduction and flexion of the little toe	Lateral plantar N. (S2, S3)
Flexor Digitorum Brevis	Tuberosity of the calcaneus	Middle phalanges of toes #2-5 (sides)	Flexion of toes #2-5	Medial plantar N. (L5, S1)
Abductor Hallucis	Tuberosity of the calcaneus	Proximal phalanx of the big toe (medial base)	Abduction and flexion of the big toe	Medial plantar N. (L5, S1)
Plantar Layer #2 (intermediate)				
Lumbrical Muscles (4)	The four tendons of the flexor digitorum longus	The four tendons of the extensor digitorum longus (attach via the medial side of the dorsal digital expansions)	Flexion of toes #2-5 at the metatarsophalangeal joints, Extension of toes #2-5 at the interphalangeal joints	Lumbrical 1: Medial plantar N. (L5, S1) Lumbricals 2-4: Lateral plantar N. (S2, S3)
Quadratus Plantae	Plantar surface of the calcaneus	Tendon of the flexor digitorum longus (lateral margin, before it goes to the 4 toes)	Flexion of toes #2-5 (assists the FDL)	Lateral plantar N. (S2, S3)
Plantar Layer #3 (almost deepest)				
Flexor Digiti Minimi	Base of 5th metatarsal (& peroneus longus tendon)	Proximal phalanx of the little toe (plantar base)	Flexion of the little toe (at the MP joint)	Lateral plantar N. (S2, S3)
Adductor Hallucis	Oblique head: Bases of metatarsals #2-4, Transverse head: Metatarsophalangeal ligaments #3-5	Proximal phalanx of the big toe (lateral base)	Adduction of the big toe	Lateral plantar N. (S2, S3)
Flexor Hallucis Brevis	Cuboid and lateral cuneiform (plantar surfaces)	Proximal phalanx of the big toe (sides of base)	Flexion of the big toe (at the MP joint)	Medial plantar N. (L5, S1)
Plantar Layer #4 (deepest)				
Plantar Interossei (3)	3rd, 4th and 5th metatarsal bones (bases and medial side of shafts)	Bases of the proximal phalanges of toes #3-5 (and the dorsal digital expansions of toes #3-5)	Adduction of toes #3-5, Assist flexion of toes #3-5 at the metatarsophalangeal joints, Assist extension of toes #3-5 at the interphalangeal joints	Lateral plantar N. (S2, S3)

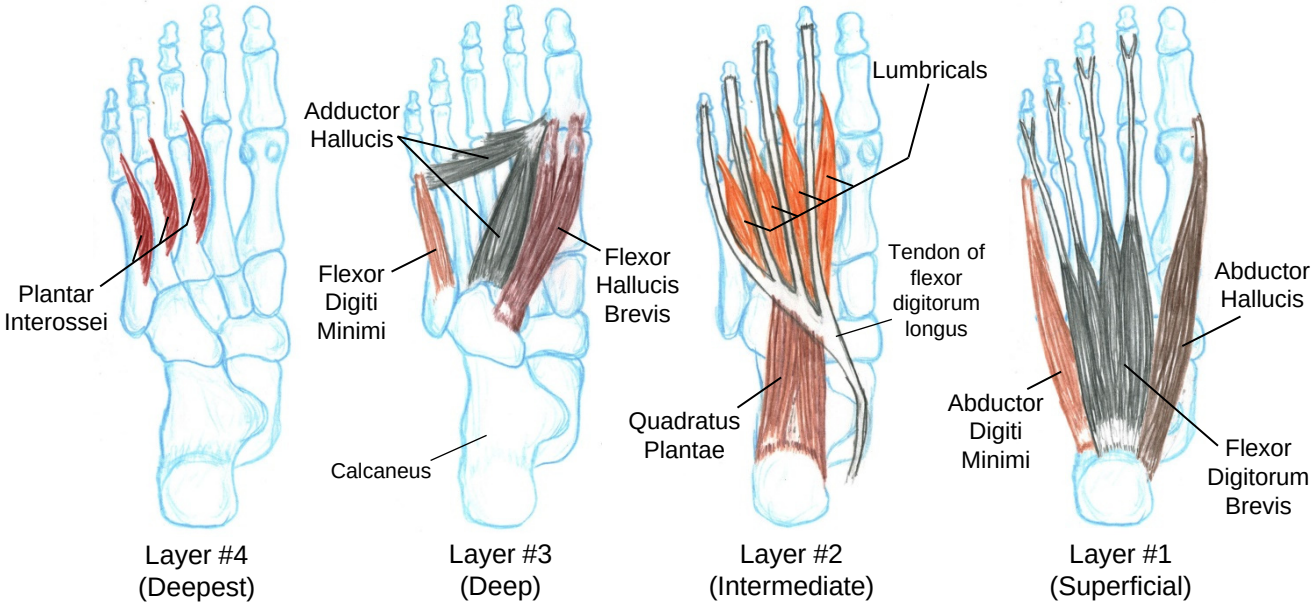
Intrinsic Muscles of the Foot – Dorsal Aspect

Muscle	Origin	Insertion	Action	Innervation
Dorsal Layer #1 (superficial)				
Extensor Digitorum Brevis	Dorsal surface of the calcaneus	Toes #2-4, via the tendons of the extensor digitorum longus (attach to the lateral side of the EDL tendons)	Extension of toes #2-4	Deep fibular N. * (L5, S1)
Extensor Hallucis Brevis	Dorsal surface of the calcaneus	Proximal phalanx of the big toe (dorsal surface of the base of the phalanx)	Extension of the big toe	Deep fibular N. * (L5, S1)
Dorsal Layer #2 (deep)	Note: This layer is sometimes considered to be part of plantar layer #4			
Dorsal Interossei (4)	Shafts of metatarsal bones #1-5 (each muscle arises from the sides of two adjacent metatarsal bones)	Bases of the proximal phalanges of toes #2-4 (and the dorsal digital expansions of toes #2-4)	Abduction of toes #2-4, Assist flexion of toes #2-4 at the metatarsophalangeal joints, Assist extension of toes #2-4 at the interphalangeal joints	Lateral plantar N. (S2, S3)

* (formerly called peroneal N.)

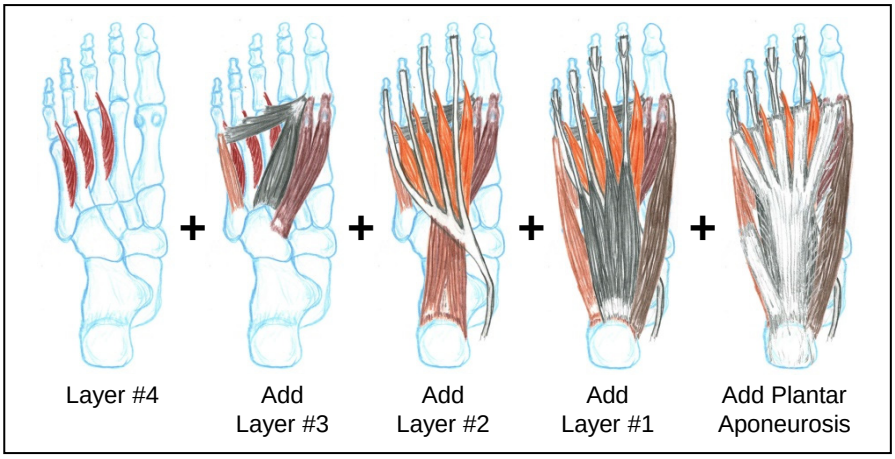
Intrinsic Muscles of the Foot

Right Foot – Layers of the Plantar Aspect

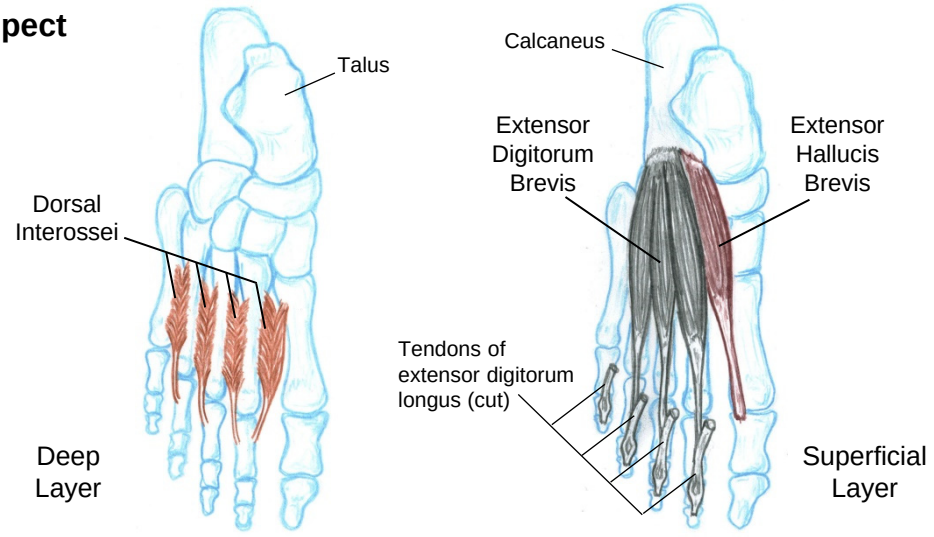


Layer #4 (Deepest) | Layer #3 (Deep) | Layer #2 (Intermediate) | Layer #1 (Superficial)

Building the Plantar Muscles One Layer at a Time



Right Foot – Dorsal Aspect



13

Note-taking page ~ (palpation, how to lengthen/shorten, cautions, common uses, etc.)

Muscle Group 13 - Muscles Acting on the Ankle, Foot and Toes

1. Gastrocnemius

7. Fibularis Brevis (Peroneus Brevis)

3. Soleus

8. Fibularis Longus (Peroneus Longus)

4. Tibialis Posterior

9. Tibialis Anterior

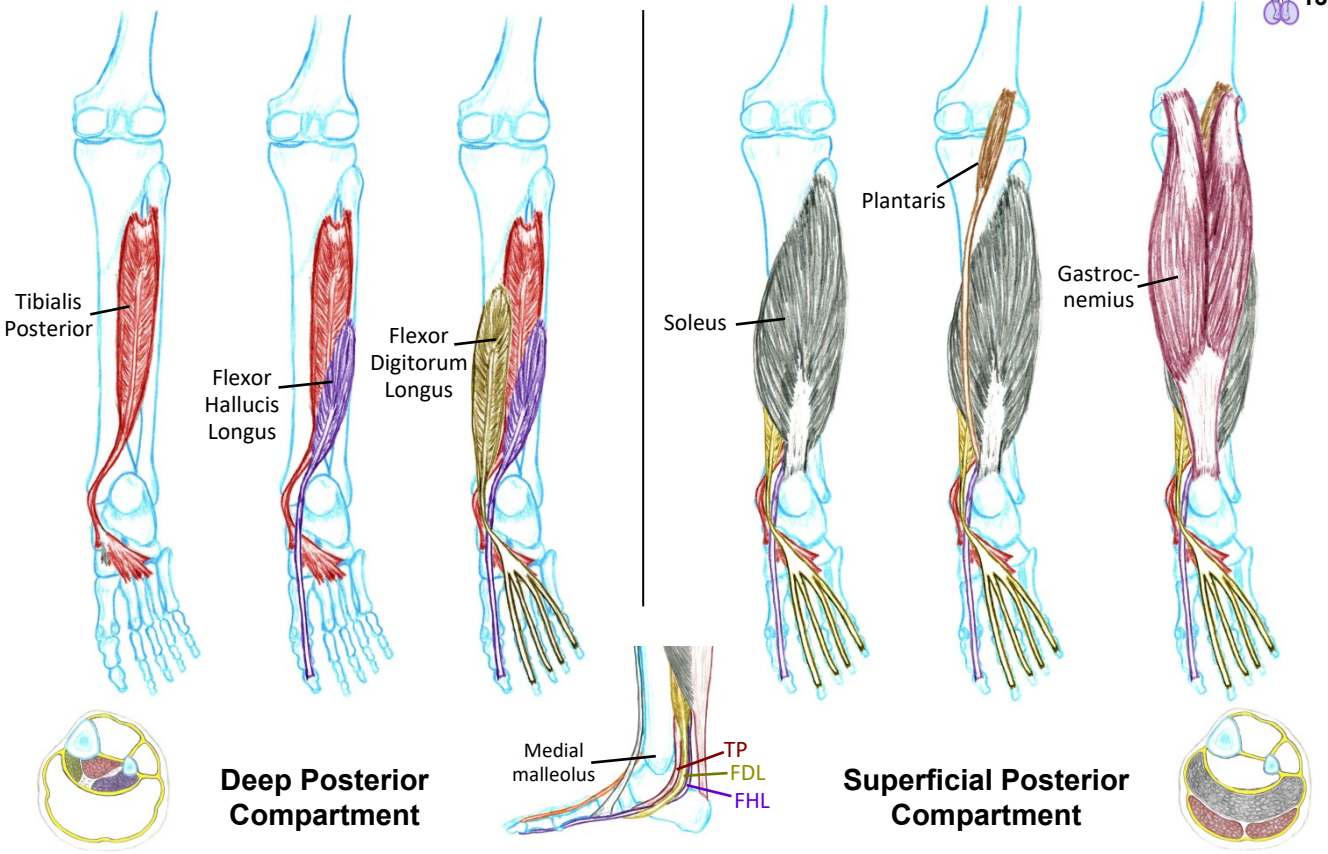
5. Flexor Digitorum Longus

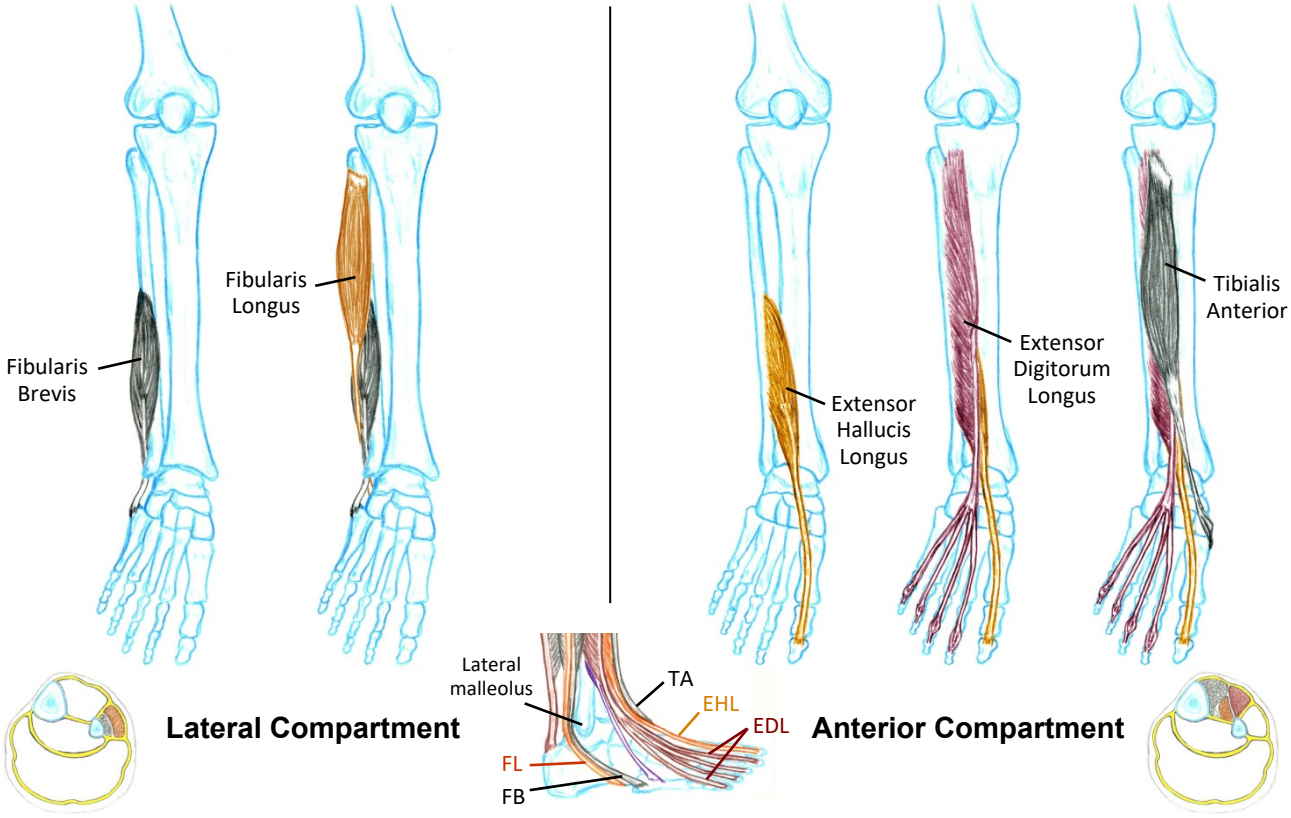
10. Extensor Digitorum Longus

6. Flexor Hallucis Longus

11. Extensor Hallucis Longus

Muscles of the Leg - by Compartment





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Chapter 7

Summary Tables and Illustrations

Introduction

Chapter 7 – Summary Tables provides a handy reference that can be quickly reviewed once you have learned all the muscles in Chapters 4, 5, and 6. It can be used when assessing/analyzing a client's movement patterns or posture, or when performing or teaching stretching and strengthening exercises.

Summary of Muscle Actions – Tables S-1, S-2, and S-3

These tables provide a comprehensive and compact format for analyzing any movement at any joint. Rows and columns can be studied to determine which muscles are acting as synergists, antagonists and stabilizers. Tables S-1, S-2 and S-3 use a format similar to the "B" Tables in Chapters 4-6. For a complete description of how to use "B" Tables, please refer to p. 62 in Chapter 3.

While these tables use a format similar to the "B" Tables in Chapters 4-6, they are different in one important way. For these summary tables, muscles are gathered from *multiple* muscle groups in cases where muscles from different groups move the same structures or joints.

Chapters 4-6 divide the muscles of the body into 13 groups to create a brain-friendly organization. However, the 13 individual B Tables do not always allow analyzing *all* muscles that may move a specific joint or structure. This can happen in Muscle Groups 1-13 because:

- Some muscles move multiple joints. For example, biceps brachii moves both the elbow and the shoulder joints.
- Sometimes in Chapters 4-6 a single joint is presented over more than one group. For example, Muscle Groups 10, 11, and 12 all have muscles that move the hip joint.

The composite organization in this summary chapter provides a single unified table for each body structure or joint, to have a complete picture of the muscles affecting its movements.

Innervation Summary – Table S-4

Table S-4 provides a color-coded list of the major nerves of the body and the muscles they supply. There is also a full body color-coded illustration showing the major nerve trunks and plexuses listed in the table.

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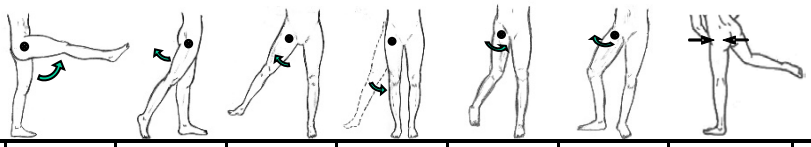
Demonstration Copy

Chapter 7 does not include pages 204-207.

Table S-3 -- Summary of Muscle Actions – LOWER EXTREMITY

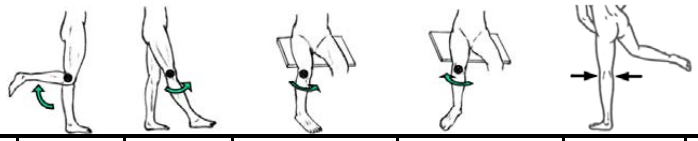
(continued on next page)



Hip Joint	Flexion @ Hip jt.	Extension @ Hip jt.	Abduction @ Hip jt.	Adduction @ Hip jt.	Medial Rotation @ Hip jt.	Lateral Rotation @ Hip jt.	Stabilization of Hip jt.	Muscl Group	Muscle also affects other joints:
Gluteus Maximus		✓	✓m assist (upper fib.)	✓ assist (lower fib.)		✓		G10	-
Gluteus Medius	✓assist (anter. fib.)	✓assist (poster. fib.)	✓		✓assist (anter. fib.)	✓assist (poster. fib.)	✓	G10	-
Gluteus Minimus	✓may assist		✓		✓		✓	G10	-
Piriformis (& other 5 lateral rotators)						✓		G10	-
iliopsoas: **Iliacus**	✓					✓may assist		G10	-
iliopsoas: **Psoas Major**	✓					✓may assist		G10	ROI: Trunk / Lumbar Spine
Sartorius	✓		✓			✓		G11	Knee
Tensor Fascia Latae	✓		✓		✓		✓	G11	Knee
Pectineus	✓			✓	✓			G11	-
Adductor Brevis	✓			✓	✓			G11	-
Adductor Longus	✓			✓	✓			G11	-
Adductor Magnus	✓ (anter. fib.)	✓ (poster. fib.)		✓ (all fibers)	✓ (anter. fib.)			G11	-
Gracilis	✓may assist			✓	✓may assist			G11	Knee
Rectus Femoris	✓							G12	Knee
Biceps Femoris		✓ (long head)				✓ (long head)		G12	Knee
Semitendinosus		✓			✓			G12	Knee
Semimembranosus		✓			✓			G12	Knee

KEY: ✓ = Muscle creates the action, ✓assist = Muscle assists the action, ✓may assist = May help action under certain circumstances
(anter. fib.) = Anterior fibers of the muscle, (poster. fib.) = Posterior fibers of the muscle

Table S-3 (continued) -- Summary of Muscle Actions – LOWER EXTREMITY



Knee	Flexion @ Knee	Extension @ Knee	Medial Rotation @ Knee (flexed)	Lateral Rotation @ Knee (flexed)	Stabilization of Knee	Muscl Group	Muscle also affects other joints:
Rectus Femoris		✓				G12	Hip Joint
Vastus Medialis		✓				G12	-
Vastus Lateralis		✓				G12	-
Vastus Intermedius		✓				G12	-
Biceps Femoris	✓			✓		G12	Hip Joint
Semitendinosus	✓		✓			G12	Hip Joint
Semimembranosus	✓		✓			G12	Hip Joint
Popliteus	✓may assist		✓			G12	-
Sartorius	✓		✓			G11	Hip Joint
Tensor Fascia Latae					✓	G11	Hip Joint
Gracilis	✓		✓		✓	G11	Hip Joint
Gastrocnemius	✓				✓	G13	Ankle
Plantaris	✓may assist					G13	Ankle

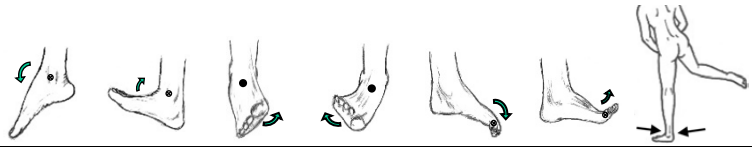
KEY

✓ = Muscle creates the action

✓assist = Muscle assists the action

Knee = Tibiofemoral Joint (TF jt.)

ROI = Reversed O/I action



Ankle, Foot, Toes	Plantarflex @ Ankle	Dorsiflex @ Ankle	Inversion (subtalar joint)	Eversion (subtalar joint).	Flexion of Toes	Extension of Toes	Stabilization of Ankle/Foot	Muscl Group	Muscle also affects other joints:
Gastrocnemius	✓							G13	Knee
Plantaris	✓may assist		✓may assist					G13	Knee
Soleus	✓							G13	-
Tibialis Posterior	✓		✓				✓	G13	-
Flexor Digitorum Longus	✓		✓		✓ #2-5			G13	-
Flexor Hallucis Longus	✓		✓		✓ #1 (hallux)			G13	-
Peroneus Brevis	✓assist			✓				G13	-
Peroneus Longus	✓assist			✓			P.L. & T.A. create stirrup	G13	-
Tibialis Anterior		✓	✓				to stabilize foot/ankle	G13	-
Extensor Digitorum Longus		✓		✓		✓ #2-5		G13	-
Peroneus Tertius		✓		✓assist				G13	
Extensor Hallucis Longus		✓	✓may assist			✓ #1 (hallux)		G13	-

KEY: ✓ = Muscle creates the action, ✓assist = Muscle assists the action, ✓may assist = May help action under certain circumstances
Ankle = Talocrural joint (TC jt.), Hallux = Big toe (digit #1)

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Chapter 7 does not include pages 210-212.

Chapter 8

Study Aids

Many study aids and supporting materials are available to accompany the textbook **Mastering Muscles & Movement: A Brain-Friendly System for Learning Musculoskeletal Anatomy and Basic Kinesiology**. These resources provide a variety of approaches for studying and practicing the information in the book. Study aids are available as downloadable PDF files or as interactive apps on the companion website www.studymuscles.com.

Access to most of the study aids is free to purchasers of the textbook. Educational programs that adopt the textbook also have access to Instructor Resources such as Powerpoint presentations and homework templates.

This chapter describes study aids currently available and provides samples of each. Some resources are in PDF form to be downloaded and printed, while others are interactive apps for online use on computers, tablets or smartphones. In addition, a few of the resources are included in the final pages of this chapter and may be photocopied by the purchaser of this book for their personal use.

Disclaimer: The internet is constantly changing and evolving, and the resources and apps presented in this chapter may or may not be available in the same form as described herein. Some may be removed, some improved or altered, and some new resources may be added.

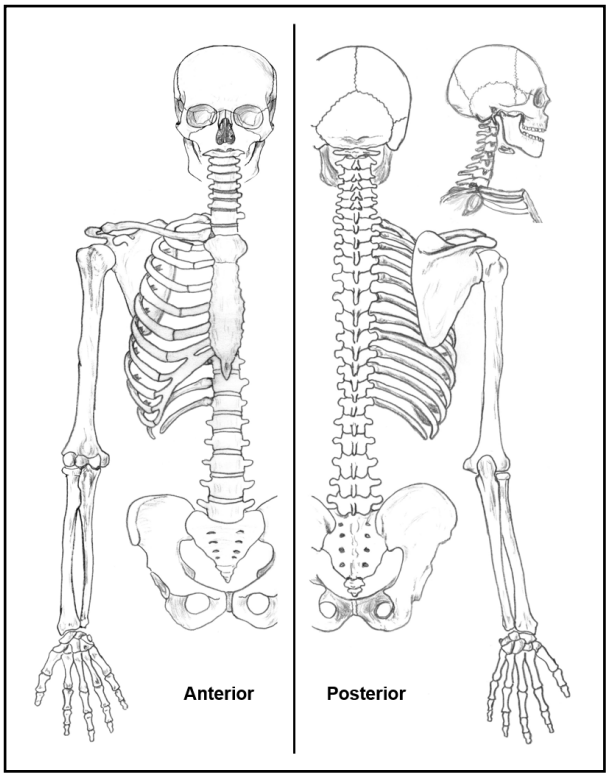
Downloadable Study Aids

This section lists study aids that can be downloaded as PDF files from the studymuscles.com website by purchasers of the book **Mastering Muscles & Movement**. Only brief descriptions and instructions are offered here. For resources that require a lengthier description, more details and instructions are included on the website.

General-Purpose Skeletons

(Online, or photocopy using pages 221-223)

These are full-page size skeleton drawings - upper body and lower body – to use as practice sheets to draw and write on while you are studying muscles. A good way to use these while saving paper is to insert them into plastic sheet protectors along with a cardboard backing or a manila folder cut to 8½ by 11". They can then be marked and erased many times using fine point dry erase markers (preferably red/blue to match the origin/insertion convention used in this book). In practice we have found that Avery plastic sheet protectors labeled PV-119 work well with dry erase markers.



General Purpose Skeleton Pictures

Muscle Tickets

(Online, or photocopy using pages 224-226)

These ticket-sized cards have the muscle names on them. As you study each of the 13 groups of muscles, cut up the muscle tickets and use them to draw out of a hat and randomly test yourself. Each ticket has a small label at the lower right corner, for example "G1-4", that tells which muscle group to go to in the book to read the origin, insertion, etc. The G is for Group, so G1-4 indicates the 4th muscle in Muscle Group 1.

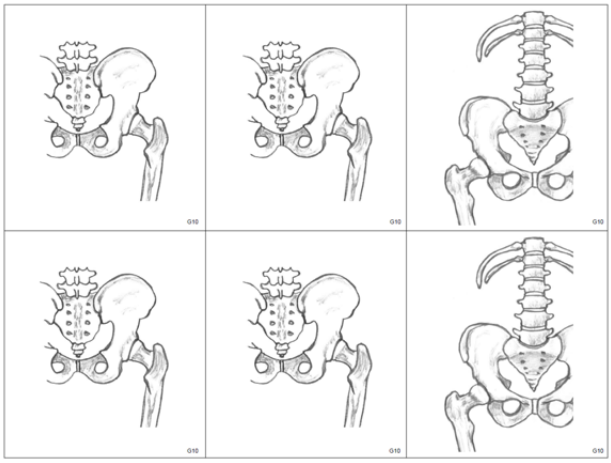
Trapezius G1 - 1	Levator Scapula G1 - 2	Rhomboid Major and Minor G1 - 3	Serratus Anterior G1 - 4
Pectoralis Minor G1 - 5	Subclavius G1 - 6		Deltoid G2 - 1
Supraspinatus G2 - 2	Infraspinatus G2 - 3	Teres Minor G2 - 4	Subscapularis G2 - 5
Pectoralis Major G2 - 6	Coracobrachialis G2 - 7	Latissimus Dorsi G2 - 8	Teres Major G2 - 9
Biceps Brachii	Brachialis	Brachioradialis	Pronator Teres

Muscle Tickets

Blank Bone Cards to Draw On

(Online, or photocopy using pages 227-230)

Blank Bone Cards give you a head start for making your own flashcards. Drawing and writing the O/I/A information yourself is like studying the muscle ten times. These flashcard size bone pictures go with each of the 13 muscle groups.



Blank Bone Cards

Bony Landmark Practice Pages
(Online)

These pages provide the bone drawings from Chapter 2 with the labels or words removed to facilitate repetitive practice to memorize bony landmarks.

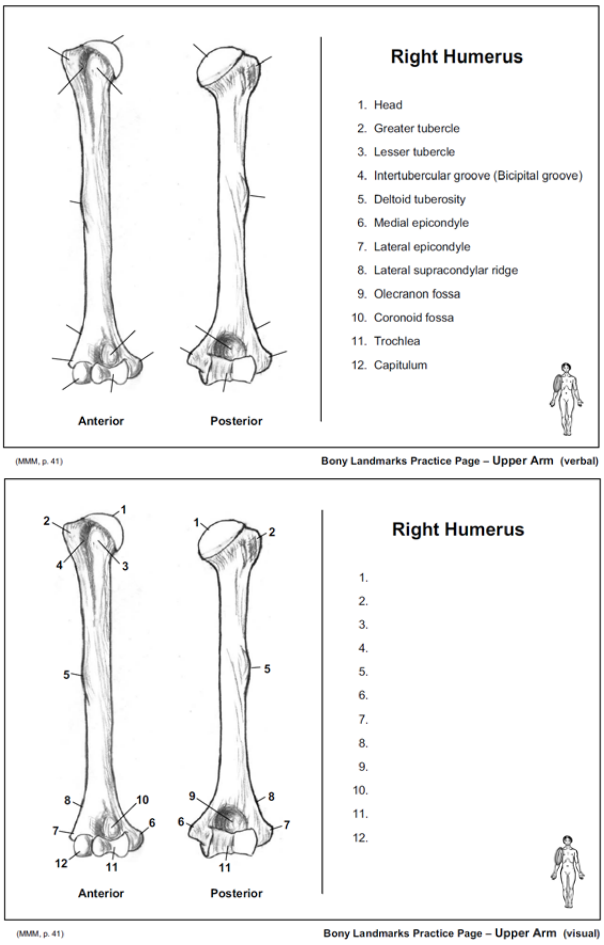
Chapter 2 of **Mastering Muscles & Movement** contains fully labeled bony landmark drawings. Each page of bone drawings is organized with the bones in one area of the page and a list of bone names, bony landmarks, and joints in a separate area of the page. The arrangement allows you to cover the list of names and use the labels on the drawings to test yourself as you memorize the names. This facilitates learning the landmarks from a *visual* direction, that is, you *see* a place on a bone and you recall its bony landmark name.

To fully learn the bones and bony landmarks, you should be able to recall the information from both visual, as described above, and *verbal* directions. Recalling from the verbal direction means you *read* or *hear* the name of a landmark and you then recall and visualize where it is on the bone.

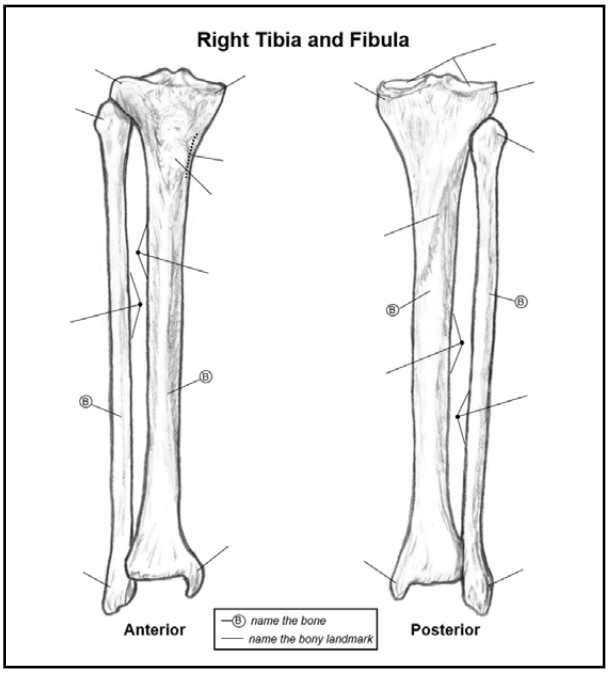
The bony landmark practice pages include dual versions of the bone drawings from Chapter 2 of the book. One version has the labels removed from the drawings and the list of landmarks is left intact. The other version has the list of landmarks removed and the drawing labels are left intact. With these opposite arrangements, you can memorize the information from both visual and verbal directions. The figure to the right shows an example of these bi-directional practice pages.

A third type of practice page is also included. It gives a larger bone picture with space to simply write the names of the bony landmarks next to the stick pins.

To save paper, the Bony Landmark Practice Sheets can be slipped into a plastic sheet protector as described on page 214, and marked using fine point dry erase markers to allow multiple practice sessions.



Bony Landmarks – Bi-Directional Practice Pages



Bony Landmarks – Write the Names

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Demonstration Copy

Chapter 8 does not include pages 216-230.

Appendix 1
Muscle Detail Cards

This Appendix is only included in the Enhanced E-book version of Mastering Muscles & Movement.
Its purpose is to provide details for each individual muscle in Muscle Groups 1 to 13 as presented in Chapters 4-6. In this e-book, the "A" Tables in Chapters 4-6 have clickable areas that allow the reader to jump to a **Detail Card** for each muscle in the table.

Each page of this Appendix presents a full-page "card" for a single muscle. The card contains all the information from the A-Table, plus a picture of the muscle, a picture of the orgin/insertion locations, a diagram illustrating the actions created by the muscle, its innervation and other pertinent information.

Detail cards for the bonus groups (e.g., Intrinsic Muscles of the Hand) have a different format and background color.

How This Appendix is Organized

The Appendix pages are displayed in landscape mode to match the landscape orientation of the A-Table page.

Each Muscle Group (G1-G13) or Bonus Group includes:

- A muscle group overview page showing a list of the muscles, the actions available for the group, and an illustration showing all muscles layered together.
- This is followed by several pages with full-page Detail Cards for the individual muscles in the group.

Two Ways to Use this Appendix

1. To use the Appendix in conjunction with the A-Tables in Chapters 4-6, simply click on a muscle in an A-Table and you will jump to the Detail Card for that muscle. Then click the "Back to Table" button to go back to the A-Table (for example ◀ Back to Table 2 (A)).
   For more information please see page 233, **Using this Appendix with the A-Tables**.

2. To use the Appendix stand-alone, go to **Appendix 1 – Table of Contents** on page 232 and click on a muscle group. You can then manually step through the muscle Detail Cards by advancing the book pages. To return to the TOC page, click the △ Appendix TOC button at the lower right of any card. For more information please see page 234, **Using this Appendix Stand-alone**.

NOTE

This appendix does not use the usual header, footer, and margin differences for odd vs even pages, as used in the rest of the book. It uses the even-page format for all pages whether odd or even. This is because the Detail Card pages are intended to be jumped to as the reader is viewing the book page that shows the A-Table. Since the A-Tables are always on even pages in chapters 4 to 6, a smoother transition between pages is perceived.

◀ Main TOC

▽ Appendix TOC

Note

This was originally a landscape-oriented page.
It has been converted to portrait for the e-book.

It should be viewed with the e-reader set to "Fit to width".

Appendix 1 – Muscle Detail Cards – Table of Contents

Click an icon to jump to that muscle group

Muscles That Move the Upper Extremity

Muscles That Move the Axial Skeleton

Muscles That Move the Lower Extremity

Main TOC

Go to Alphabetical Index of Muscles

Note

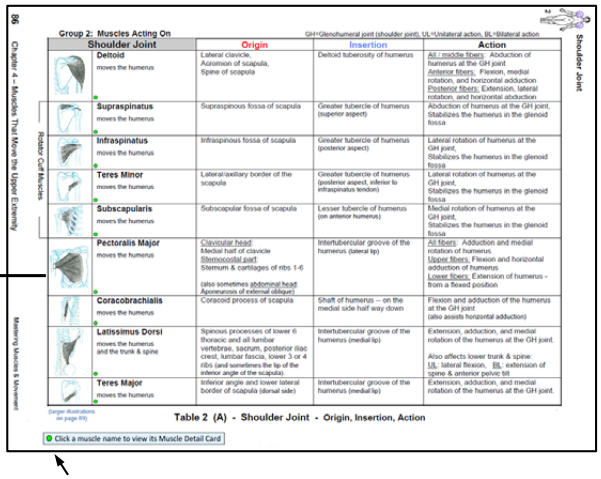
This was originally a landscape-oriented page.
It has been converted to portrait for the e-book.

It should be viewed with the e-reader set to "Fit to width".

Using Appendix 1 with the A-Tables in Chapters 4, 5, and 6

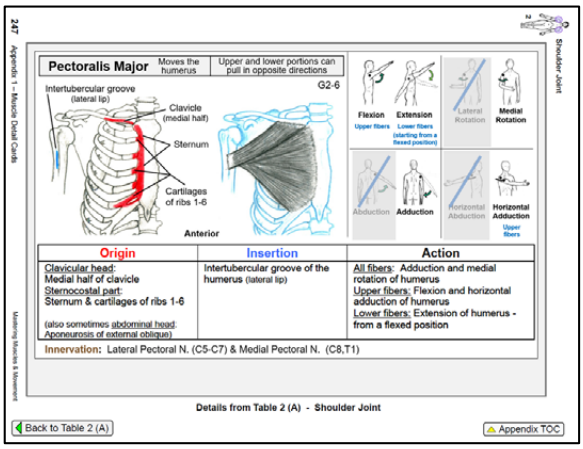
A-Table pages are linked to Muscle Detail Cards

"A" Tables present origins, insertions, and actions for the muscles in each Muscle Group. Pages in the book that show A-Tables are linked to "detail" pages in **Appendix 1** that gather and enlarge all the details for each specific muscle. To view a **Detail Card**, click on a muscle in the A-Table.



Click on a muscle

The book will jump to a page in the Appendix with the muscle's **Detail Card**.



Click a muscle name to view its Muscle Detail Card

A green medallion indicates that Detail Cards are available.

Click the button at the lower left corner to go back to the page with the **A-Table**.

Back to Table 2 (A)

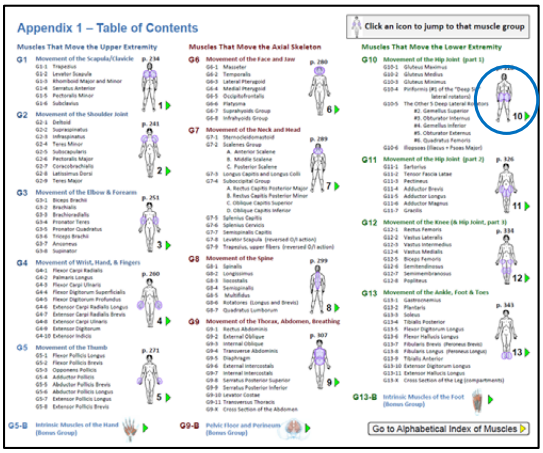
Appendix TOC

Note

This was originally a landscape-oriented page.
It has been converted to portrait for the e-book.

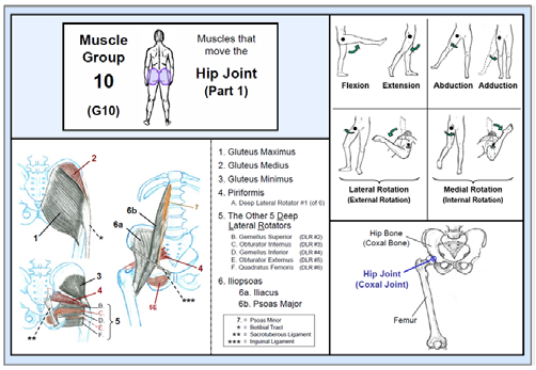
It should be viewed with the e-reader set to "Fit to width".

Using Appendix 1 Stand-alone



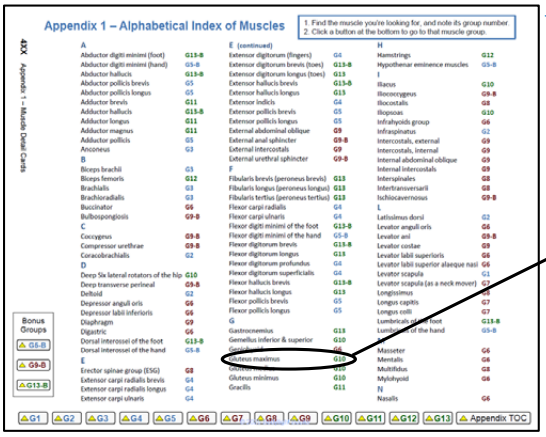
For stand-alone mode, use the **Table of Contents** (**TOC**) on page 232.

Click on a Muscle Group icon to jump to the title card for the muscles you want to study. Then, manually advance the book pages to step through the muscle Detail Cards.



To search for a specific muscle, use the Alphabetical Index on pages 394-395.

Go to Alphabetical Index of Muscles



In the **Alphabetical Index**, find the muscle you're looking for, and note the indicated Group number ...

Gluteus maximus **G10** → 7 △G8 △G9 △G10 △G11 △

... then, click the Group button at the bottom of the page.

To return to the **TOC** page, click the △ Appendix TOC button at the lower right of any page.

△ Appendix TOC

Note

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Appendix – Other Information

Abbreviations

Bones

SP – Spinous Process of a vertebra
TVP – Transverse Process of a vertebra
C# – One of the 7 cervical vertebrae (C1 – C7)
T# – One of the 12 thoracic vertebrae (T1 - T12)
L# – One of the 5 lumbar vertebrae (L1 – L5)

Joints

GH – Glenohumeral
HU – Humeroulnar
RU – Radioulnar
RC – Radiocarpal
CM – Carpometacarpal
MP or MCP – Metacarpophalangeal
PIP – Proximal Interphalangeal
DIP – Distal Interphalangeal
TF – Tibiofemoral
TC – Talocrural
TM – Tarsometatarsal
MP or MTP – Metatarsophalangeal
TMJ – Temporomandibular Joint

Innervation

N. – Nerve (example: Sciatic N.)
Cr.N. – Cranial Nerve (example: Cr.N. VII)

C1-C8
T1-T12
L1-L5
S1-S5

} Spinal segment where motor nerve roots emerge (see MMM pages 22-24)

Actions

Actions – General

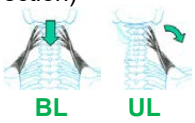
(assist) – The muscle assists the action, but is not a prime mover.

(may assist) – The muscle may assist, depending on strength requirements or relative bone angles.

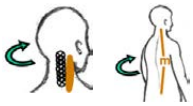
Actions – Axial Skeleton

(see Chapter 5 introductory section)

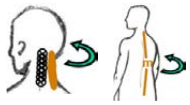
BL – Bilateral contraction of a muscle
UL – Unilateral contraction of a muscle



UL to the same side – Muscle **rotates** the neck or spine to its own side of the body (ipsilateral).



UL to the opposite side – Muscle **rotates** the neck or spine to the other side of the body (contralateral).



Note that **lateral flexion** actions are always to the same side (ipsilateral).

Other

---- or ---- (dashed line):
Muscle attachment is hidden from view, on the opposite side of the bone.

△ Appendix TOC

Note

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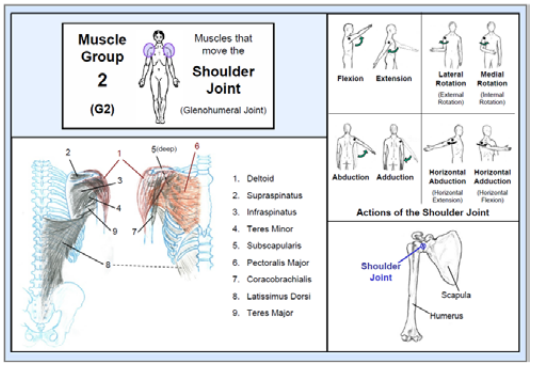
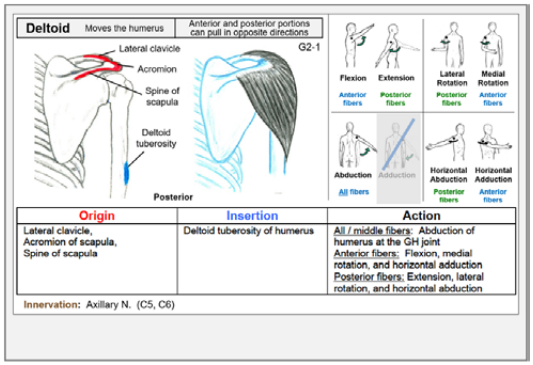
Appendix – Formatting of Muscle Detail Cards

Beginning on the next page, there are 170 Muscle Detail Cards. The pictures below demonstrate how the cards are formatted for easy identification.

For the main muscle groups (G1-G13):

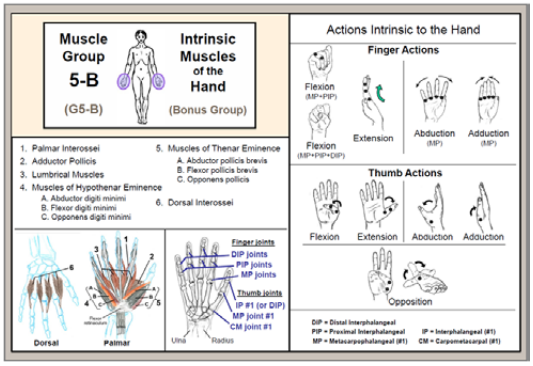
Each group starts with a blue-border overview card, followed by gray-border cards for individual muscles.

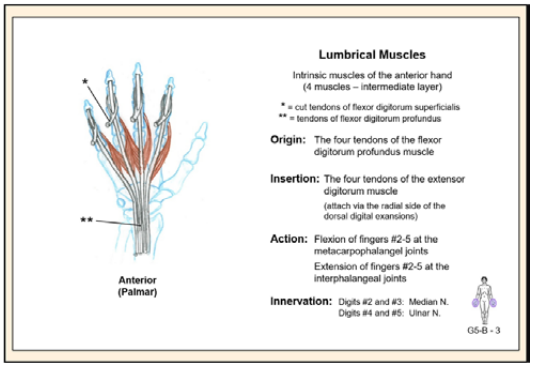




For the bonus muscle groups (G5-B, G9-B, and G13-B):

Each group starts with a brown-border overview card, followed by yellow-border cards for individual muscles.





△ Appendix TOC

Note

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Mastering Muscles & Movement

Demonstration Copy

Pages 237-355 are not included.

Appendix 1 only includes **Lower Extremity** muscle groups (pages 356-406).

page 356 →

△ Appendix TOC

Note

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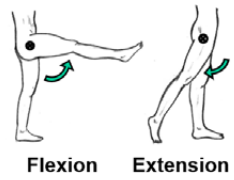
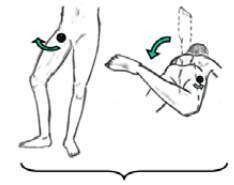
back to Table 10 (A)

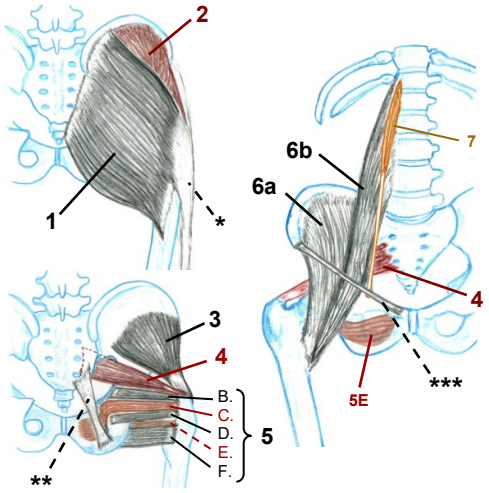
Appendix 1 TOC

Muscle Group 10 (G10)

Muscles that move the **Hip Joint (Part 1)**

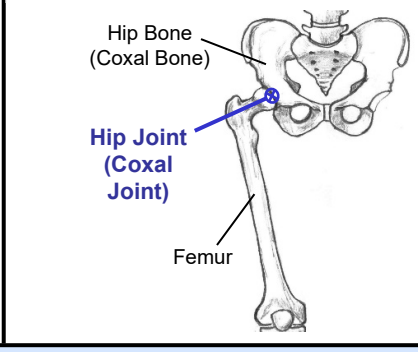






1. Gluteus Maximus
2. Gluteus Medius
3. Gluteus Minimus
4. Piriformis
   - A. Deep Lateral Rotator #1 (of 6)
5. The Other 5 Deep Lateral Rotators
   - B. Gemellus Superior (DLR #2)
   - C. Obturator Internus (DLR #3)
   - D. Gemellus Inferior (DLR #4)
   - E. Obturator Externus (DLR #5)
   - F. Quadratus Femoris (DLR #6)
6. Iliopsoas
   - 6a. Iliacus
   - 6b. Psoas Major

7. = Psoas Minor
***** = Iliotibial Tract
****** = Sacrotuberous Ligament
******* = Inguinal Ligament



Details from Table 10 (A) - Hip Joint (Part 1)

Note

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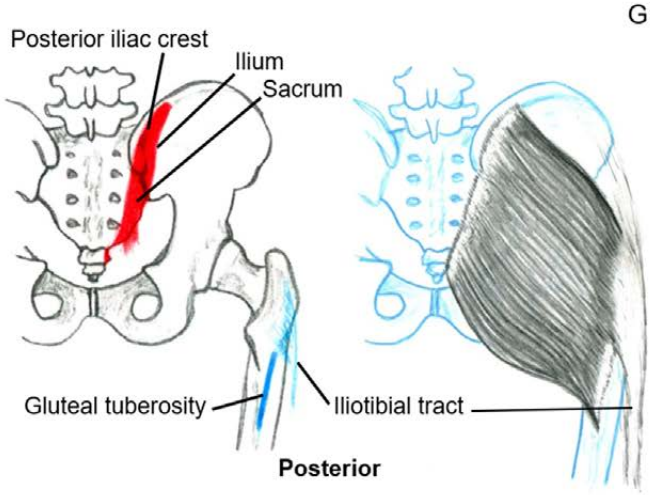
back to Table 10 (A)

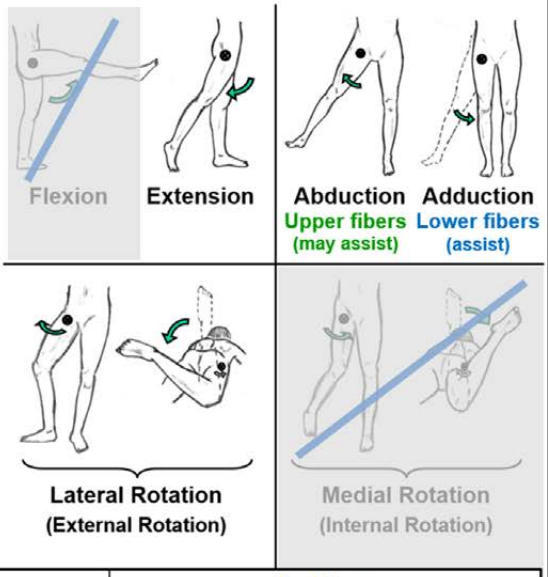
Appendix 1 TOC

Gluteus Maximus

Moves the hip joint

G10-1





Origin	Insertion	Action
Posterior iliac crest, ilium, and sacrum (also lateral coccyx and sacrotuberous ligament)	Gluteal tuberosity of femur, and the iliotibial tract (ITB)	Extension and lateral rotation at the hip joint (also lower fibers assist adduction, and upper fibers may assist abduction)

Innervation: Inferior gluteal N. (L5, S1, S2)

Details from Table 10 (A) - Hip Joint (Part 1)

Note

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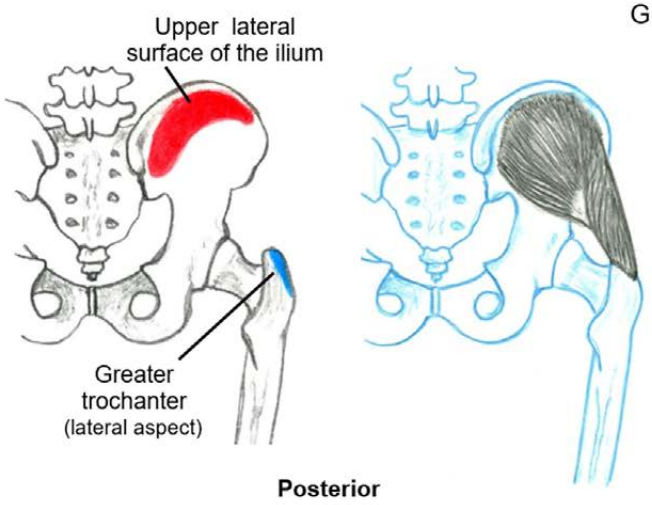
back to Table 10 (A)

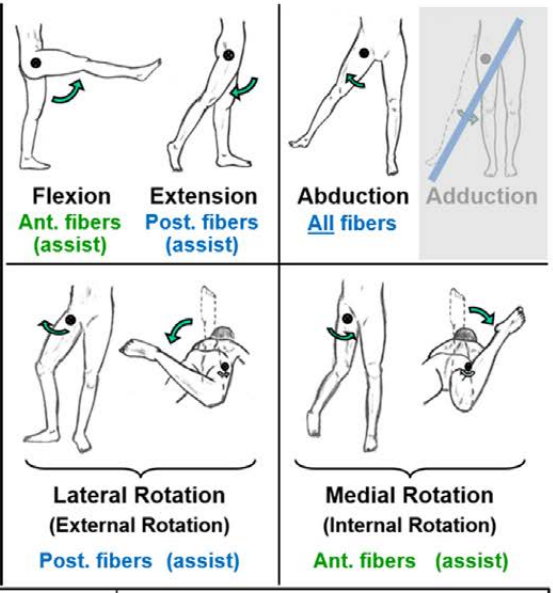
Appendix 1 TOC

Gluteus Medius

Moves the hip joint

G10-2





Origin	Insertion	Action
Upper lateral surface of the ilium (upper half of the wing of the ilium, starting just below the iliac crest)	Greater trochanter of femur (lateral aspect)	All fibers: Abduction at the hip joint. Ant. fibers: Assist flexion and medial rotation Post. fibers: Assist extension and lateral rotation

Innervation: Superior gluteal N. (L4, L5, S1)

Details from Table 10 (A) - Hip Joint (Part 1)

Note

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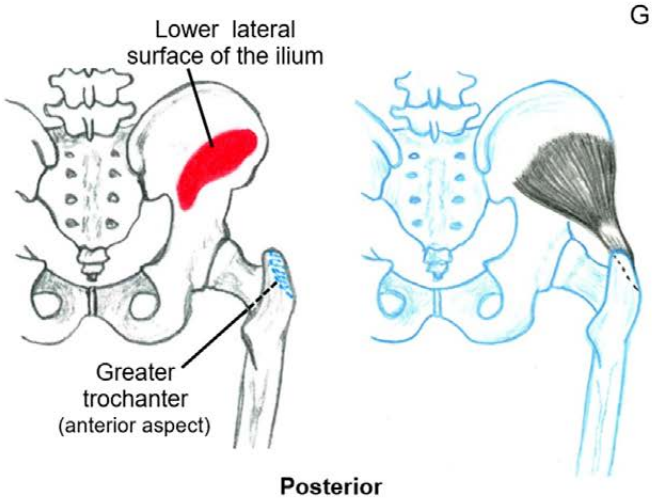
back to Table 10 (A)

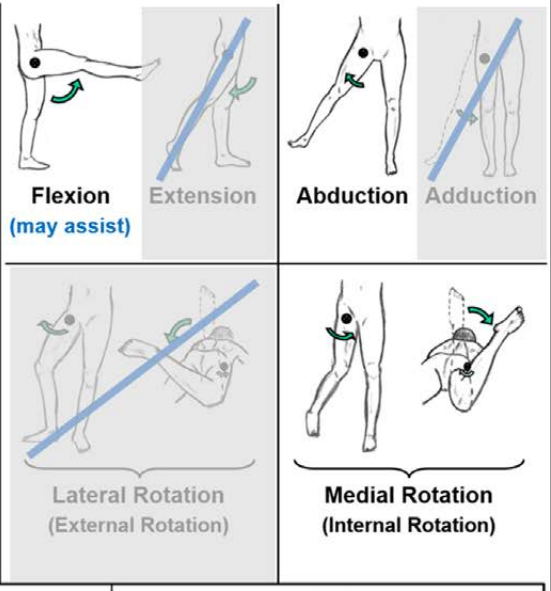
Appendix 1 TOC

Gluteus Minimus

Moves the hip joint

G10-3





Origin	Insertion	Action
Lower lateral surface of the ilium (lower half of the wing of the ilium, inferior to the origin of gluteus medius)	Greater trochanter of femur (anterior aspect)	Abduction and medial rotation at the hip joint. (Also may assist flexion)

Innervation: Superior gluteal N. (L4, L5, S1)

Details from Table 10 (A) - Hip Joint (Part 1)

Note

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back to Table 10 (A)

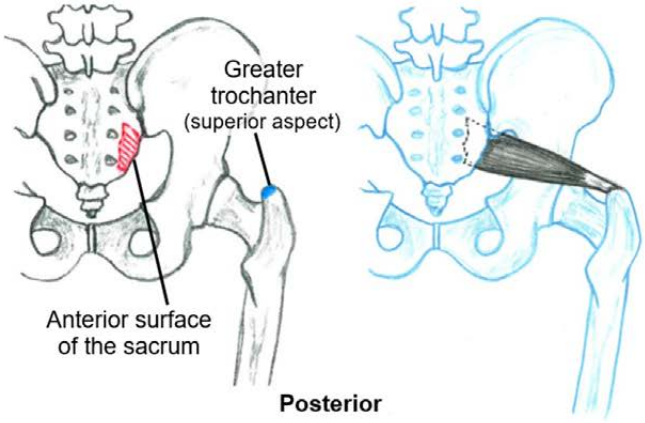
Appendix 1 TOC

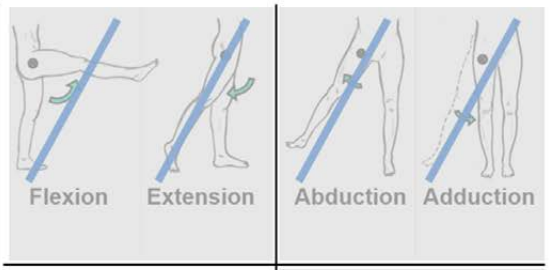
Piriformis

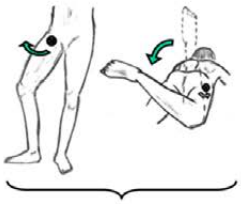
Moves the hip joint

(#1 of the "Deep Six" lateral rotators)

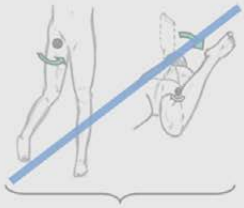
G10-4







Lateral Rotation
(External Rotation)



Medial Rotation
(Internal Rotation)

Origin	Insertion	Action
Anterior surface of sacrum	Greater trochanter of femur (superior aspect)	Lateral rotation at the hip joint

Innervation: Sacral Plexus (S1, S2)

Details from Table 10 (A) - Hip Joint (Part 1)

Note

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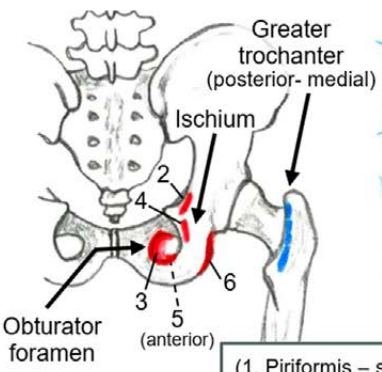
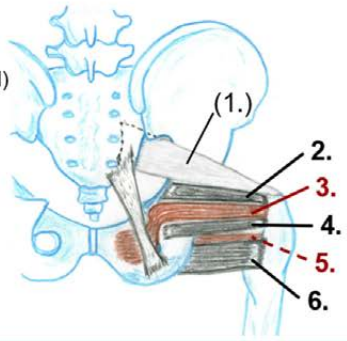
back to Table 10 (A)

Appendix 1 TOC

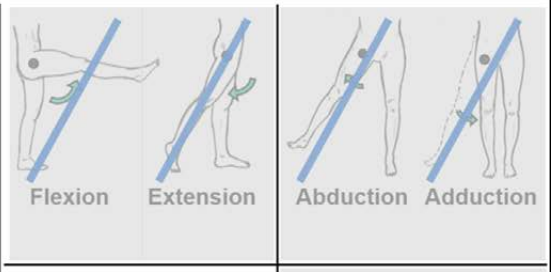
Lateral Rotators #2 - #6 — Moves the hip joint

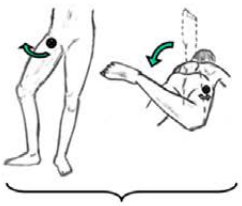
(#2 - #6 of the "Deep Six" lateral rotators) G10-5



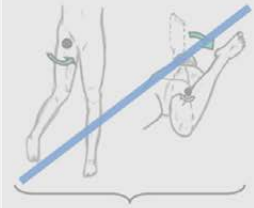


(1. Piriformis – see G10-4)
2. Gemellus Superior
3. Obturator Internus
4. Gemellus Inferior
5. Obturator Externus
6. Quadratus Femoris





Lateral Rotation (External Rotation)



Medial Rotation (Internal Rotation)

Origin	Insertion	Action
Gemelli & Quad.Fem.: Ischium Obturators: Obturator foramen (ischium & pubis) All Deep 6 Collective: Sacrum, Ischium, and Pubis	Greater trochanter of femur (posterior-medial aspect)	Lateral rotation at the hip joint

Innervation: Gemelli,Quad.Fem.,Obt.Int.: Sacral Plexus (L4-S2) , Obt.Ext.: Obturator N. (L3-L4)

Details from Table 10 (A) - Hip Joint (Part 1)

Note

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back to Table 10 (A)

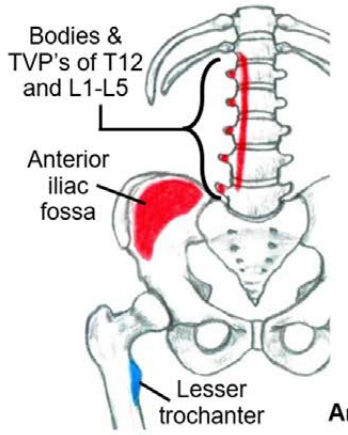
Appendix 1 TOC

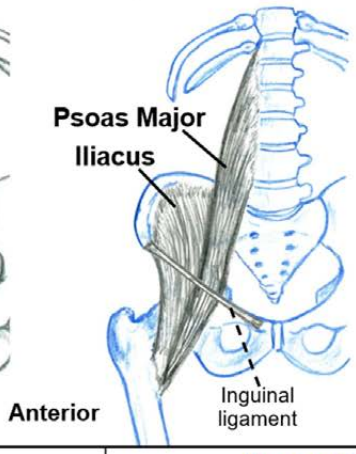
Iliopsoas

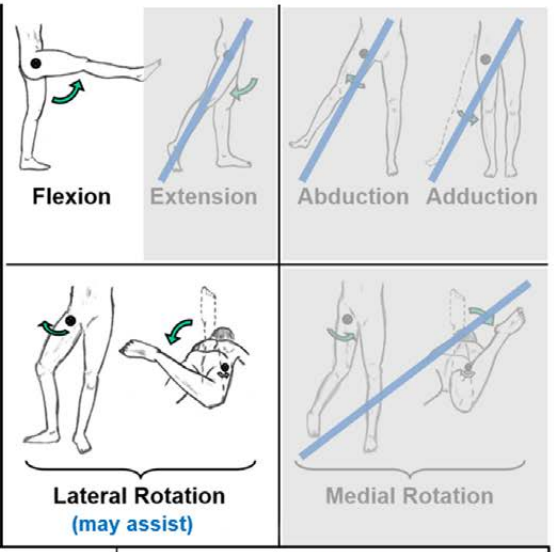
Moves the hip joint and the spine

(Iliopsoas = Iliacus & Psoas Major)

G10-6







Origin	Insertion	Action
Iliacus: Anterior iliac fossa Psoas Major: Bodies & TVP's of T12 and L1-L5	Both: Lesser trochanter of the femur	Flexion at the hip joint. (May assist lateral rotation at the hip joint) If the femur is fixed (in a standing position): Pulls on lumbar spine, increasing lordosis and anterior pelvic tilt.

Innervation: Femoral nerve (L2, L3)

Details from Table 10 (A) - Hip Joint (Part 1)

Note

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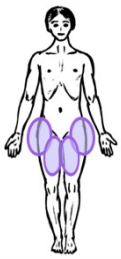
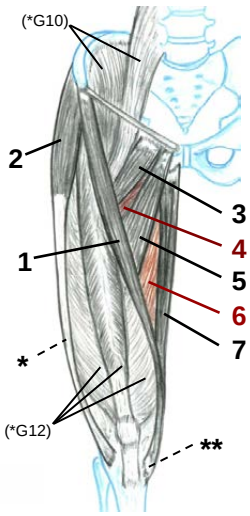
back to Table 11 (A)

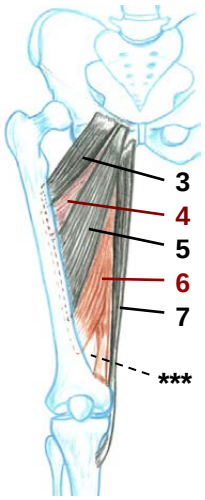
Appendix 1 TOC

Muscle Group 11 (G11)



Muscles that move the **Hip Joint (Part 2)**

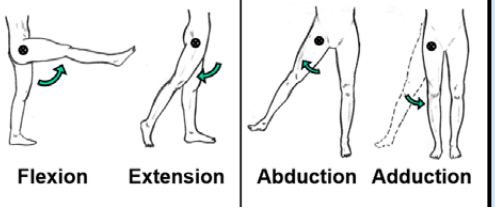


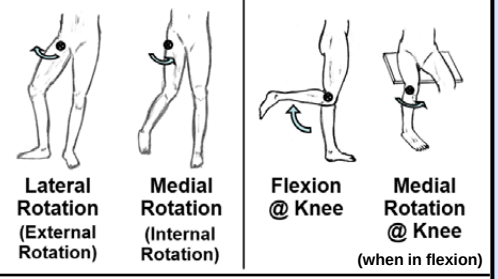


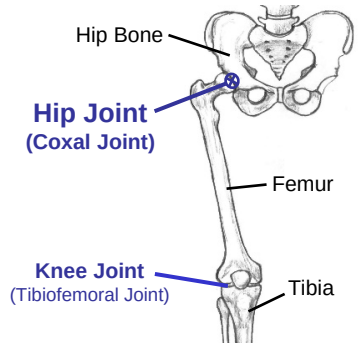
1. Sartorius
2. Tensor Fascia Latae
3. Pectineus
4. Adductor Brevis
5. Adductor Longus
6. Adductor Magnus
7. Gracilis

* = Iliotibial Tract
** = Pes Anserinus Tendon
*** = Adductor Hiatus

(*G10): Iliopsoas (see Muscle Group 10)
(*G12): Quadriceps (see Muscle Group 12)







10 cards

Details from Table 11 (A) - Hip Joint (Part 2)

To view this landscape-oriented content:

Tablet: Turn tablet horizontal. Pinch out to desired size.

Desktop/Laptop: Use your e-reader's **Zoom** function (instructions on the first page of this e-book).

After zooming in, click the on-page navigation buttons to move from page to page.

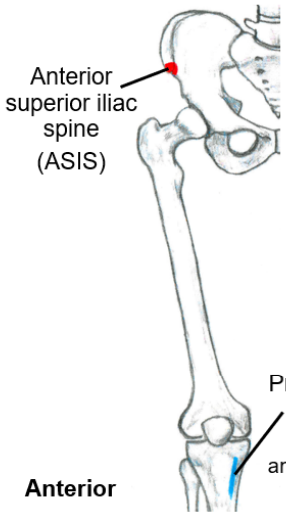
back to Table 11 (A)

Appendix 1 TOC

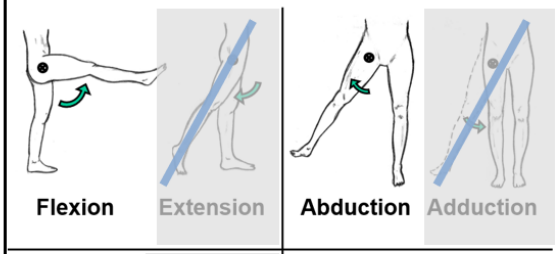
Sartorius

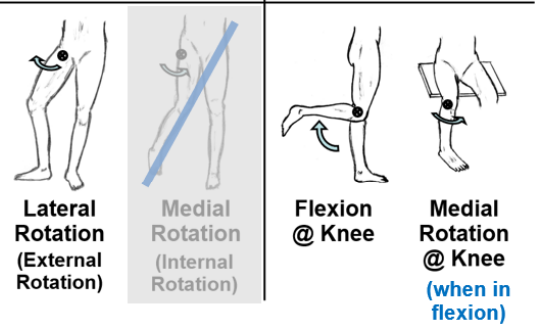
Moves the hip joint

G11-1



(all actions combined)





Origin	Insertion	Action
Anterior Superior Iliac Spine (ASIS) of the hip bone	Proximal medial shaft of tibia (by way of the pes anserinus tendon)	Flexion, abduction, and lateral rotation at the hip joint. Flexion of the knee and medial rotation of the tibia at the flexed knee.

Innervation: Femoral N. (L2, L3)

Details from Table 11 (A) - Hip Joint (Part 2)

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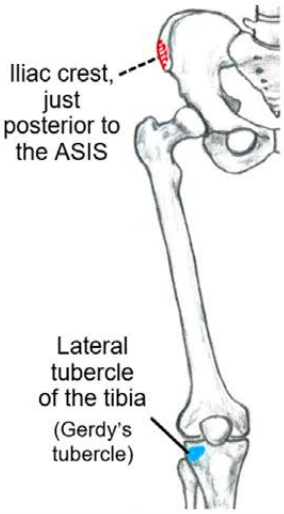
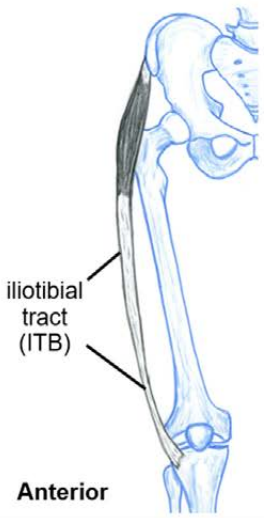
Appendix 1 TOC

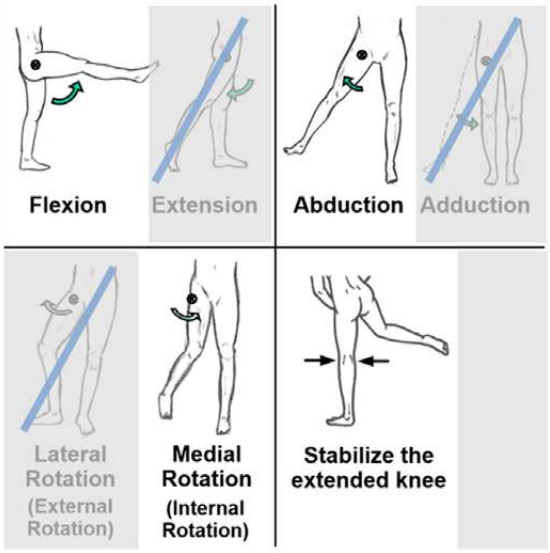
Tensor Fascia Latae

Moves the hip joint and stabilizes the knee

G11-2







Origin	Insertion	Action
Iliac crest, just posterior to the ASIS (i.e., next to the sartorius origin)	Iliotibial tract, which continues on to the lateral tubercle of the tibia (Gerdy's tubercle)	Flexion, abduction, and medial rotation at the hip joint Stabilizes the extended knee

Innervation: Superior Gluteal N. (L4, L5, S1)

Details from Table 11 (A) - Hip Joint (Part 2)

To view this landscape-oriented content:

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After zooming in, click the on-page navigation buttons to move from page to page.

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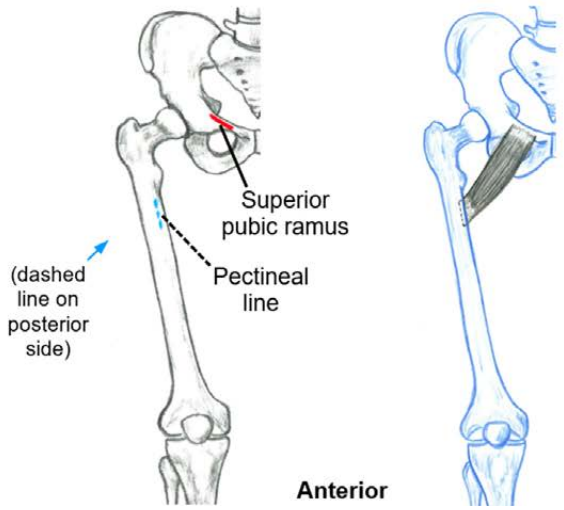
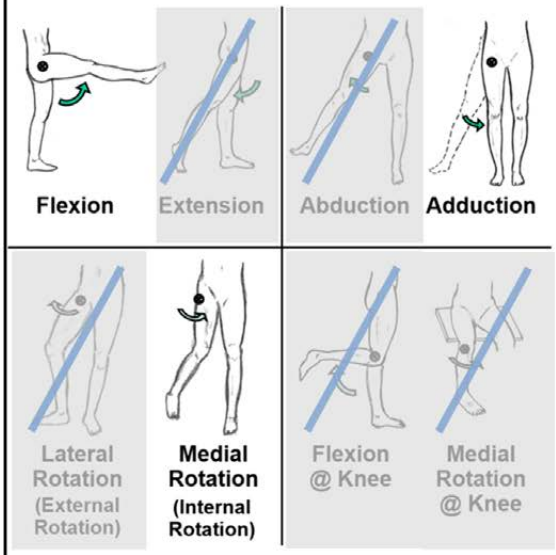
Appendix 1 TOC

Pectineus

Moves the hip joint

G11-3





Origin	Insertion	Action
Superior ramus of pubis	Pectineal line of femur (on posterior femur, proximal to linea aspera)	Adduction, flexion, and medial rotation at the hip joint

Innervation: Femoral N. (L2, L3) (and sometimes Obturator N.)

Details from Table 11 (A) - Hip Joint (Part 2)

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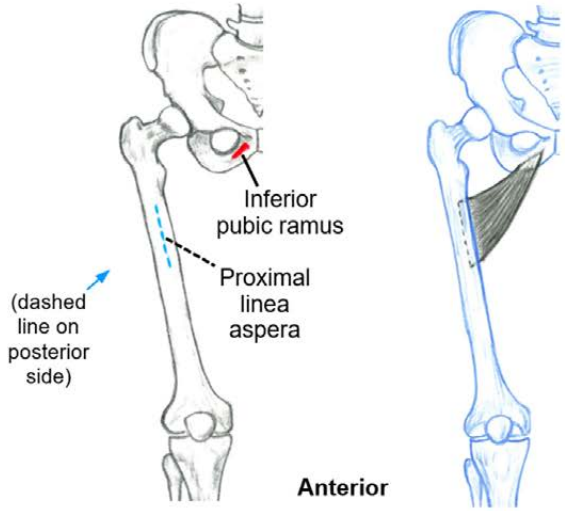
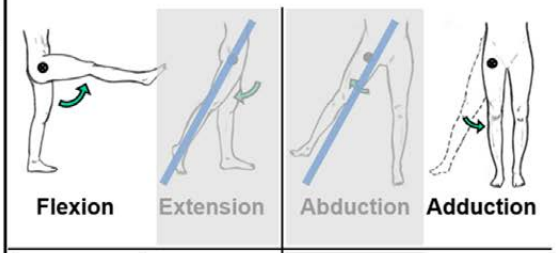
Appendix 1 TOC

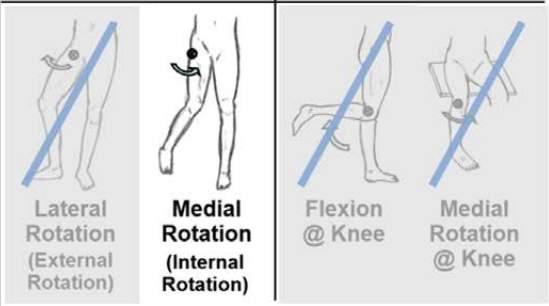
Adductor Brevis

Moves the hip joint

G11-4







Origin	Insertion	Action
Inferior ramus of pubis (near the obturator foramen, lateral to the gracilis attachment)	Proximal linea aspera of femur	Adduction, flexion, and medial rotation at the hip joint

Innervation: Obturator N. (L2, L3, L4)

Details from Table 11 (A) - Hip Joint (Part 2)

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Tablet: Turn tablet horizontal. Pinch out to desired size.

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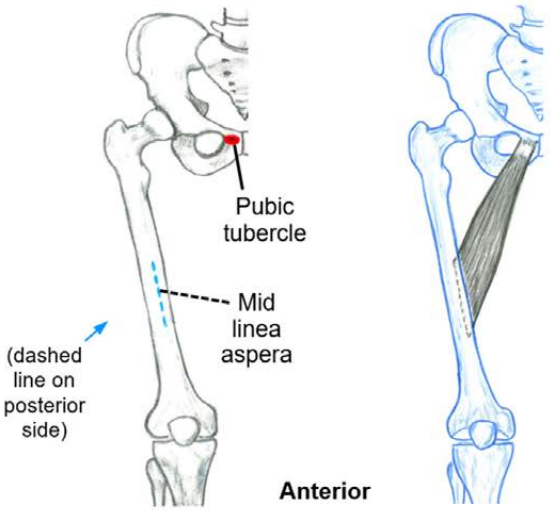
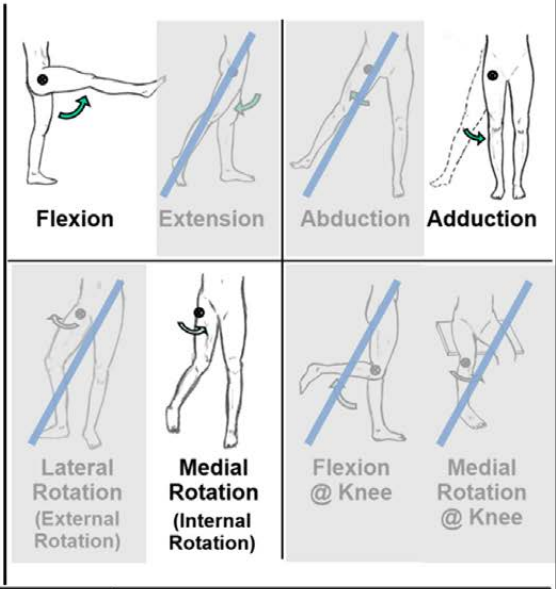
Appendix 1 TOC

Adductor Longus

Moves the hip joint

G11-5





Origin	Insertion	Action
Pubic tubercle	Mid linea aspera of femur	Adduction, flexion, and medial rotation at the hip joint

Innervation: Obturator N. (L2, L3, L4)

Details from Table 11 (A) - Hip Joint (Part 2)

To view this landscape-oriented content:

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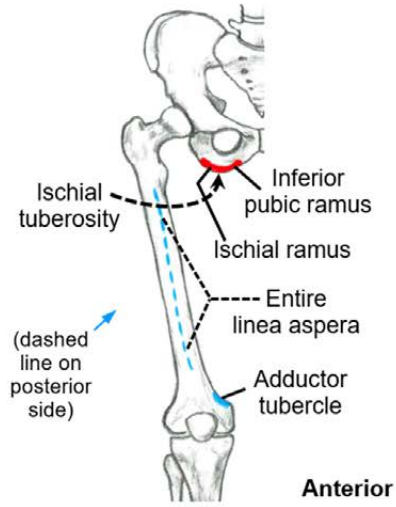
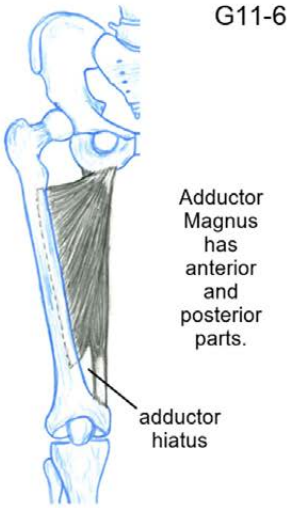
Appendix 1 TOC

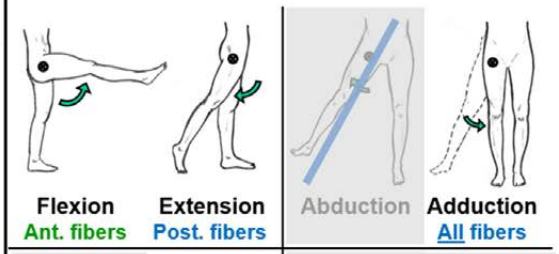
Adductor Magnus

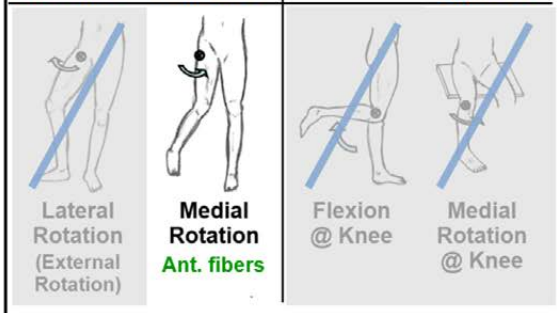
Moves the hip joint

G11-6









Origin	Insertion	Action
Overall Description: Ischio-pubic ramus and ischial tuberosity	Entire linea aspera, and adductor tubercle of femur (with hiatus in between for vessels to pass through)	All fibers: Adduction at the hip joint. Anterior fibers: Flexion and medial rotation at the hip joint. Posterior fibers: Extension at the hip joint

Innervation: Anterior part: Obturator N. (L2, L3, L4), Posterior part: Sciatic N. (L4, L5, S1)

Details from Table 11 (A) - Hip Joint (Part 2)

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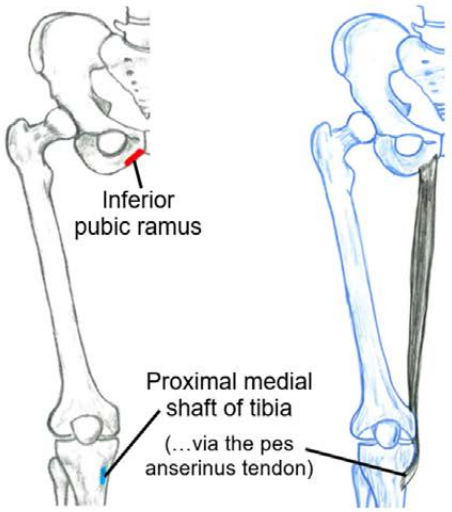
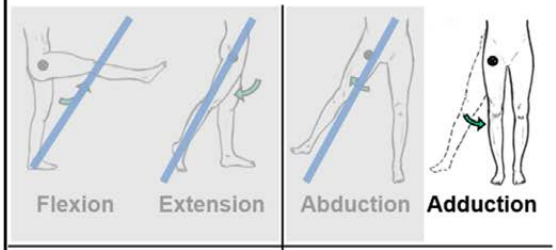
Appendix 1 TOC

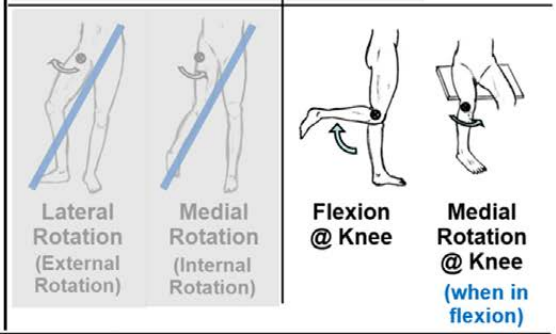
Gracilis

Moves the hip joint and knee

G11-7







Origin	Insertion	Action
Inferior ramus of pubis (medial edge of ramus, near the symphysis pubis)	Proximal medial shaft of tibia (by way of the pes anserinus tendon)	Adduction at the hip joint. Flexion of the knee and medial rotation of the tibia at the flexed knee

Innervation: Obturator N. (L2, L3)

Details from Table 11 (A) - Hip Joint (Part 2)

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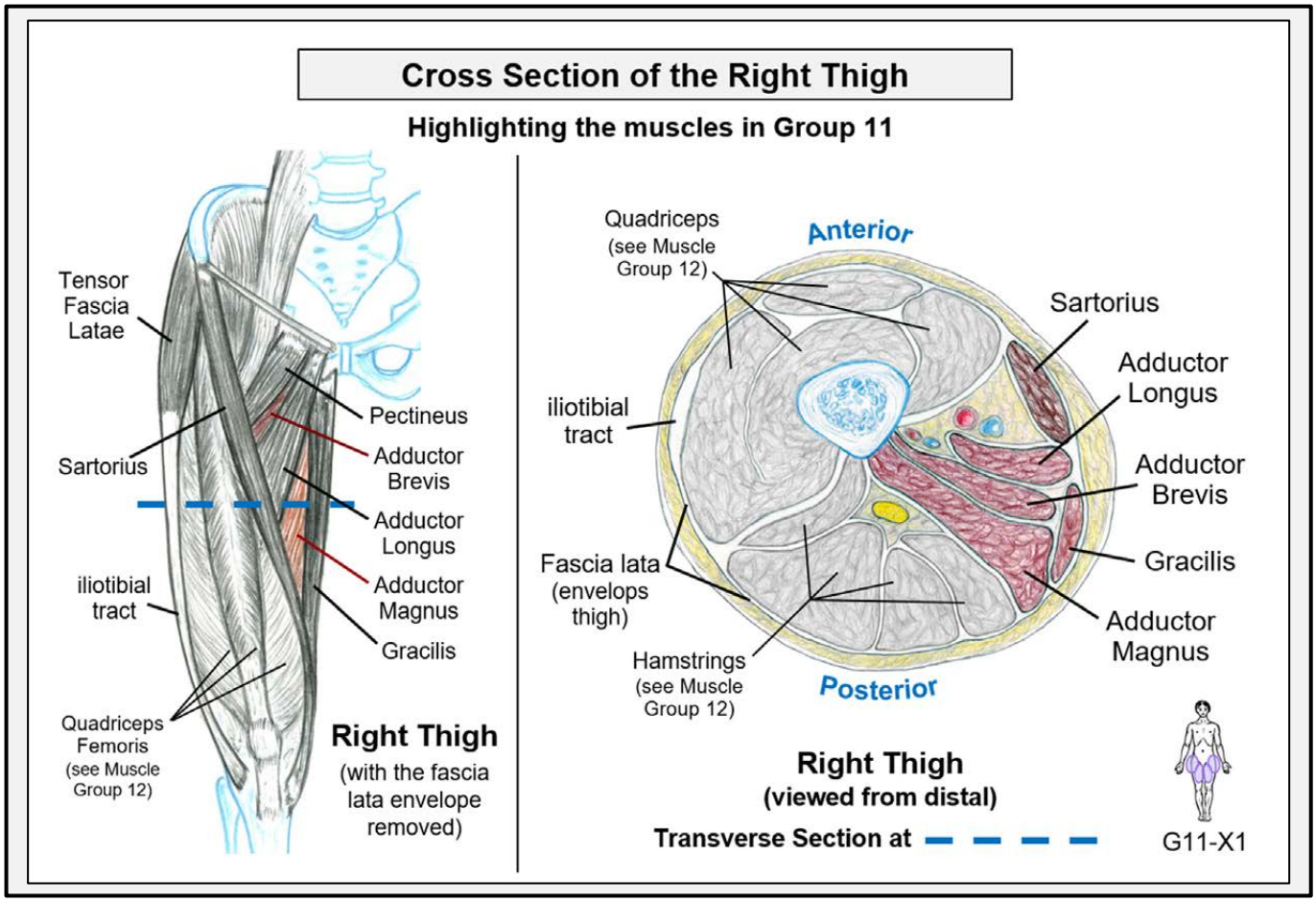
Appendix 1 TOC



Details from Table 11 (A) - Hip Joint (Part 2)

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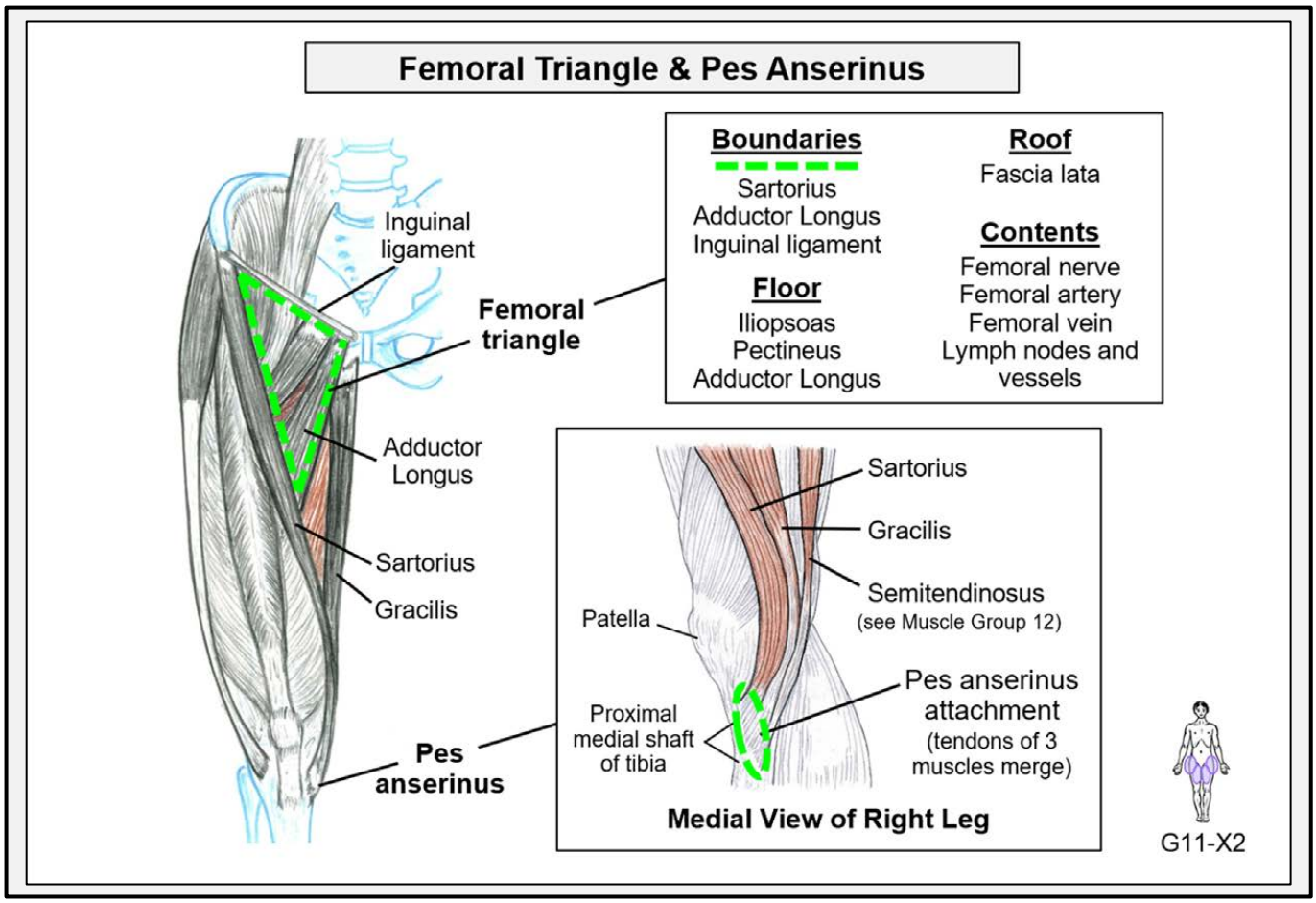
Appendix 1 TOC



Details from Table 11 (A) - Hip Joint (Part 2)

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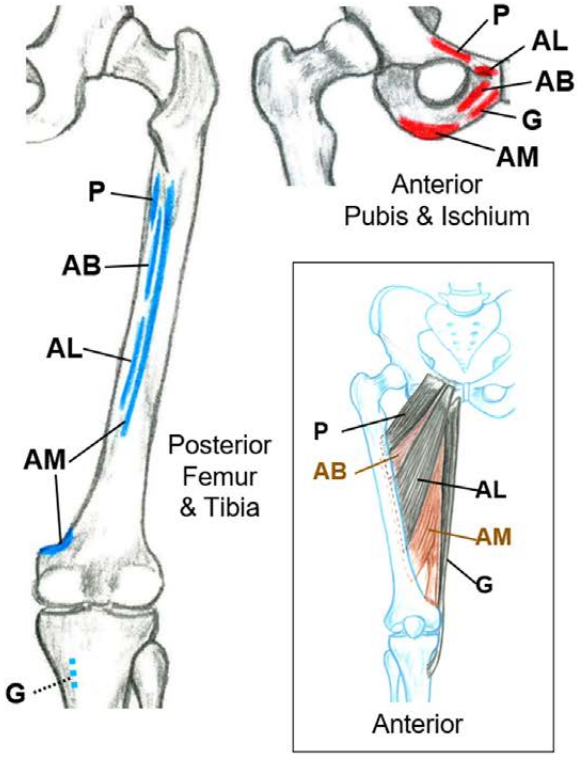
Appendix 1 TOC

Adductor Group Attachments



Adductor Origins (clockwise)

Pectineus	(superior pubic ramus)
Add. **L**ongus	(pubic tubercle)
Add. **B**revis	(inferior pubic ramus, lateral to gracilis)
Gracilis	(inferior pubic ramus, medial edge)
Add. **M**agnus	(inferior pubic ramus , ischial ramus, & ischial tuberosity)

Adductor Insertions (superior to inferior)

Pectineus	(pectineal line of femur)
Add. **B**revis	(proximal linea aspera of femur)
Add. **L**ongus	(mid linea aspera of femur)
Add. **M**agnus	(entire linea aspera & adductor tubercle of femur)
Gracilis	(proximal medial shaft of tibia)

G11-X3

Details from Table 11 (A) - Hip Joint (Part 2)

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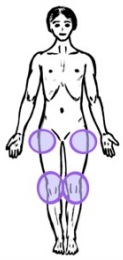
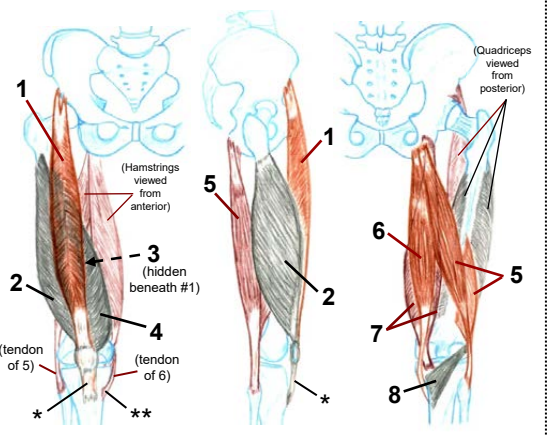
Appendix 1 TOC

Muscle Group 12 (G12)



Muscles that move the **Knee** **(& Hip Joint Part 3)**



Quadriceps:

1. Rectus Femoris
2. Vastus Lateralis
3. Vastus Intermedius
4. Vastus Medialis

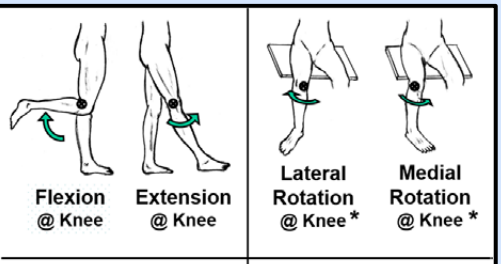
Hamstrings:

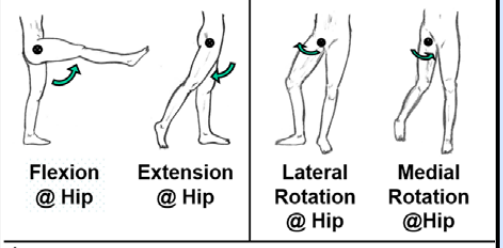
5. Biceps Femoris
6. Semitendinosus
7. Semimembranosus

Other:

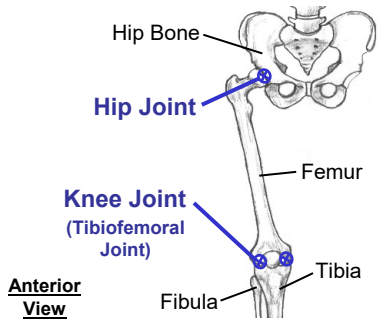
8. Popliteus

* = Patellar Ligament
** = Pes Anserinus Tendon





* The tibia can rotate when the knee is in a flexed position.



Details from Table 12 (A) - Knee (and Hip Joint, Part 3)

Note

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It has been converted to portrait for the e-book.

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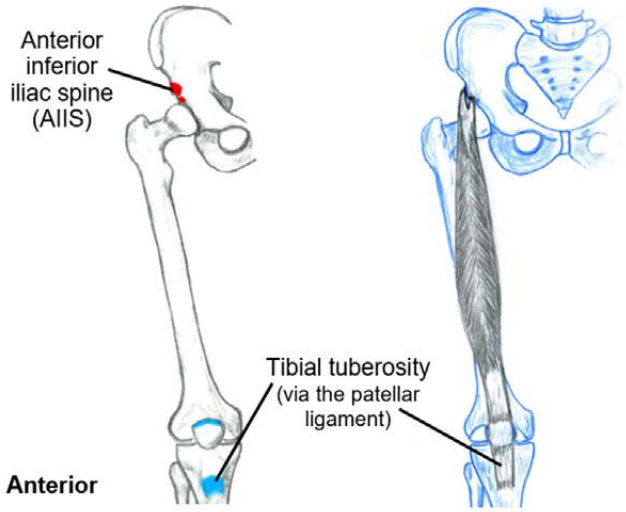
back to Table 12 (A)

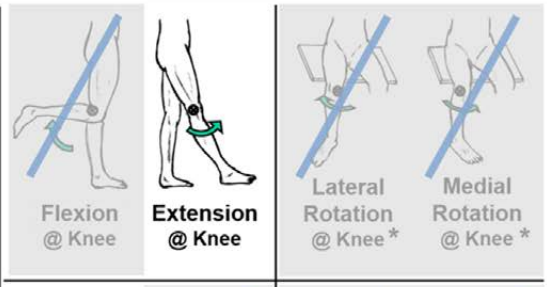
Appendix 1 TOC

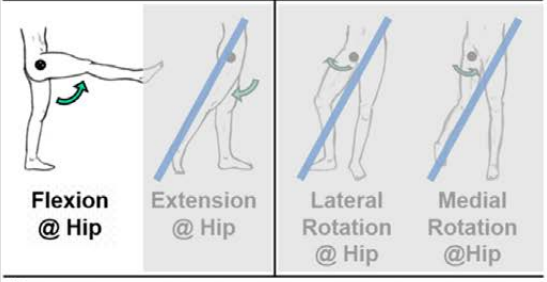
Rectus Femoris

Moves the knee and the hip joint

G12-1







* The tibia can rotate when the knee is in a flexed position.

Origin	Insertion	Action
Anterior Inferior Iliac Spine (AIIS) of the hip bone (and superior margin of the acetabulum just below the AIIS)	Tibial tuberosity via the patellar ligament	Extension at the knee, Flexion at the hip joint

Innervation: Femoral N. (L2, L3, L4)

Details from Table 12 (A) - Knee (and Hip Joint, Part 3)

Note

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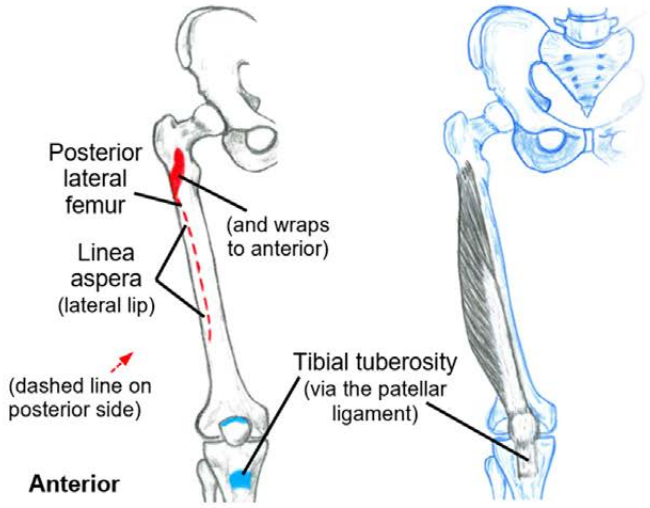
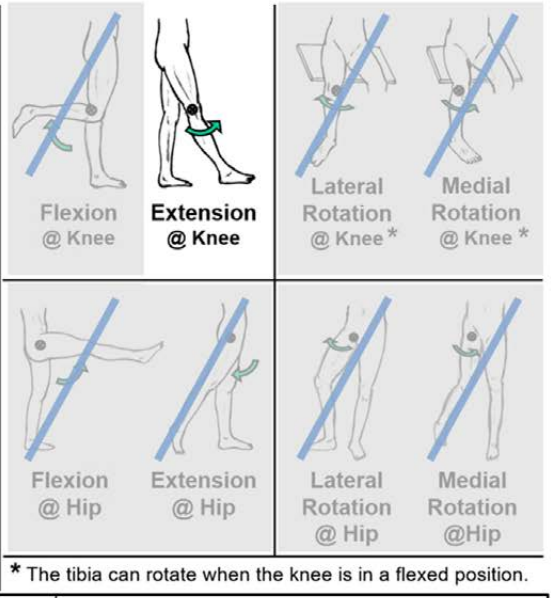
Appendix 1 TOC

Vastus Lateralis

Moves the knee

G12-2





* The tibia can rotate when the knee is in a flexed position.

Origin	Insertion	Action
Posterior lateral femur, lateral lip of linea aspera (and wraps to anterior at the base of the greater trochanter)	Tibial tuberosity via the patellar ligament	Extension at the knee

Innervation: Femoral N. (L2, L3, L4)

Details from Table 12 (A) - Knee (and Hip Joint, Part 3)

Note

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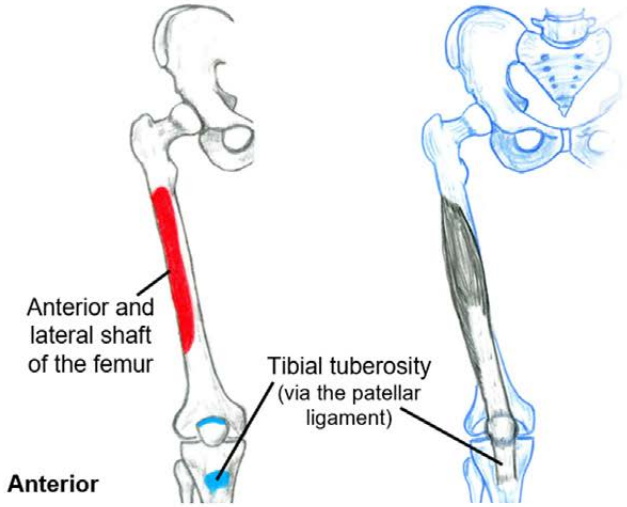
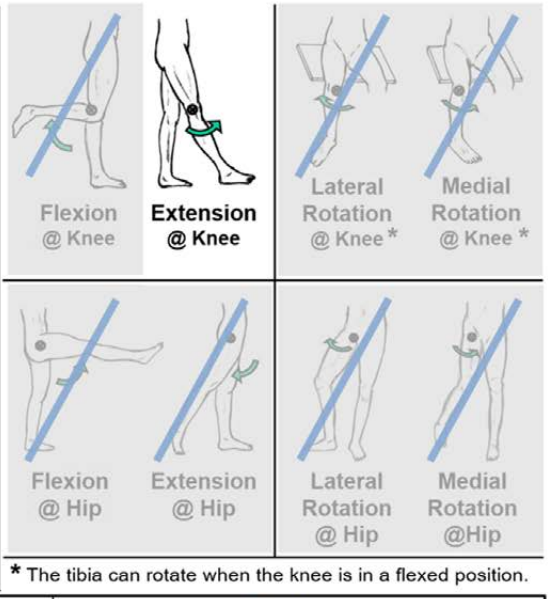
Appendix 1 TOC

Vastus Intermedius

Moves the knee

G12-3





* The tibia can rotate when the knee is in a flexed position.

Origin	Insertion	Action
Anterior and lateral shaft of femur (upper 2/3 of the shaft)	Tibial tuberosity via the patellar ligament	Extension at the knee

Innervation: Femoral N. (L2, L3, L4)

Details from Table 12 (A) - Knee (and Hip Joint, Part 3)

Note

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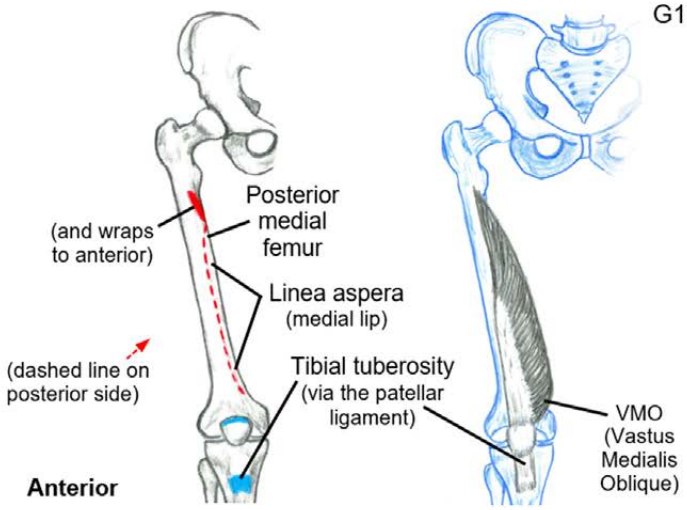
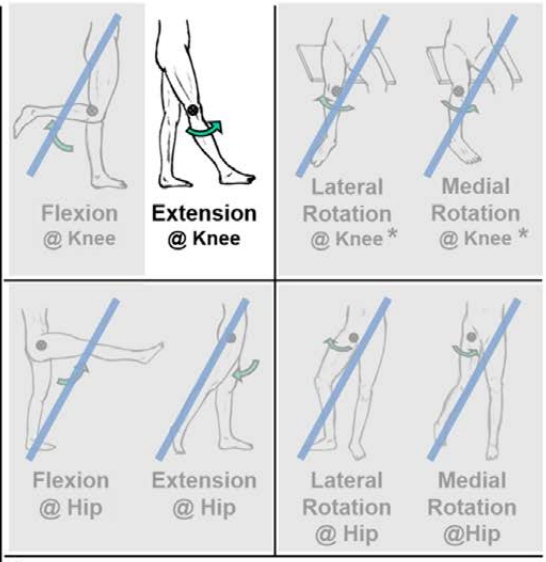
Appendix 1 TOC

Vastus Medialis

Moves the knee

G12-4





* The tibia can rotate when the knee is in a flexed position.

Origin	Insertion	Action
Posterior medial femur, medial lip of linea aspera (and wraps to anterior at the base of the lesser trochanter)	Tibial tuberosity via the patellar ligament	Extension at the knee (distal portion, the VMO, pulls patella medially so it tracks properly)

Innervation: Femoral N. (L2, L3, L4)

Details from Table 12 (A) - Knee (and Hip Joint, Part 3)

Note

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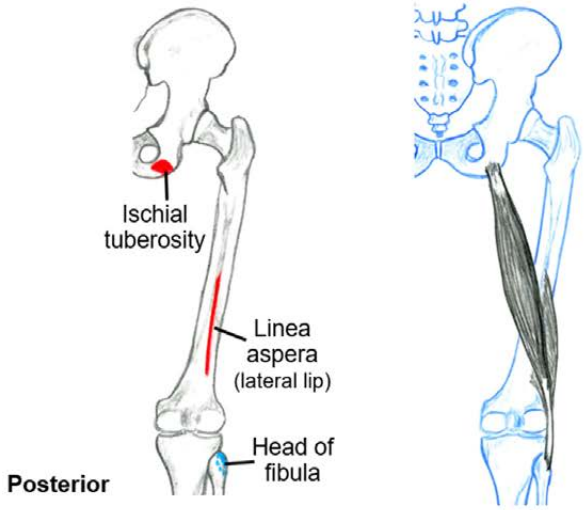
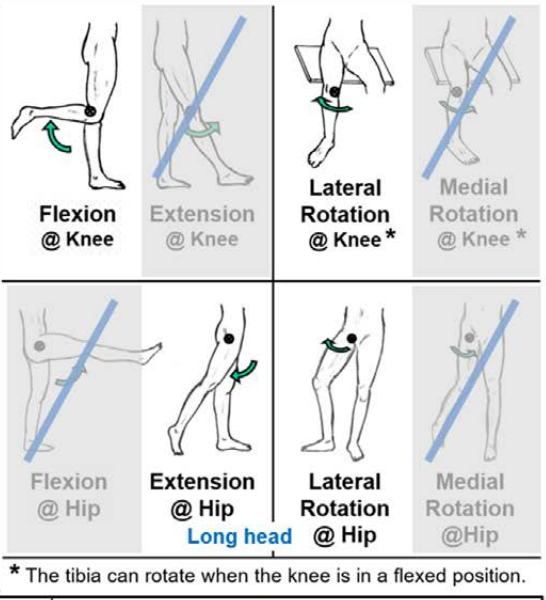
Appendix 1 TOC

Biceps Femoris

Moves the knee and the hip joint

G12-5





* The tibia can rotate when the knee is in a flexed position.

Origin	Insertion	Action
Long head: Ischial tuberosity Short head: Lateral lip of linea aspera (distal half)	Head of fibula	*Both* heads: Flexion and lateral rotation* at the knee Long head: Extension and lateral rotation at the hip joint.

Innervation: Long head: Tibial part of sciatic N. (S1, S2, S3)
Short head: Peroneal part of sciatic N. (L5, S1, S2)

Details from Table 12 (A) - Knee (and Hip Joint, Part 3)

Note

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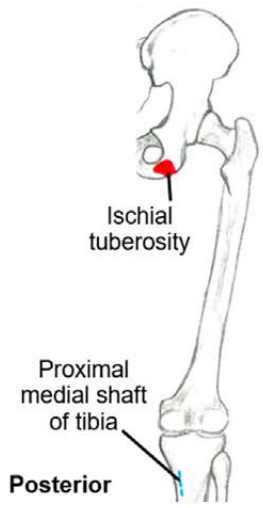
back to Table 12 (A)

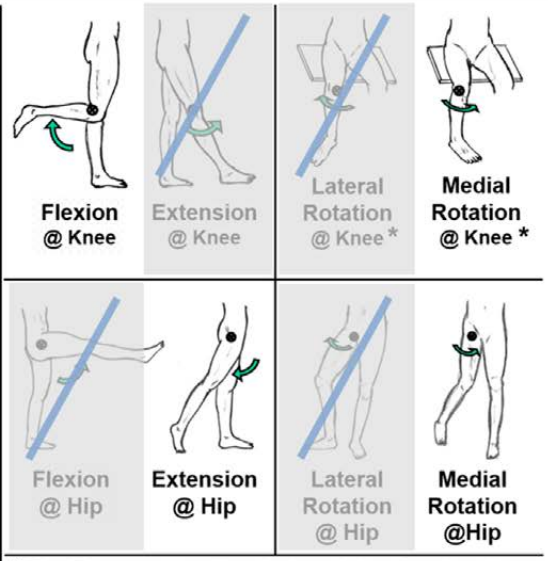
Appendix 1 TOC

Semitendinosus

Moves the knee and the hip joint

G12-6





* The tibia can rotate when the knee is in a flexed position.

Origin	Insertion	Action
Ischial tuberosity	Proximal medial shaft of tibia (by way of the pes anserinus tendon)	Flexion and medial rotation* at the knee, Extension and medial rotation at the hip joint

Innervation: Tibial part of the sciatic nerve (L5, S1, S2)

Details from Table 12 (A) - Knee (and Hip Joint, Part 3)

Note

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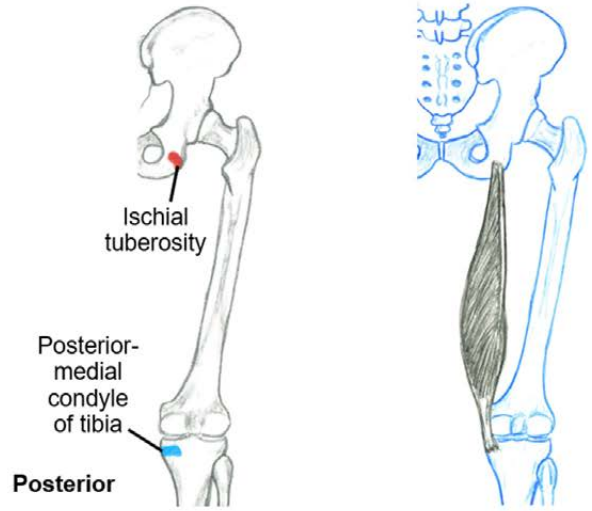
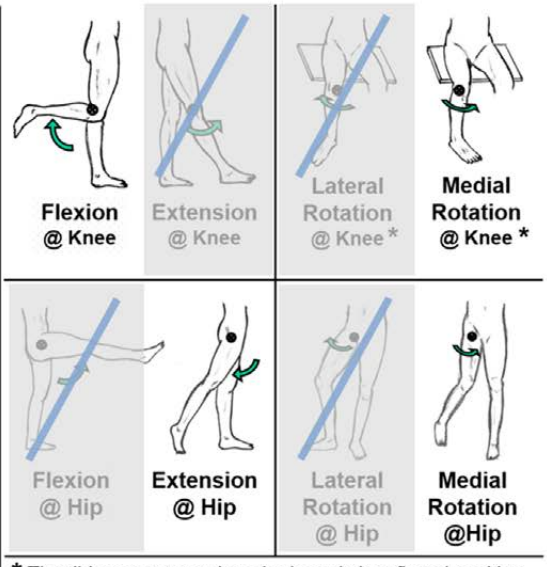
Appendix 1 TOC

Semimembranosus

Moves the knee and the hip joint

G12-7





* The tibia can rotate when the knee is in a flexed position.

Origin	Insertion	Action
Ischial tuberosity	Posterior medial condyle of tibia	Flexion and medial rotation* at the knee, Extension and medial rotation at the hip joint

Innervation: Tibial part of the sciatic nerve (L5, S1, S2)

Details from Table 12 (A) - Knee (and Hip Joint, Part 3)

Note

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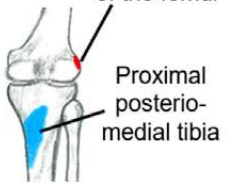
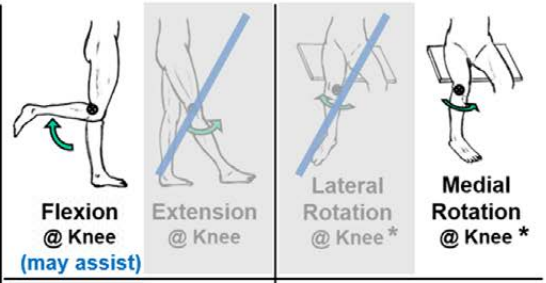
Appendix 1 TOC

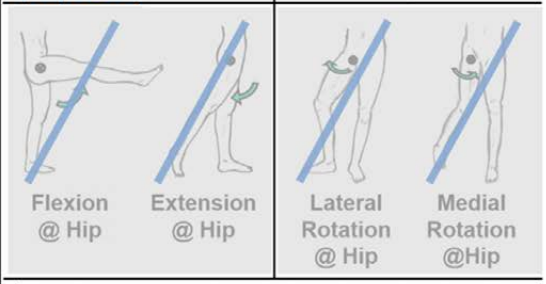
Popliteus

Moves the knee

G12-8







* The tibia can rotate when the knee is in a flexed position.

Origin	Insertion	Action
Lateral condyle of the femur	Proximal posterio-medial tibia	Medial rotation* at the knee, May assist flexion at the knee When weight bearing: Lateral rotation of femur, to unlock straightened knee

Innervation: Tibial N. (L4, L5, S1)

Details from Table 12 (A) - Knee (and Hip Joint, Part 3)

Note

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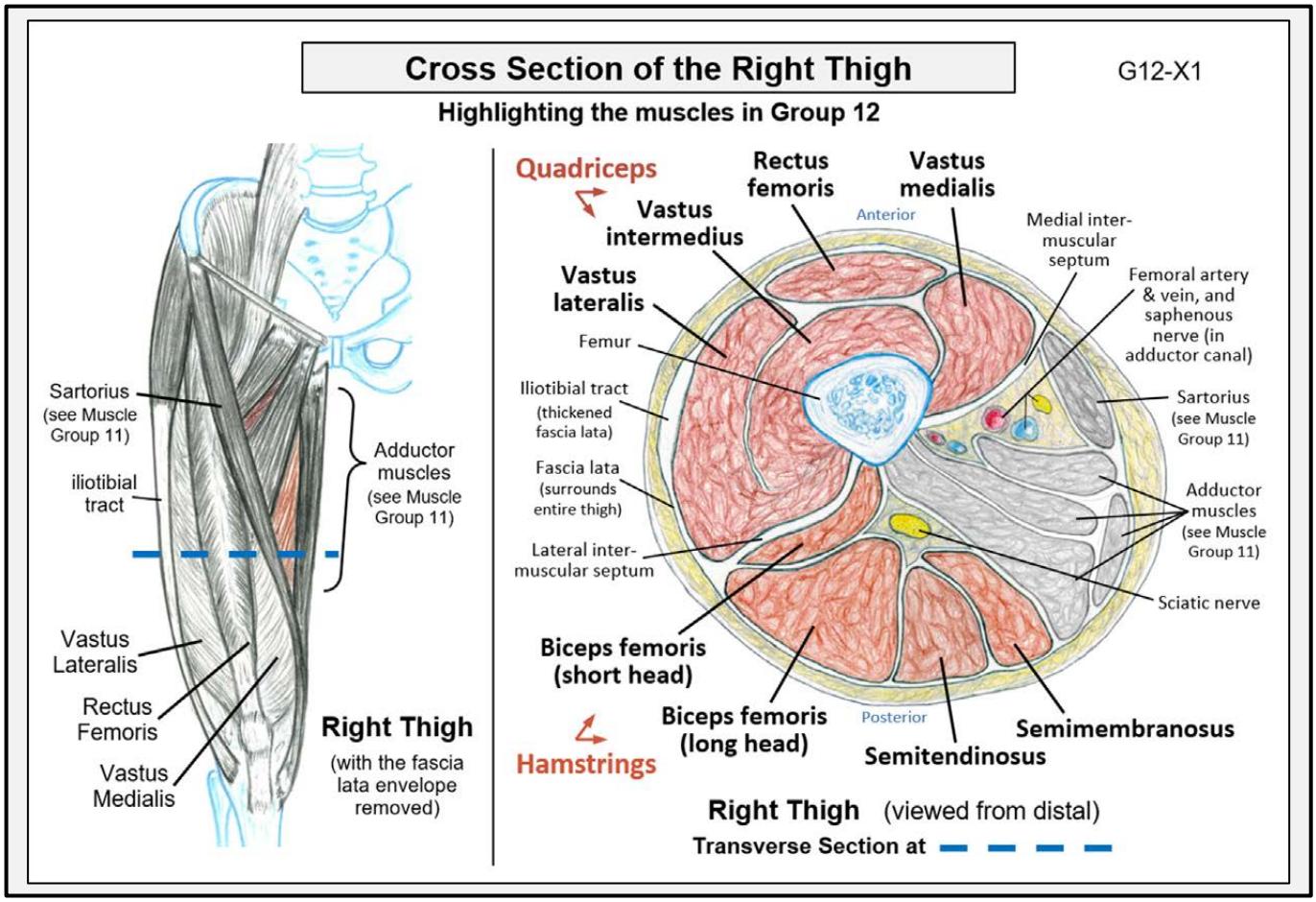
Appendix 1 TOC



Details from Table 12 (A) - Knee (and Hip Joint, Part 3)

Note

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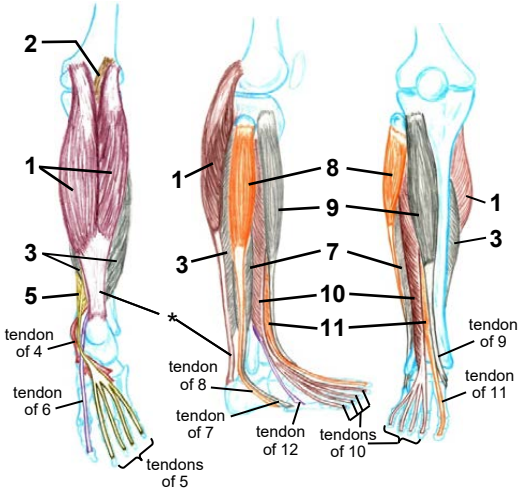
back to Table 13 (A)

Appendix 1 TOC

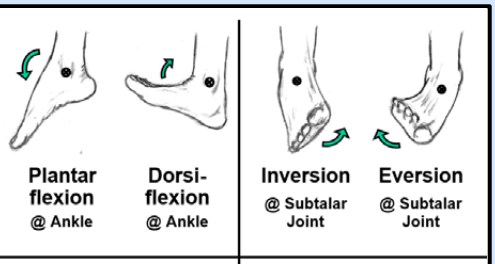
Muscle Group 13 (G13)

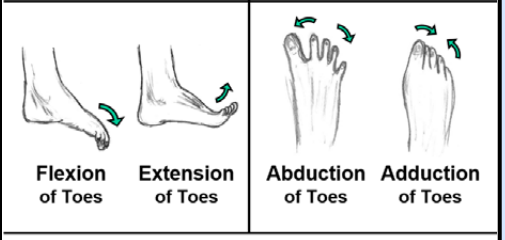
Muscles that move the **Ankle, Foot & Toes**



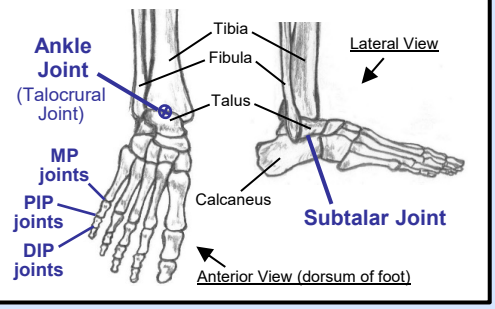
1. Gastrocnemius
2. Plantaris
3. Soleus
4. Tibialis Posterior
5. Flexor Digitorum Longus
6. Flexor Hallucis Longus
7. Fibularis Brevis
8. Fibularis Longus
9. Tibialis Anterior
10. Extensor Digitorum Longus
11. Extensor Hallucis Longus

* = Calcaneal Tendon (Achilles Tendon)





#1 = Hallux ("big toe")
#5 = Digiti minimi ("little toe")



Details from Table 13 (A) - Ankle, Foot, Toes

Note

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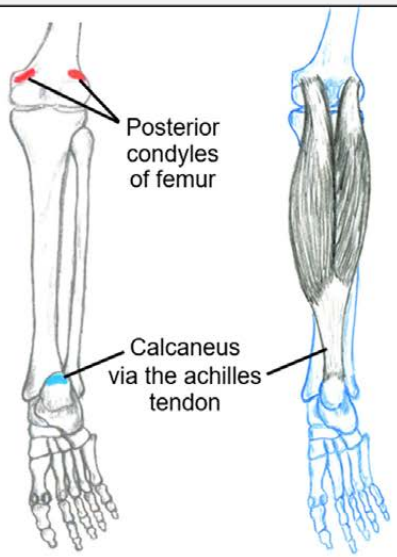
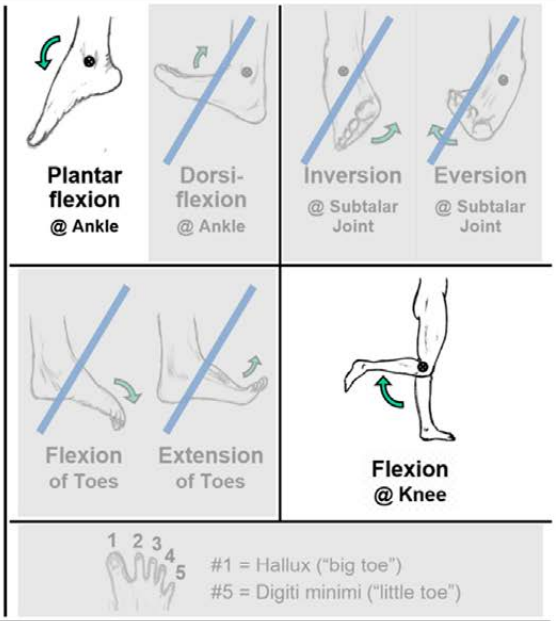
Appendix 1 TOC

Gastrocnemius

Moves the ankle and knee

G13-1





Origin	Insertion	Action
Posterior condyles of femur (lateral & medial)	Calcaneus via the achilles tendon	Plantar flexion of the ankle, Flexion of the knee (also stabilizes the knee in standing, walking, running)

Innervation: Tibial N. (S1, S2)

Details from Table 13 (A) - Ankle, Foot, Toes

Note

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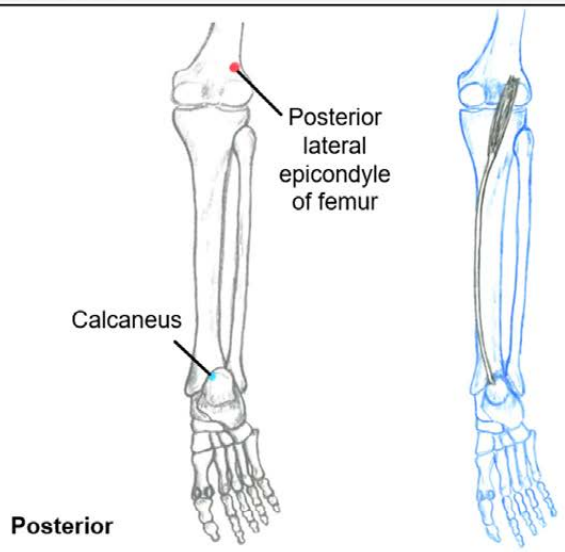
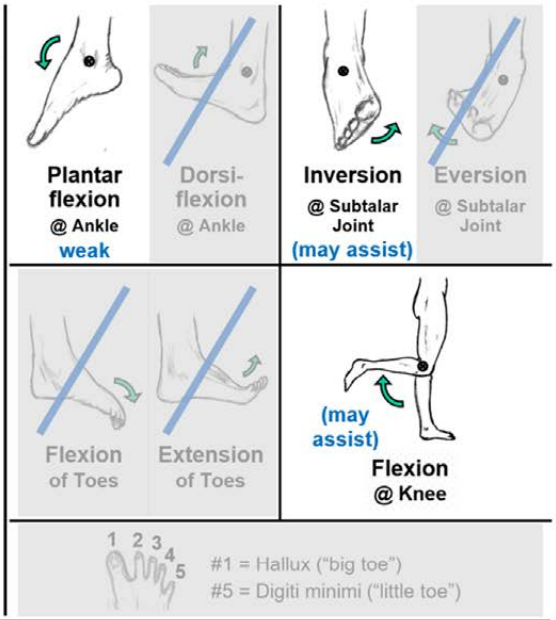
Appendix 1 TOC

Plantaris

Moves the ankle and knee

G13-2





Origin	Insertion	Action
Posterior lateral epicondyle of femur	Calcaneus via the achilles tendon (small spot on the medial side)	Weak plantar flexion of ankle, may assist with inversion of the foot and flexion of the knee

Innervation: Tibial N. (L4, L5, S1)

Details from Table 13 (A) - Ankle, Foot, Toes

Note

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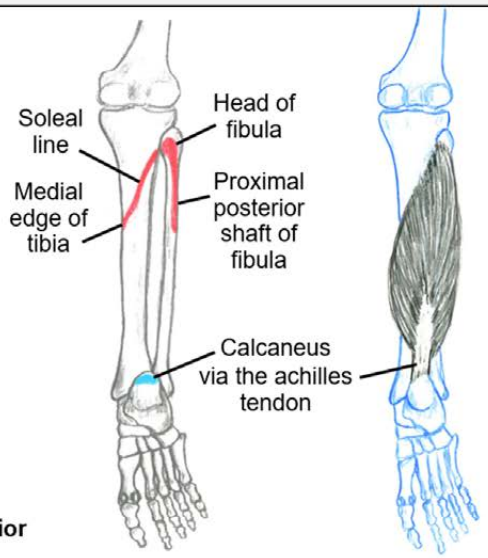
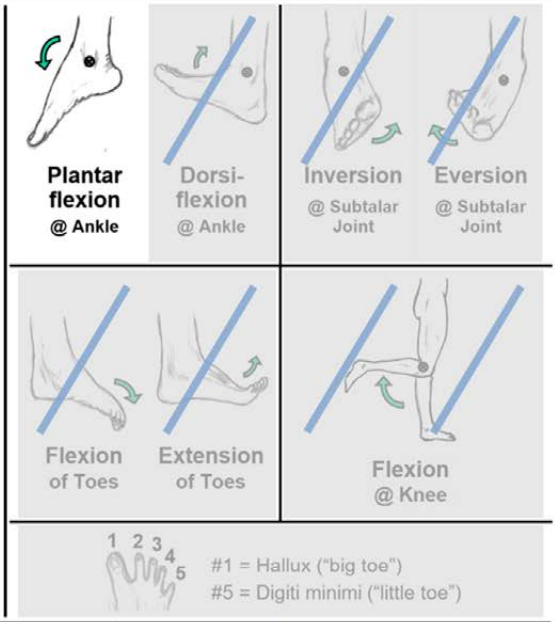
Appendix 1 TOC

Soleus

Moves the ankle

G13-3





Origin	Insertion	Action
Proximal posterior shaft and head of fibula, Soleal line & middle medial edge of tibia	Calcaneus via the achilles tendon	Plantar flexion of the ankle

Innervation: Tibial N. (S1, S2)

Details from Table 13 (A) - Ankle, Foot, Toes

Note

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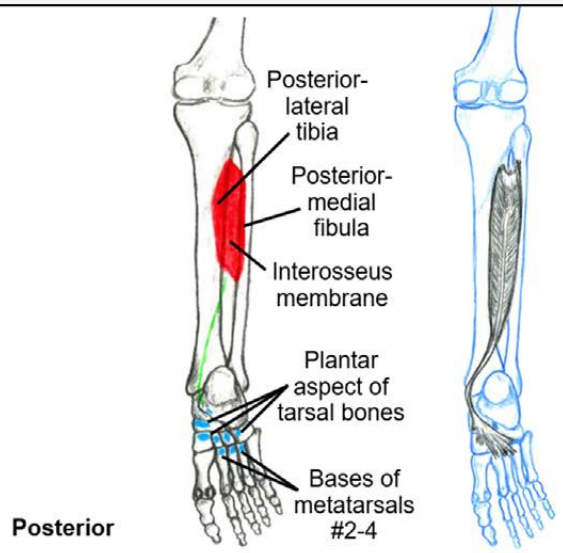
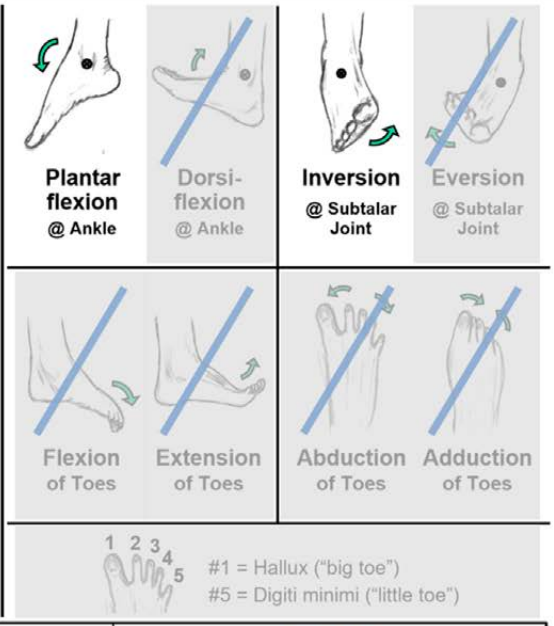
Appendix 1 TOC

Tibialis Posterior

Moves the ankle and foot

G13-4





Origin	Insertion	Action
Posterior lateral tibia, Posterior medial fibula, and interosseus membrane.	Plantar aspect of all tarsals except talus, and bases of metatarsals #2-4 (Tarsal attachments: calcaneus, navicular, cuboid, 3 cuneiforms)	Inversion of the foot, Plantar flexion of the ankle

Innervation: Tibial N. (L5, S1)

Details from Table 13 (A) - Ankle, Foot, Toes

Note

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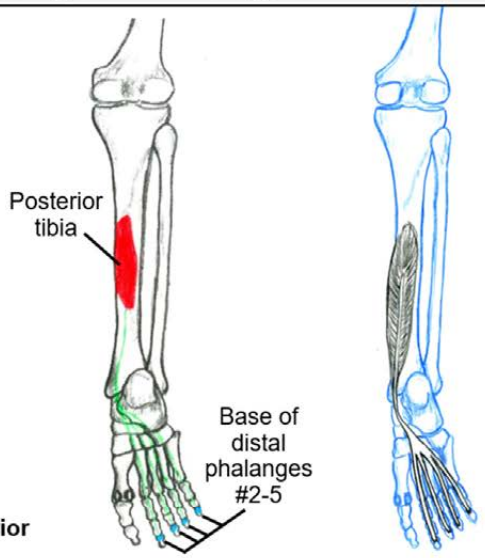
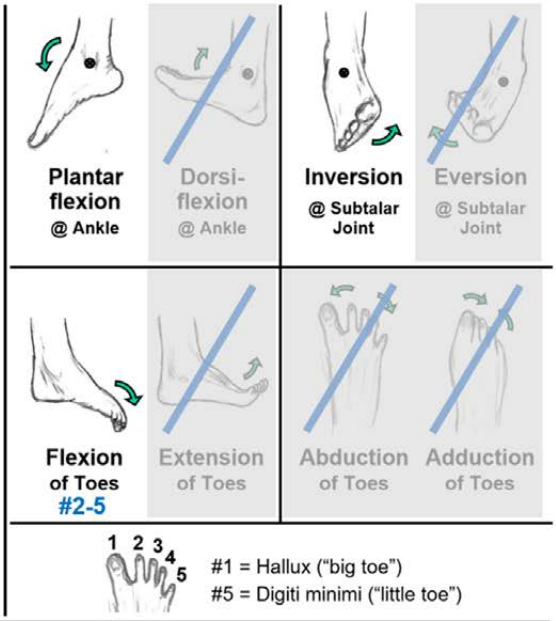
Appendix 1 TOC

Flexor Digitorum Longus

Moves toes #2-5 and foot

G13-5





Origin	Insertion	Action
Posterior tibia (starts 1/3 of the way down)	Base of distal phalanges #2-5 (plantar aspect)	Flexion of toes #2-5, Inversion of foot, Plantar flexion of ankle

Innervation: Tibial N. (L5, S1)

Details from Table 13 (A) - Ankle, Foot, Toes

Note

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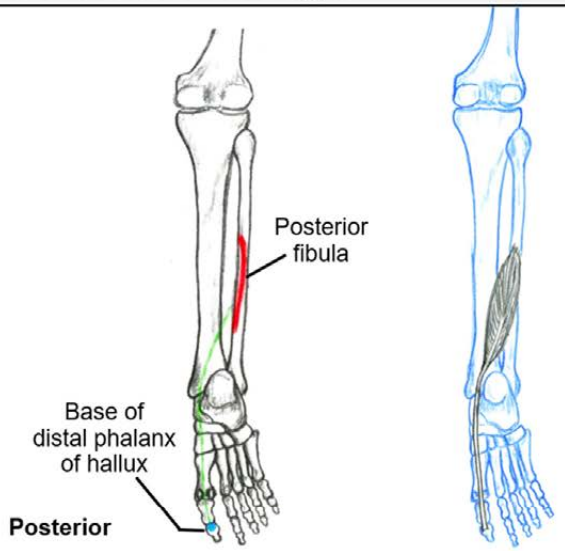
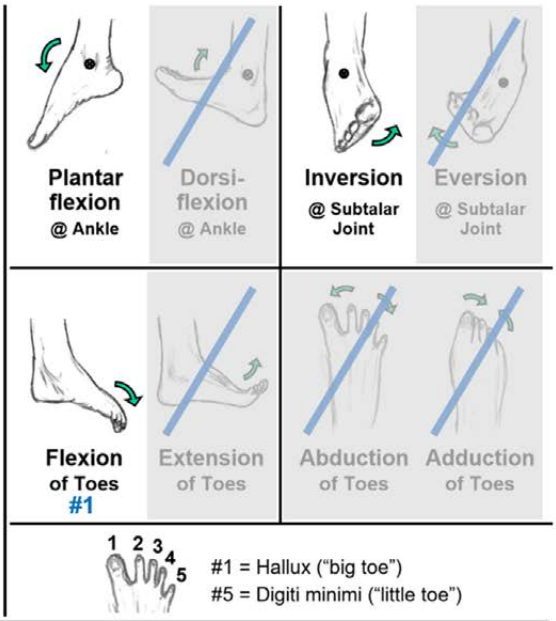
Appendix 1 TOC

Flexor Hallucis Longus

Moves toe #1 and foot

G13-6





Origin	Insertion	Action
Posterior fibula (starts 1/3 of the way down)	Base of distal phalanx of hallux - big toe (plantar aspect)	Flexion of toe #1 (hallux), Inversion of foot, Plantar flexion of ankle

Innervation: Tibial N. (L5, S1, S2)

Details from Table 13 (A) - Ankle, Foot, Toes

Note

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back to Table 13 (A)

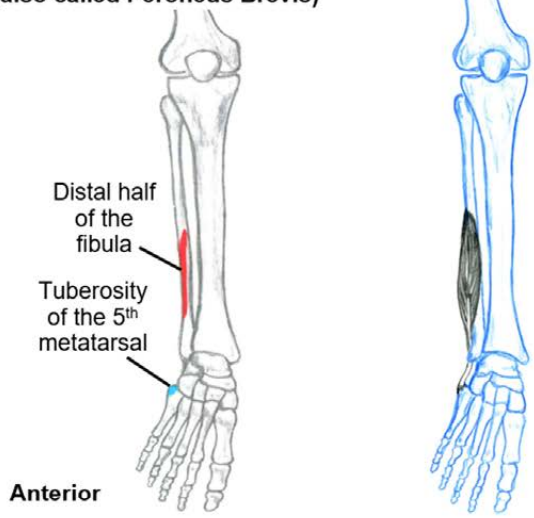
Appendix 1 TOC

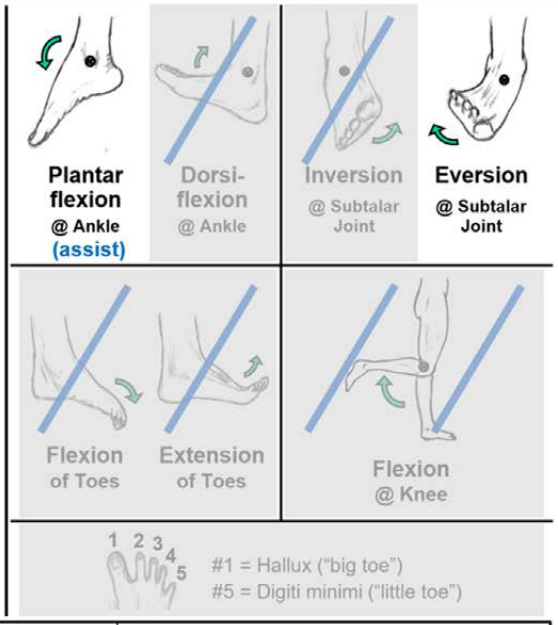
Fibularis Brevis

Moves the foot

(also called Peroneus Brevis)

G13-7





Origin	Insertion	Action
Distal half of fibula (lateral aspect)	Tuberosity of the 5th metatarsal	Eversion of the foot, Assists plantar flexion of ankle

Innervation: Superficial fibular N. (L4, L5, S1)

Details from Table 13 (A) - Ankle, Foot, Toes

Note

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back to Table 13 (A)

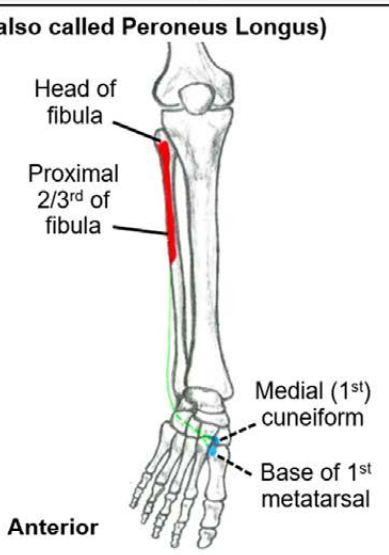
Appendix 1 TOC

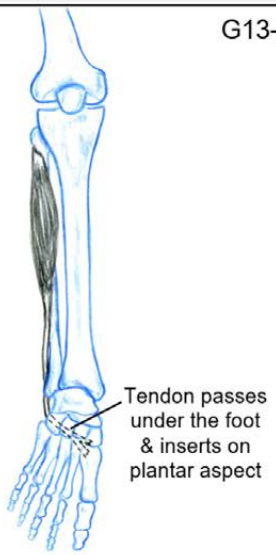
Fibularis Longus

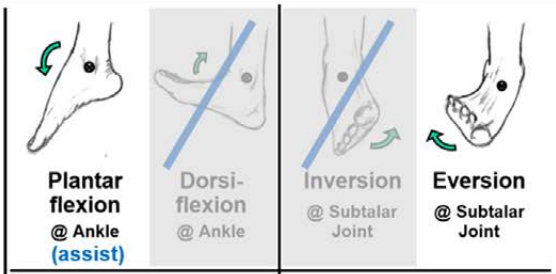
Moves the foot

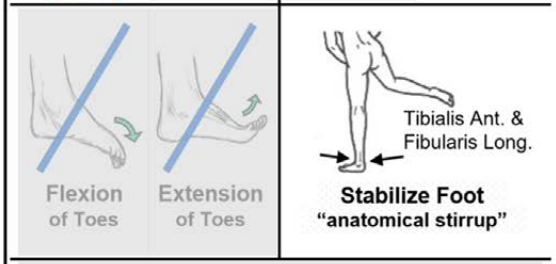
(also called Peroneus Longus)

G13-8









#1 = Hallux ("big toe")
#5 = Digiti minimi ("little toe")

Origin	Insertion	Action
Head and proximal two-thirds of fibula (lateral aspect)	Medial (1st) cuneiform and base of 1st metatarsal (plantar aspect)	Eversion of the foot, Assists plantar flexion of ankle

Innervation: Superficial fibular N. (L4, L5, S1)

Details from Table 13 (A) - Ankle, Foot, Toes

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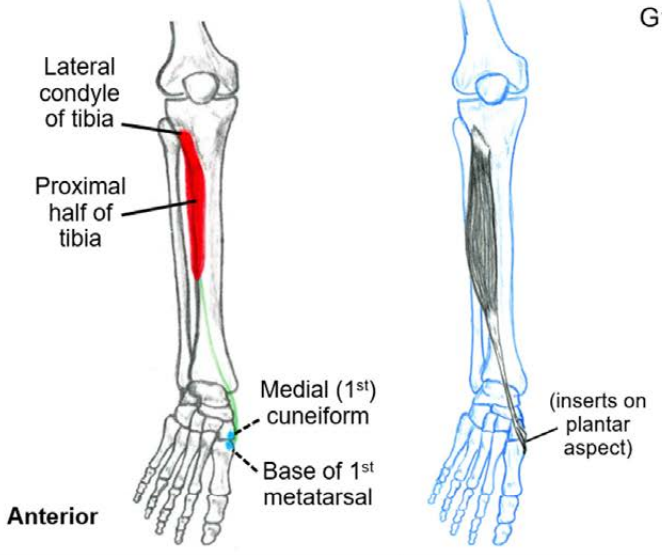
back to Table 13 (A)

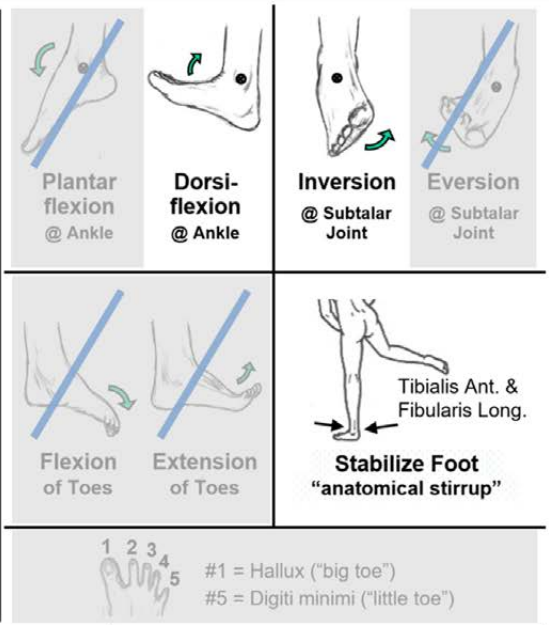
Appendix 1 TOC

Tibialis Anterior

Moves the foot

G13-9





Origin	Insertion	Action
Lateral condyle and proximal half of tibia (lateral aspect) (and interosseus membrane)	Medial (1st) cuneiform and base of 1st metatarsal (medial edge of plantar aspect)	Dorsiflexion of the ankle, Inversion of the foot

Innervation: Deep fibular N. (L4, L5, S1)

Details from Table 13 (A) - Ankle, Foot, Toes

Note

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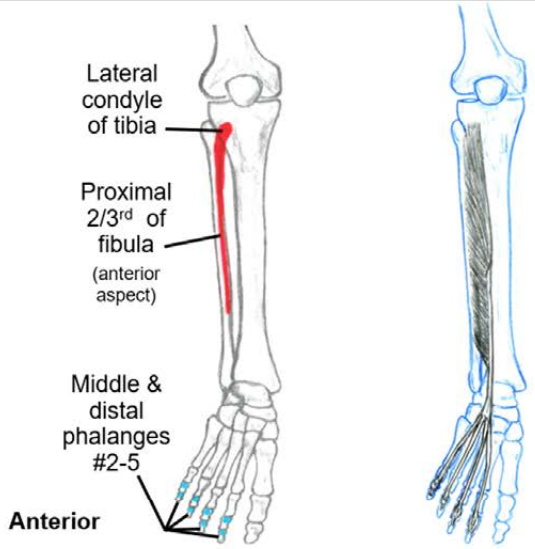
back to Table 13 (A)

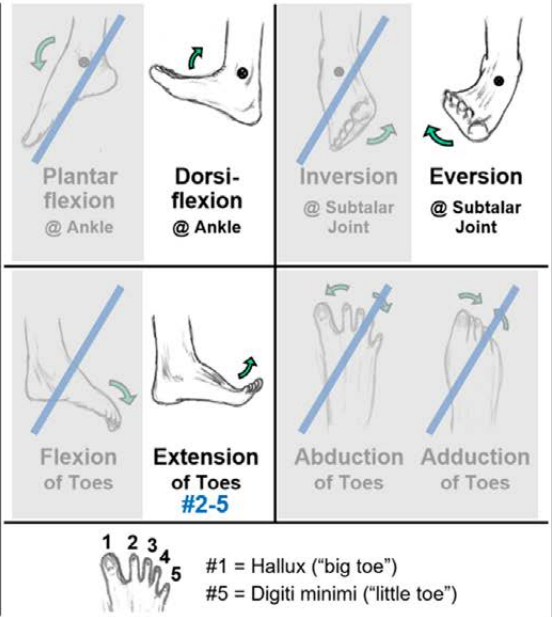
Appendix 1 TOC

Extensor Digitorum Longus

Moves toes #2-5 and foot

G13-10





Origin	Insertion	Action
Lateral condyle of tibia, and proximal 2/3 of fibula (anterior aspect)	Middle & distal phalanges #2-5 (dorsal aspect)	Extension of toes #2-5, Dorsiflexion of the ankle, Eversion of the foot

Innervation: Deep fibular N. (L4, L5, S1)

Details from Table 13 (A) - Ankle, Foot, Toes

Note

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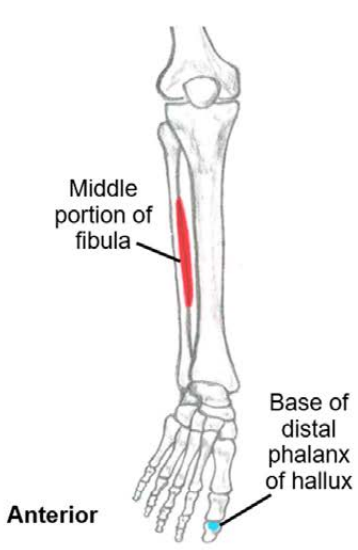
back to Table 13 (A)

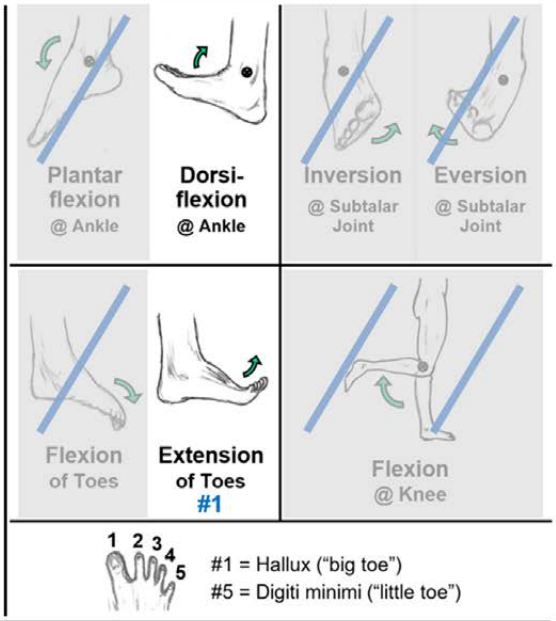
Appendix 1 TOC

Extensor Hallucis Longus

Moves toe #1 and foot

G13-11





#1 = Hallux ("big toe")
#5 = Digiti minimi ("little toe")

Origin	Insertion	Action
Middle portion of fibula (anterior medial aspect) (and interosseus membrane)	Base of distal phalanx of hallux -big toe (dorsal aspect)	Extension of toe #1 (hallux), Dorsiflexion of the ankle (May assist inversion of foot)

Innervation: Deep fibular N. (L4, L5, S1)

Details from Table 13 (A) - Ankle, Foot, Toes

Note

This was originally a landscape-oriented page.
It has been converted to portrait for the e-book.

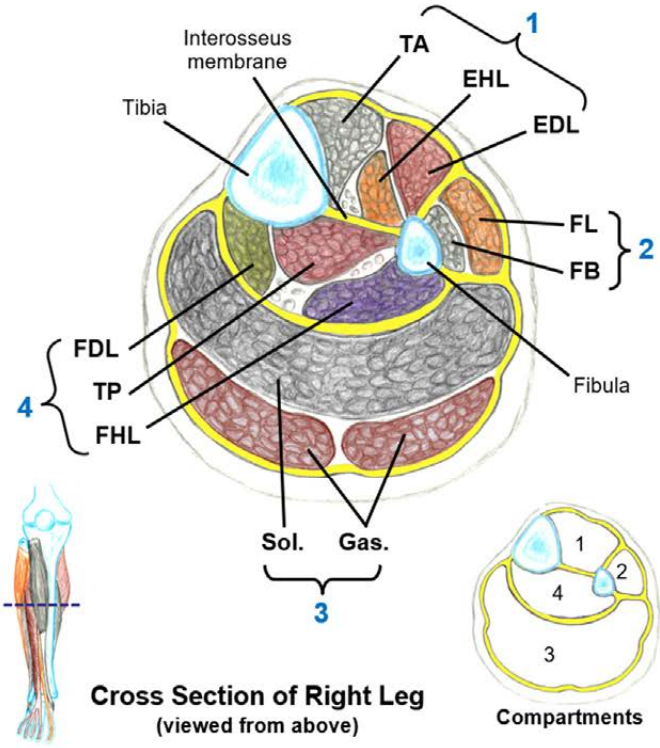
It is intended to be viewed with the e-reader set to "Fit to width".

back to Table 13 (A)

Appendix 1 TOC

Cross Section of the Leg (compartments)

G13-X1



Cross Section of Right Leg
(viewed from above)

Compartments

Muscles of the Leg

(Four Compartments)

1. Anterior Compartment

TA - Tibialis Anterior

EHL - Extensor Hallucis Longus

EDL - Extensor Digitorum Longus

2. Lateral Compartment

FL - Fibularis Longus

FB - Fibularis Brevis

3. Superficial Posterior Compartment

Gas. - Gastrocnemius

Sol. - Soleus

4. Deep Posterior Compartment

FDL - Flexor Digitorum Longus

TP - Tibialis Posterior

FHL - Flexor Hallucis Longus

Details from Table 13 (A) - Ankle, Foot, Toes

Note

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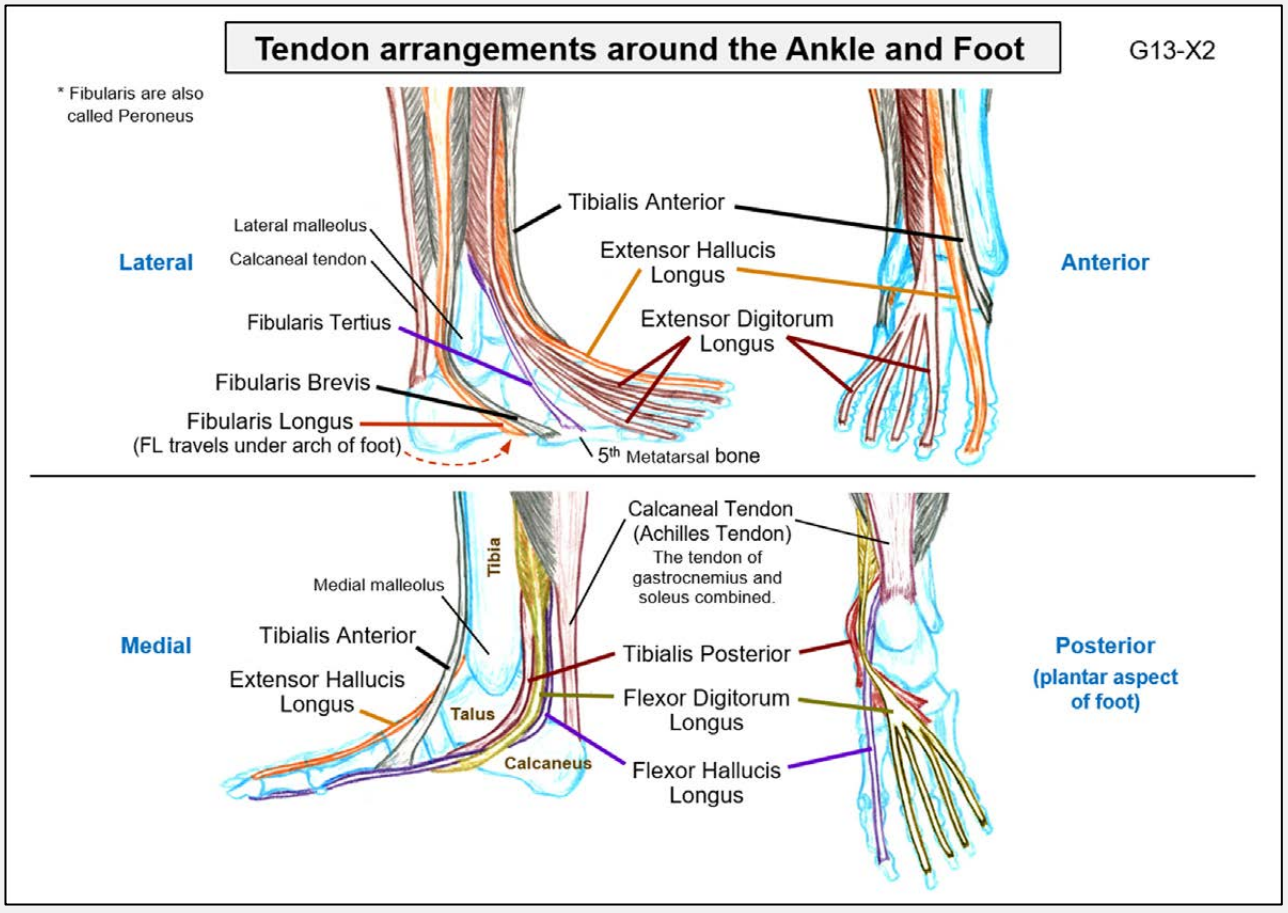

back to Table 13 (A)
Appendix 1 TOC

Details from Table 13 (A) - Ankle, Foot, Toes

Note

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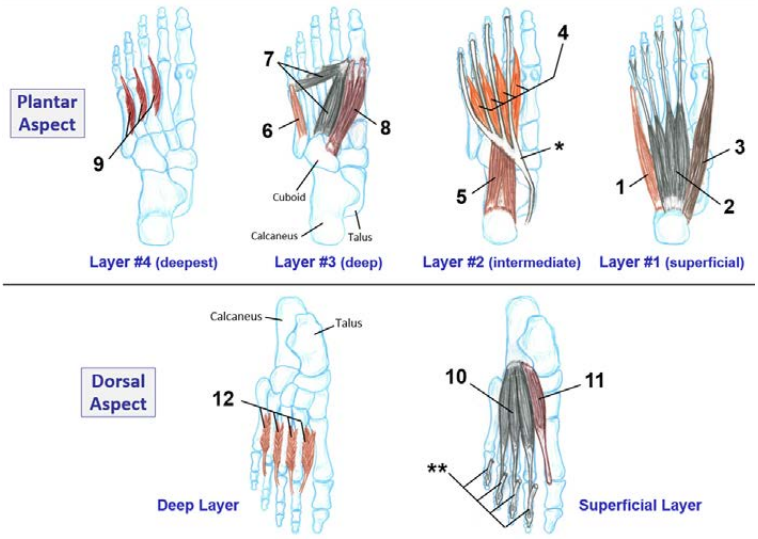
back to Bonus 13-B

Appendix 1 TOC

Muscle Group 13-B (G13-B)

Intrinsic Muscles of the Foot (Bonus Group)



Plantar Layer #1 (superficial)

1. Abductor Digiti Minimi
2. Flexor Digitorum Brevis
3. Abductor Hallucis

Plantar Layer #2 (intermediate)

4. Lumbrical Muscles (4)
5. Quadratus Plantae

Plantar Layer #3 (deep)

6. Flexor Digiti Minimi
7. Adductor Hallucis
8. Flexor Hallucis Brevis

Plantar Layer #4 (deepest)

9. Plantar Interossei (3)

Dorsal Layer #1 (superficial)

10. Extensor Digitorum Brevis
11. Extensor Hallucis Brevis

Dorsal Layer #2 (deep)

12. Dorsal Interossei (4)

* = Tendon of flexor digitorum longus
** = Cut tendons of extensor digitorum longus

Details for Bonus Group 13-B - Intrinsic Muscles of the Foot

Note

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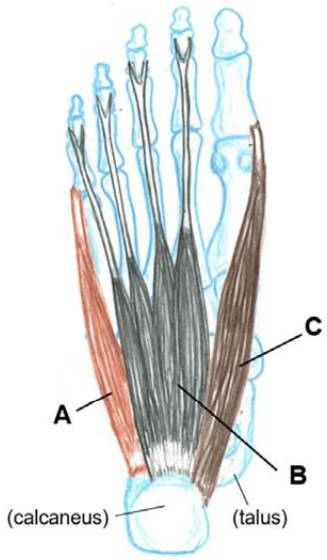
back to Bonus 13-B

Appendix 1 TOC

Plantar Layer #1 (superficial)



Plantar Aspect

Intrinsic Muscles of the Foot

Plantar Layer #1 of 4 (superficial)

A. Abductor Digiti Minimi

Origin: Tuberosity of the calcaneus

Insertion: Proximal phalanx of the little toe (lateral base)

Action: Abduction and flexion of the little toe

Nerve: Lateral plantar N. (S2, S3)

B. Flexor Digitorum Brevis

Origin: Tuberosity of the calcaneus

Insertion: Middle phalanges of toes #2-5 (sides)

Action: Flexion of toes #2-5

Nerve: Medial plantar N. (L5, S1)

C. Abductor Hallucis

Origin: Tuberosity of the calcaneus

Insertion: Proximal phalanx of big toe (medial base)

Action: Abduction and flexion of the big toe

Nerve: Medial plantar N. (L5, S1)

G13-B - 1

Details for Bonus Group 13-B - Intrinsic Muscles of the Foot

Note

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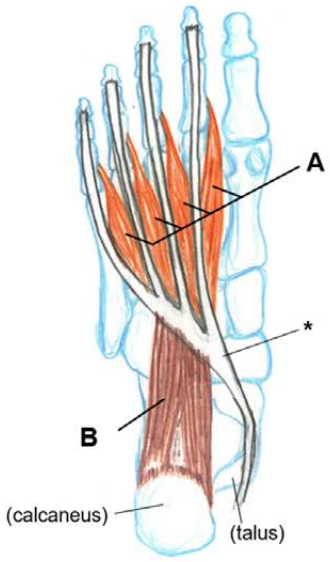
back to Bonus 13-B

Appendix 1 TOC

Plantar Layer #2 (intermediate)



Plantar Aspect

Intrinsic Muscles of the Foot

Plantar Layer #2 of 4 (intermediate)

* = Tendons of the flexor digitorum longus

A. Lumbrical Muscles (4)

Origin:
The four tendons of the flexor digitorum longus

Insertion:
The four tendons of the extensor digitorum longus
(attach via the medial side of the dorsal digital expansions)

Action:
Flexion of toes #2-5 at the metatarsophalangeal joints,
Extension of toes #2-5 at the interphalangeal joints

Nerve: Lumbrical 1: Medial plantar N. (L5, S1)
Lumbricals 2-4: Lateral plantar N. (S2, S3)

B. Quadratus Plantae

Origin: Plantar surface of the calcaneus

Insertion: Tendon of the flexor digitorum longus
(lateral margin, before it goes to the 4 toes)

Action: Flexion of toes #2-5 (assists the FDL)

Nerve: Lateral plantar N. (S2, S3)

G13-B - 2

Details for Bonus Group 13-B - Intrinsic Muscles of the Foot

Note

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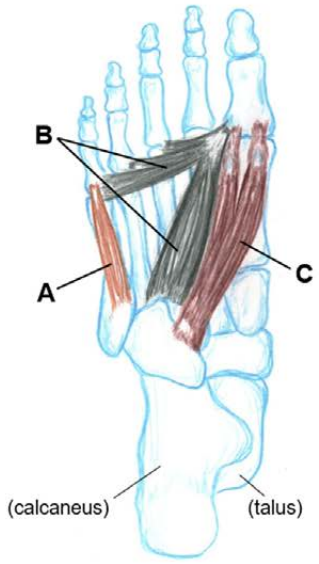
back to Bonus 13-B

Appendix 1 TOC

Plantar Layer #3 (deep)



Plantar Aspect

Intrinsic Muscles of the Foot

Plantar Layer #3 of 4 (almost deepest)

A. Flexor Digiti Minimi

Origin: Base of 5th metatarsal (& peroneus longus tendon)
Insertion: Proximal phalanx of the little toe (plantar base)
Action: Flexion of the little toe (at the MP joint)
Nerve: Lateral plantar N. (S2, S3)

B. Adductor Hallucis

Origin: *Oblique head:* Bases of metatarsals #2-4
Transverse head: Metatarsophalangeal ligaments #3-5
Insertion: Proximal phalanx of big toe (lateral base)
Action: Adduction of the big toe
Nerve: Lateral plantar N. (S2, S3)

C. Flexor Hallucis Brevis

Origin: Cuboid and lateral cuneiform (plantar surfaces)
Insertion: Proximal phalanx big toe (sides of base)
Action: Flexion of the big toe (at the MP joint)
Nerve: Medial plantar N. (L5, S1)

G13-B - 3

Details for Bonus Group 13-B - Intrinsic Muscles of the Foot

Note

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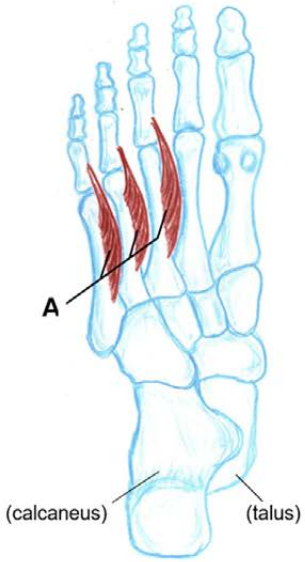
back to Bonus 13-B

Appendix 1 TOC

Plantar Layer #4 (deepest)



Plantar Aspect

Intrinsic Muscles of the Foot

Plantar Layer #4 of 4 (deepest)

A. Plantar Interossei (3)

Origin: 3rd, 4th and 5th metatarsal bones
(bases and medial side of shafts)

Insertion: Bases of the proximal phalanges of toes #3-5
(and the dorsal digital expansions of toes #3-5)

Action: Adduction of toes #3-5,
Assist flexion of toes #3-5 at the metatarsophalangeal joints,
Assist extension of toes #3-5 at the interphalangeal joints

Nerve: Lateral plantar N. (S2, S3)

G13-B - 4

Details for Bonus Group 13-B - Intrinsic Muscles of the Foot

Note

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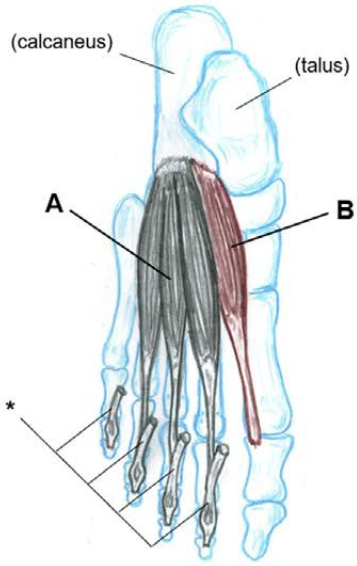
back to Bonus 13-B

Appendix 1 TOC

Dorsal Layer #1 (superficial)



Dorsal Aspect

Intrinsic Muscles of the Foot

Dorsal Layer #1 of 2 (superficial)

* = cut tendons of the extensor digitorum longus

A. Extensor Digitorum Brevis

Origin: Dorsal surface of the calcaneus

Insertion: Toes #2-4, via the tendons of the extensor digitorum longus
(attach to the lateral side of the EDL tendons)

Action: Extension of toes #2-4

Nerve: Deep fibular N. (L5, S1)

B. Extensor Hallucis Brevis

Origin: Dorsal surface of the calcaneus

Insertion: Proximal phalanx of the big toe
(dorsal surface of the base of the phalanx)

Action: Extension of the big toe

Nerve: Deep fibular N. (L5, S1)

G13-B - 5

Details for Bonus Group 13-B - Intrinsic Muscles of the Foot

Note

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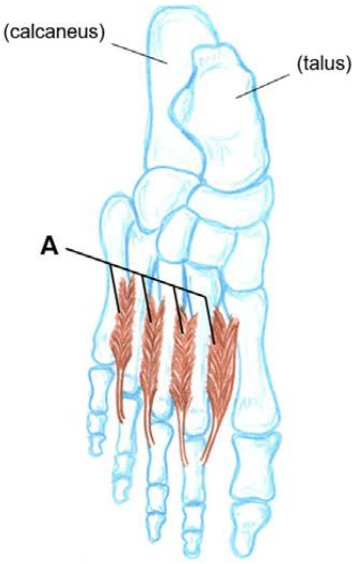
back to Bonus 13-B

Appendix 1 TOC

Dorsal Layer #2 (deep)



Dorsal Aspect

Intrinsic Muscles of the Foot

Dorsal Layer #2 of 2 (deep)

A. Dorsal Interossei (4)

Origin: Shafts of metatarsal bones #1-5
(each muscle arises from the sides of two adjacent metatarsal bones)

Insertion: Bases of the proximal phalanges of toes #2-4
(and the dorsal digital expansions of toes #2-4)

Action: Abduction of toes #2-4,
Assist flexion of toes #2-4 at the metatarsophalangeal joints,
Assist extension of toes #2-4 at the interphalangeal joints

Nerve: Lateral plantar N. (S2, S3)

G13-B - 6

Details for Bonus Group 13-B - Intrinsic Muscles of the Foot

Note

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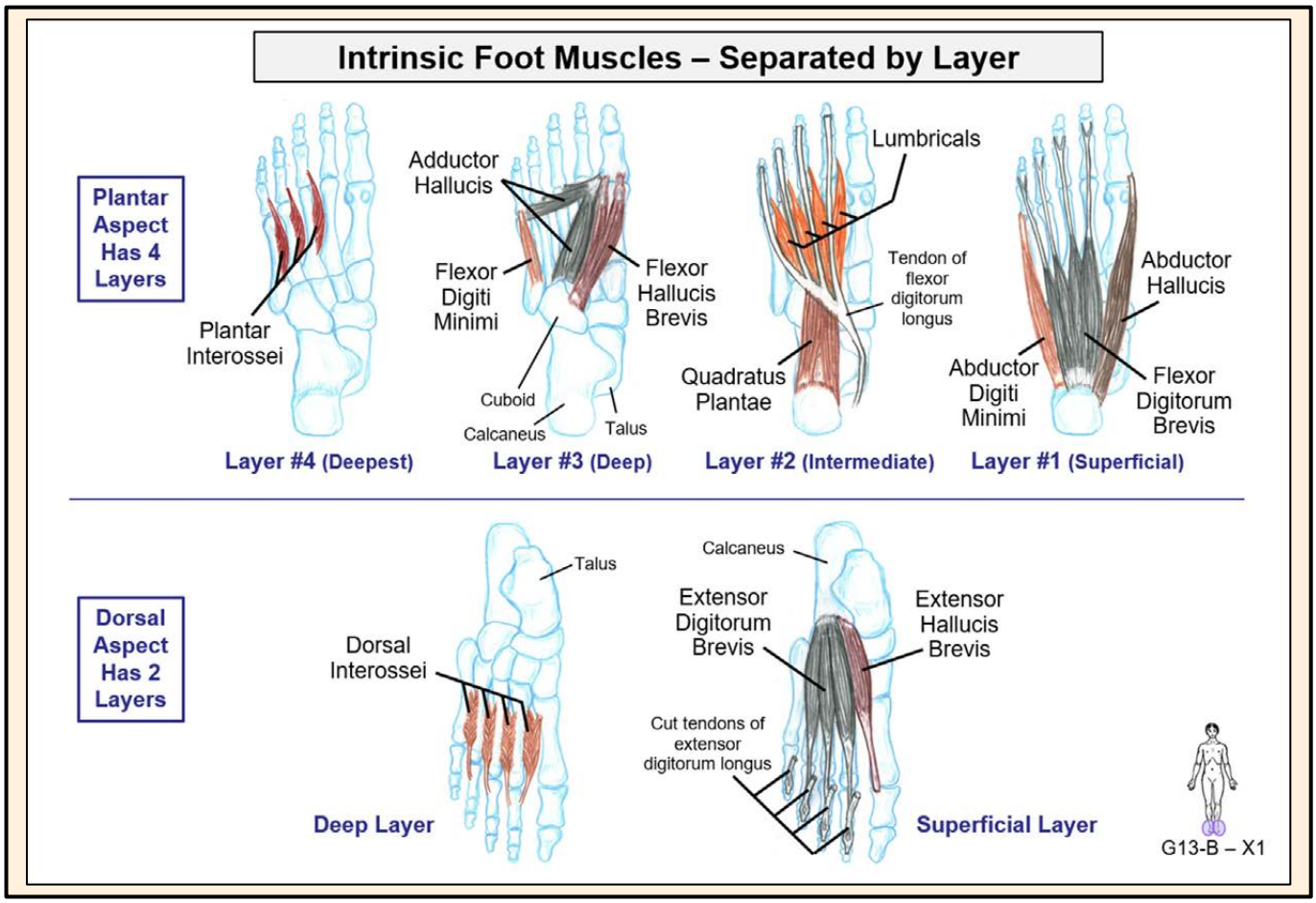

back to Bonus 13-B
Appendix 1 TOC

Details for Bonus Group 13-B - Intrinsic Muscles of the Foot

Note

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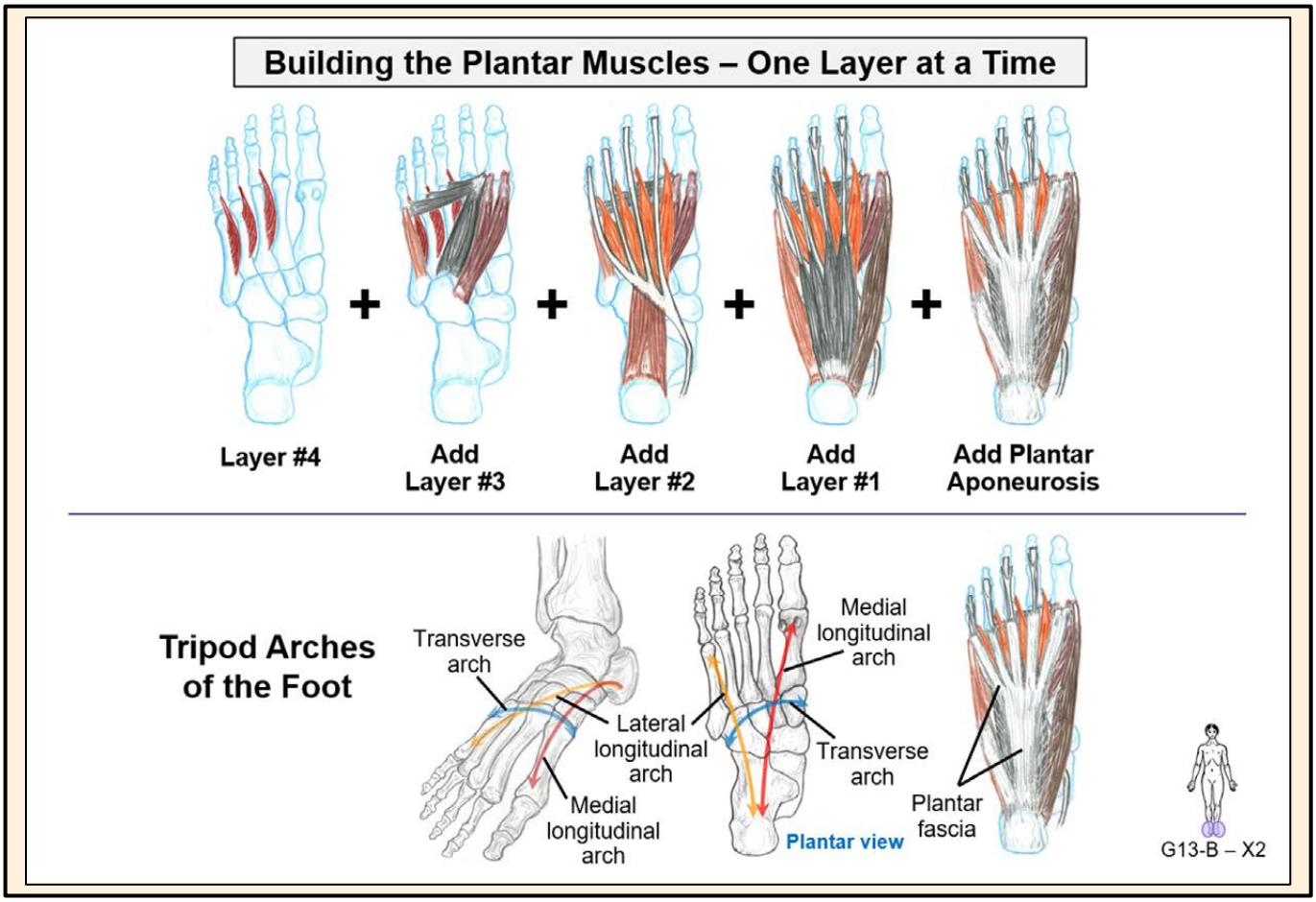
back to Bonus 13-B

Appendix 1 TOC



Details for Bonus Group 13-B - Intrinsic Muscles of the Foot

Note

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Appendix 1 – Alphabetical Index of Muscles

1. Find the muscle you're looking for, and note its group number.
2. Click a △G1 button to go to that muscle group.

Upper Extremity

△G1 △G2 △G3 △G4 △G5 △ G5-B

Axial Skeleton

△G6 △G7 △G8 △G9 △ G9-B

Lower Extremity

△G10 △G11 △G12 △G13 △G13-B

Muscle Index O–Z

△ Appendix 1 TOC

407

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Tablet: Turn tablet horizontal. Pinch out to desired size.

Desktop/Laptop: Use your e-reader's **Zoom** function (instructions on the first page of this e-book).

After zooming in, click the on-page navigation buttons to move from page to page.

Appendix 1 – Alphabetical Index of Muscles

1. Find the muscle you're looking for, and note its group number.
2. Click a △G1 button to go to that muscle group.

Upper Extremity

△G1 △G2 △G3 △G4 △G5 △G5-B

Axial Skeleton

△G6 △G7 △G8 △G9 △G9-B

Lower Extremity

△G10 △G11 △G12 △G13 △G13-B

Muscle Index A–N

△ Appendix 1 TOC

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Desktop/Laptop: Use your e-reader's **Zoom** function (instructions on the first page of this e-book).

After zooming in, click the on-page navigation buttons to move from page to page.

Appendix 2 – Action Pair Cards

Study synergists & antagonists for all movements of the body

This Appendix is only included in the Enhanced E-book version of Mastering Muscles & Movement.

Its purpose is to provide a full accounting of the **synergists and antagonists** for the actions available at all joints and other structures of the body. The concept of **action pairs** is described in MMM Chapter 1 on pages 6-8, including diagrams that illustrate all the actions of the body organized by their planes of movement.

In Chapters 4-6, each Muscle Group includes a **B-Table** that organizes the actions and synergist/antagonist relationships for the muscles in that group (B-Tables are described on page 62). Then in Chapter 7, action information across all muscle groups is compiled in Summary Tables S-1 to S-3 (see page 203). This Appendix 2 is essentially a graphic representation of all the information in those Summary Tables.

Two Ways to Use this Appendix

1. To use Appendix 2 in conjunction with the B-Tables in Chapters 4-6, simply click on an action picture in the B-Table and you will jump to the Action Pair Card for that action. Then click the "Back to Table" button to go back to the B-Table (e.g., Back to Table 2 (B)) For more information please see page 411, **Using this Appendix with the B-Tables**.

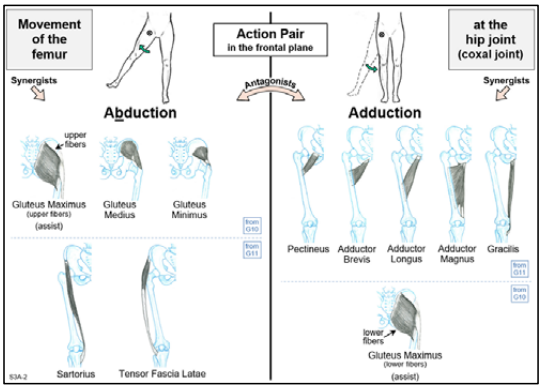
2. To use Appendix 2 stand-alone, go to **Appendix 2 – Table of Contents** (TOC) on page 410 and click on any action picture. This will take you to the Action Pair Card. Click the Appendix 2 TOC button at the lower right of any card to return to the TOC page. For more information please see page 412, **Using this Appendix Stand-alone**.

Synergists

Left side of card shows all muscles that contribute to an action.

Antagonists

Muscles on one side of the card are antagonists to the muscles on the other side of the card



Synergists

Right side of card shows all muscles that contribute to the opposite action.

from G10 from G11

Muscles are gathered in areas based on their muscle group in chapters 4-6.

Main TOC

Appendix 2 TOC

Note

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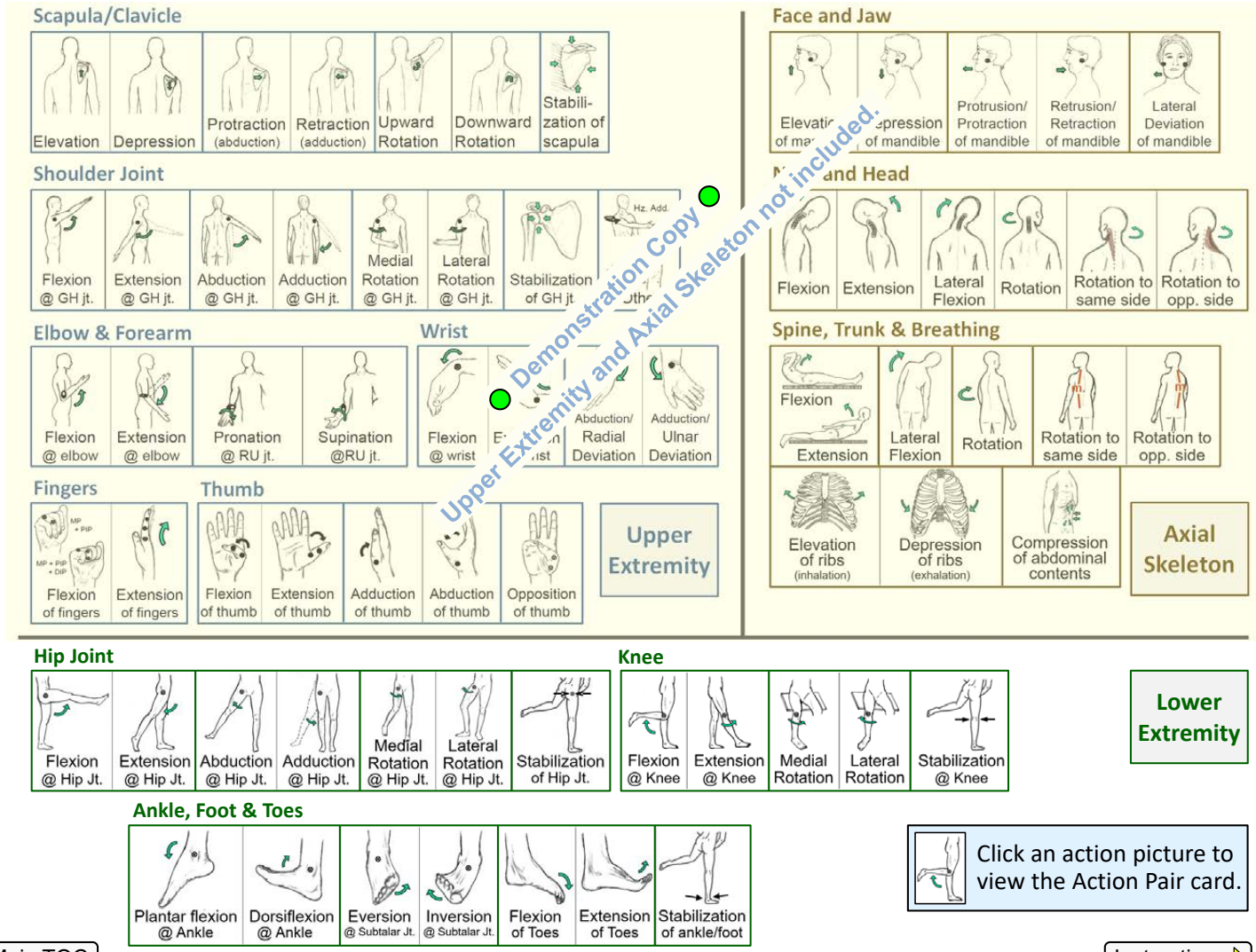
Appendix 2 – Action Pair Cards - Table of Contents



Click an action picture to view the Action Pair card.

Main TOC

Instructions

Note

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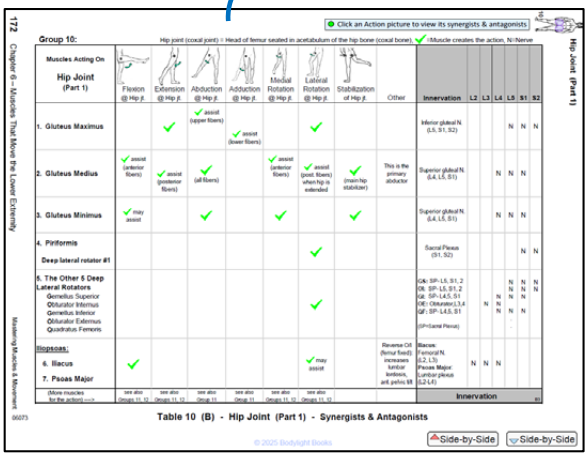
Using Appendix 2 with the B-Tables in Chapters 4, 5, and 6

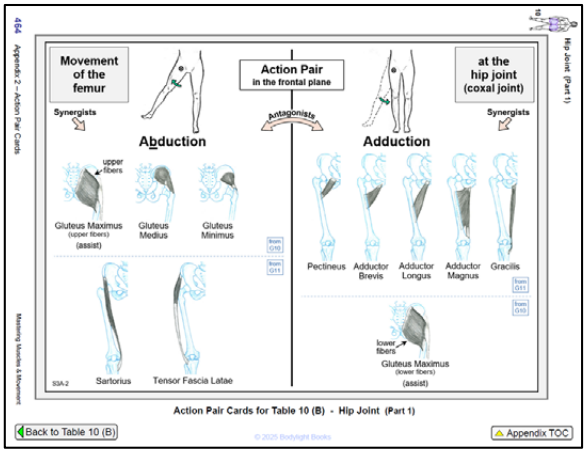
B-Table pages are linked to Action Pair Cards

”B” Tables show the synergists and antagonists for all of the actions available in a Muscle Group. Pages in the book that show B-Tables are linked to ”Action Pair” pages in this Appendix that graphically display the information. To view an **Action Pair Card** click on an action picture at the top of the B-Table.

Click on an action picture.

The book will jump to a page in Appendix 2.





Back to Table 10 (B)

Click the button at the lower left corner to go back to the page with the **B-Table**.

from G10 **Note** from G11

The muscles displayed on the Action Pair card show ***all*** muscles that create the action, and therefore will often show muscles from multiple groups. Please see page 203 for more info.

Appendix 2 TOC

Note

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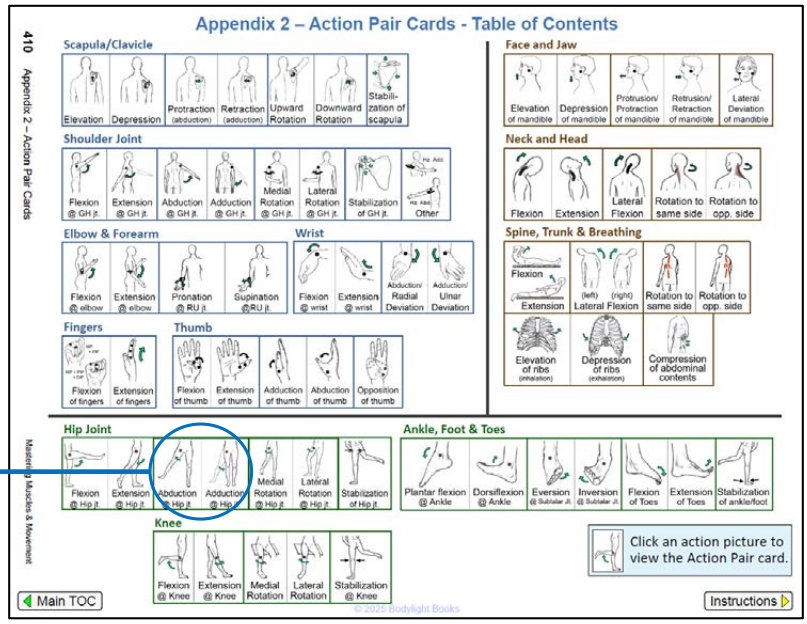
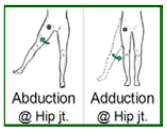
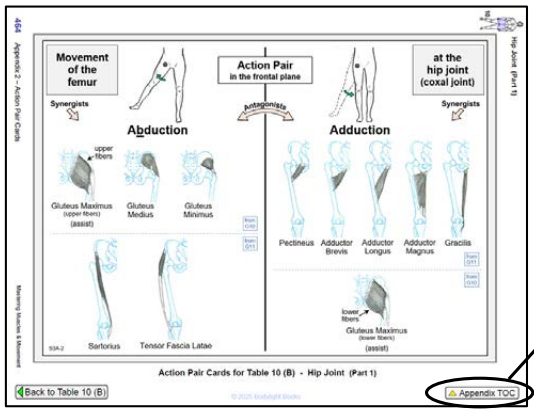
Using Appendix 2 Stand-alone

For stand-alone mode, use the **Appendix 2 Table of Contents** (**TOC**) on page 410. Click on an action picture to jump to the **Action Pair Card** you want to study. The left side of the card shows all muscles that contribute to one action (the **synergists** for that action), and the right side shows the synergists for the opposing action. Conversely, the muscles on one side of the card are the **antagonists** to the action on the other side of the card.







To return to the **TOC** page, click the △ Appendix 2 TOC button at the lower right of any page.

△ Appendix 2 TOC

Note

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Appendix 2 – Other Information

Abbreviations

Joints

GH – Glenohumeral
HU – Humeroulnar
RU – Radioulnar
RC – Radiocarpal
CM – Carpometacarpal
MP or MCP – Metacarpophalangeal
PIP – Proximal Interphalangeal
DIP – Distal Interphalangeal
TF – Tibiofemoral
TC – Talocrural
TM – Tarsometatarsal
MP or MTP – Metatarsophalangeal
TMJ – Temporomandibular Joint

Labels on Cards

All the muscles that create the action on the left side of the card

All the muscles that create the action on the right side of the card

Indicates that the muscles on one side of the card are the **antagonists** to the muscles on the opposite side of the card .

Small boxes indicate which Muscle Groups the muscles come from.

Actions

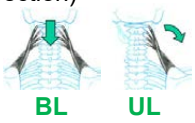
(assist) – The muscle assists the action, but is not a prime mover.

(may assist) – The muscle may assist, depending on strength requirements or relative bone angles.

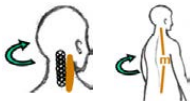
Actions – Axial Skeleton only

(see Chapter 5 introductory section)

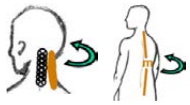
BL – Bilateral contraction of a muscle
UL – Unilateral contraction of a muscle



UL to the same side – Muscle **rotates** the neck or spine to its own side of the body (ipsilateral).



UL to the opposite side – Muscle **rotates** the neck or spine to the other side of the body (contralateral).



Note that **lateral flexion** actions are always to the same side (ipsilateral).

Muscle Qualifiers

(upper fibers), (long head), etc.

A portion of the muscle contributes to the action, but not the whole muscle.

△ Appendix 2 TOC

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Mastering Muscles & Movement

Demonstration Copy

Pages 414-461 are not included.

Appendix 2 only includes **Lower Extremity** action pairs (pages 462-484).

page 462 →

△ Appendix 2 TOC

Note

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back to Table 10 (B)

Appendix 2 TOC

Action Pair Cards

Muscle Group 10 muscles that move the **Hip Joint (Part 1)** (Coxal Joint) **G10**

Group 10: Hip joint (coxal joint) = Head of femur seated in acetabulum of the hip bone (coxal bone), ✓=Muscle creates the action, N=Nerve

Muscles Acting On Hip Joint (Part 1)	 Flexion @ Hip jt.	 Extension @ Hip jt.	 Abduction @ Hip jt.	 Adduction @ Hip jt.	 Medial Rotation @ Hip jt.	 Lateral Rotation @ Hip jt.	 Stabilization of Hip jt.	Other	Innervation	L2	L3	L4	L5	S1	S2
1. Gluteus Maximus		✓	✓ assist (upper fibers)	✓ assist (lower fibers)		✓			Inferior gluteal N. (L5, S1, S2)				N	N	N
2. Gluteus Medius	✓ assist (anterior fibers)	✓ assist (posterior fibers)	✓ (all fibers)		✓ assist (anterior fibers)	✓ assist (post. fibers) when hip is extended	✓ (main hip stabilizer)	This is the primary abductor	Superior gluteal N. (L4, L5, S1)			N	N	N	
3. Gluteus Minimus	✓ may assist		✓		✓		✓		Superior gluteal N. (L4, L5, S1)			N	N	N	
4. Piriformis Deep lateral rotator #1						✓			Sacral Plexus (S1, S2)					N	N
5. The Other 5 Deep Lateral Rotators Gemellus Superior Obturator Internus Gemellus Inferior Obturator Externus Quadratus Femoris						✓			**GS:** SP- L5, S1, 2 **OI:** SP- L5, S1, 2 **GI:** SP- L4,5, S1 **OE:** Obturator,L3,4 **QF:** SP- L4,5, S1 (SP=Sacral Plexus)		N	N N N N N	N N N N	N N
Iliopsoas: 6. Iliacus 7. Psoas Major	✓					✓ may assist		Reverse O/I (femur fixed): increases lumbar lordosis, ant. pelvic tilt	**Iliacus**: Femoral N. (L2, L3) **Psoas Major**: Lumbar plexus (L2-L4)	N	N	N			
(More muscles for the action) ---->	see also Groups 11, 12	see also Groups 11, 12	see also Group 11	see also Group 11	see also Groups 11, 12	see also Groups 11, 12			Innervation						B3

4 cards →

Action Pair Cards for Table 10 (B) - Hip Joint (Part 1)

Note

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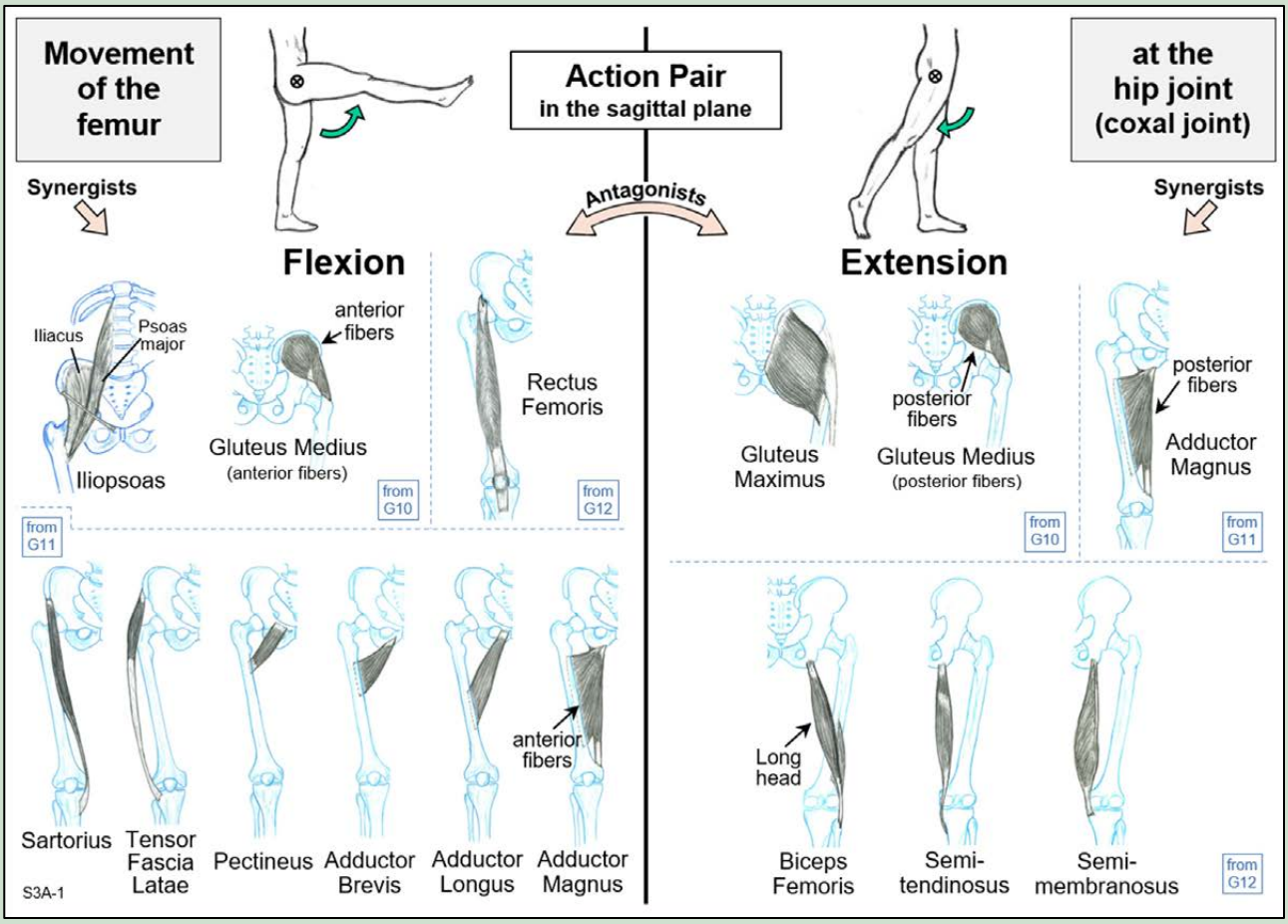
back to Table 10 (B)



Action Pair Cards for Table 10 (B) - Hip Joint (Part 1)

Appendix 2 TOC

Note

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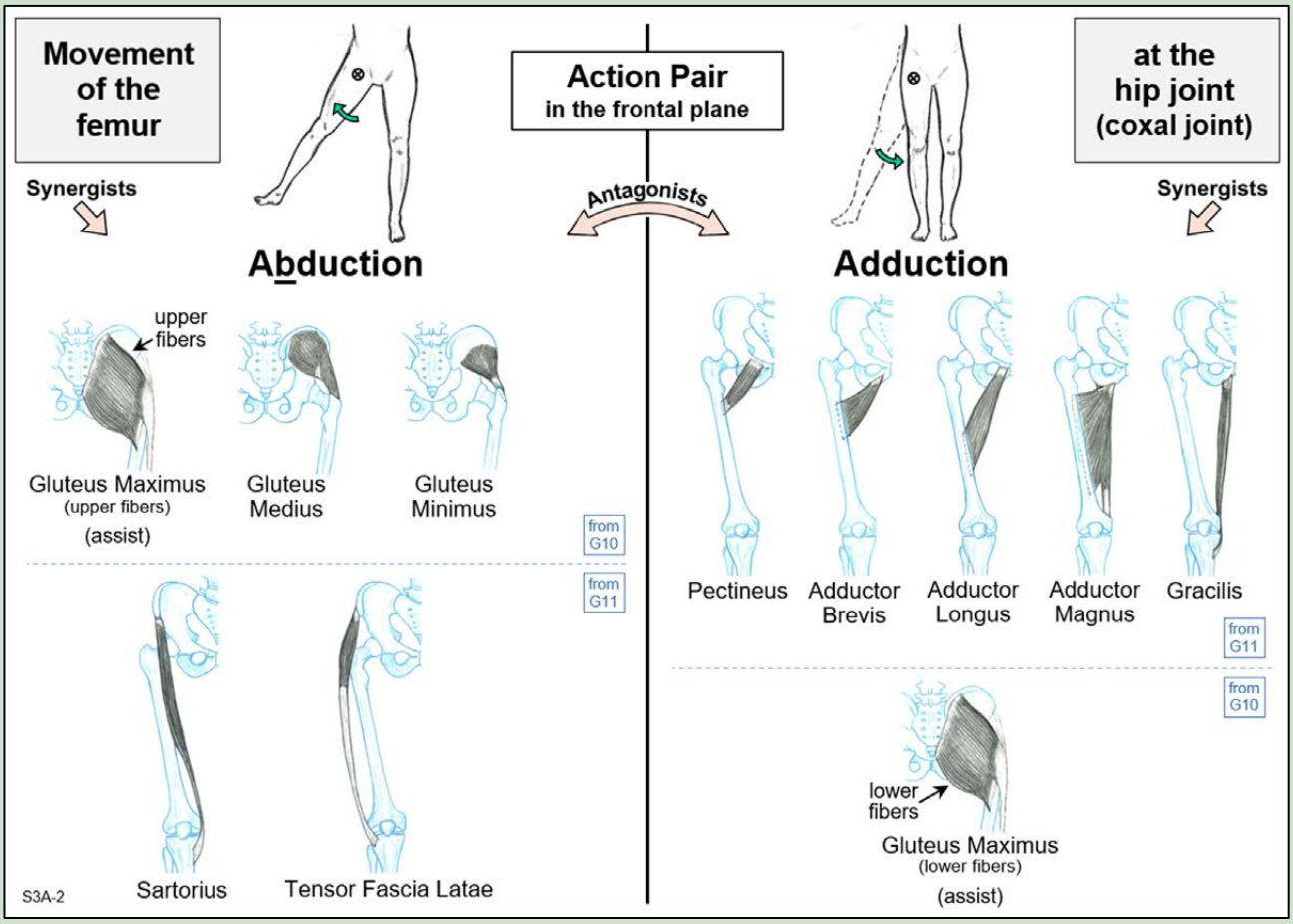

Action Pair Cards for Table 10 (B) - Hip Joint (Part 1)

back to Table 10 (B)
Appendix 2 TOC

Note

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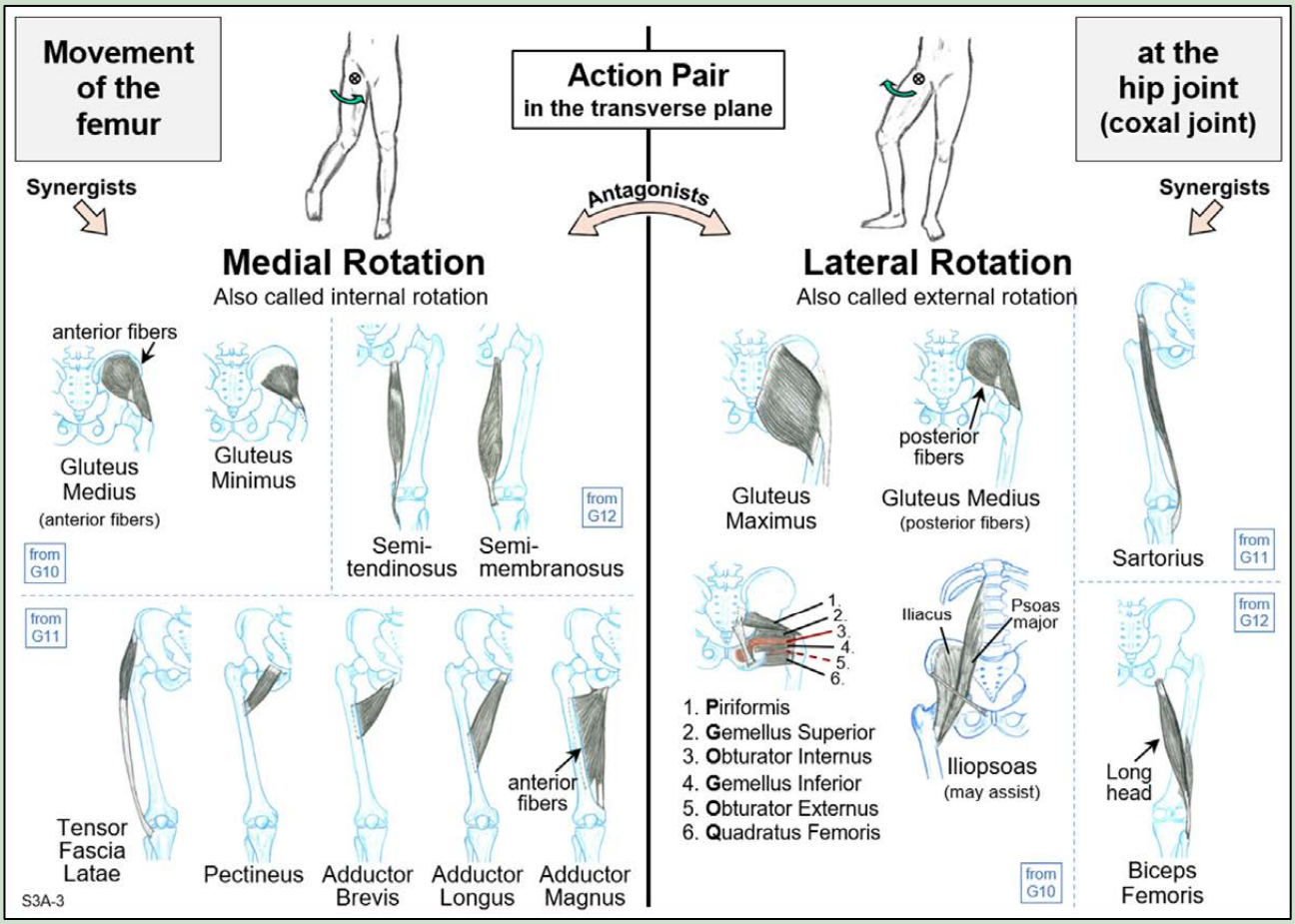
back to Table 10 (B)

Appendix 2 TOC



Action Pair Cards for Table 10 (B) - Hip Joint (Part 1)

Note

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back to Table 10 (B)

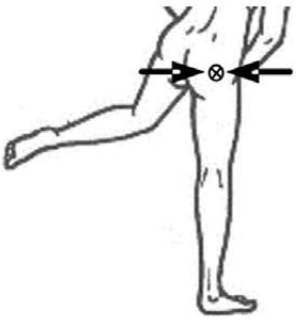
Appendix 2 TOC

Movement of the femur

Stabilization
at the hip joint

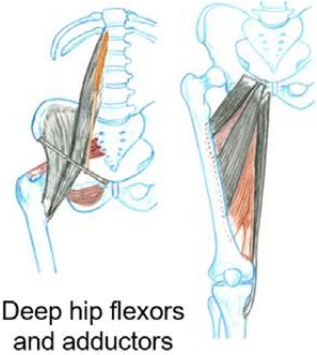
at the hip joint (coxal joint)

Short muscles and ligaments around the hip joint work together to stabilize the head of the femur in the acetabulum (keep the ball in the socket). And, to keep the hip from collapsing medially or laterally when weight bearing.

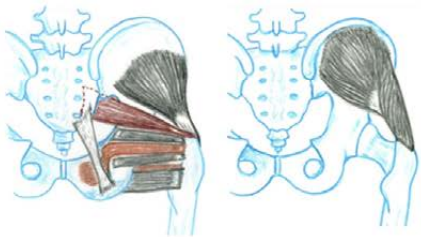


Ligaments

Note spiral arrangement goes slack with flexion and taut with extension.



Deep hip flexors and adductors



Deep lateral rotators and abductors

S3A-4

Action Pair Cards for Table 10 (B) - Hip Joint (Part 1)

Note

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back to Table 11 (B)

Appendix 2 TOC

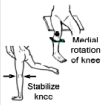
Action Pair Cards

Muscle Group 11 muscles that move the **Hip Joint (Part 2)** (Coxal Joint)

G11

Group 11:

Knee=Tibiofemoral joint (TF jt.), ✓=Muscle creates the action, N=Nerve

Muscles Acting On Hip Joint (Part 2)	 Flexion @ Hip jt.	 Extension @ Hip jt.	 Abduction @ Hip jt.	 Adduction @ Hip jt.	 Medial Rotation @ Hip jt.	 Lateral Rotation @ Hip jt.	 Flexion @ Knee	 Other	Innervation	L2	L3	L4	L5	S1	S2	S3
1. Sartorius	✓		✓			✓	✓	Medial rotation of tibia at flexed knee	Femoral N. (L2, L3)	N	N					
2. Tensor Fascia Latae	✓		✓		✓			Stabilizes the extended knee	Superiror Gluteal N. (L4, L5, S1)			N	N	N		
3. Pectineus	✓			✓	✓				Femoral N. (L2, L3) (& sometimes Obturator N.)	N	N					
4. Adductor Brevis	✓			✓	✓			(deep to adductor longus)	Obturator N. (L2, L3, L4)	N	N	N				
5. Adductor Longus	✓			✓	✓				Obturator N. (L2, L3, L4)	N	N	N				
6. Adductor Magnus	✓ Anterior fibers (which insert proximally)	✓ Posterior fibers (which insert distally)		✓ All fibers	✓ Anterior fibers			Can be an antagonist to itself (posterior vs. anterior fibers)	Anterior part: Obturator N. (L2,L3,L4) Posterior part: Sciatic N. (L4,L5, S1)	N	N	N	N	N		
7. Gracilis	✓ may assist			✓	✓ may assist		✓	Medial rotation of tibia at flexed knee	Obturator N. (L2, L3)	N	N					
(More muscles for the action) ⟶	see also Groups 10,12	see also Groups 10,12	see also Group 10	see also Group 10	see also Groups 10,12	see also Groups 10,12	see also Groups 12,13		Innervation							

5 cards

Action Pair Cards for Table 11 (B) - Hip Joint (Part 2)

Note

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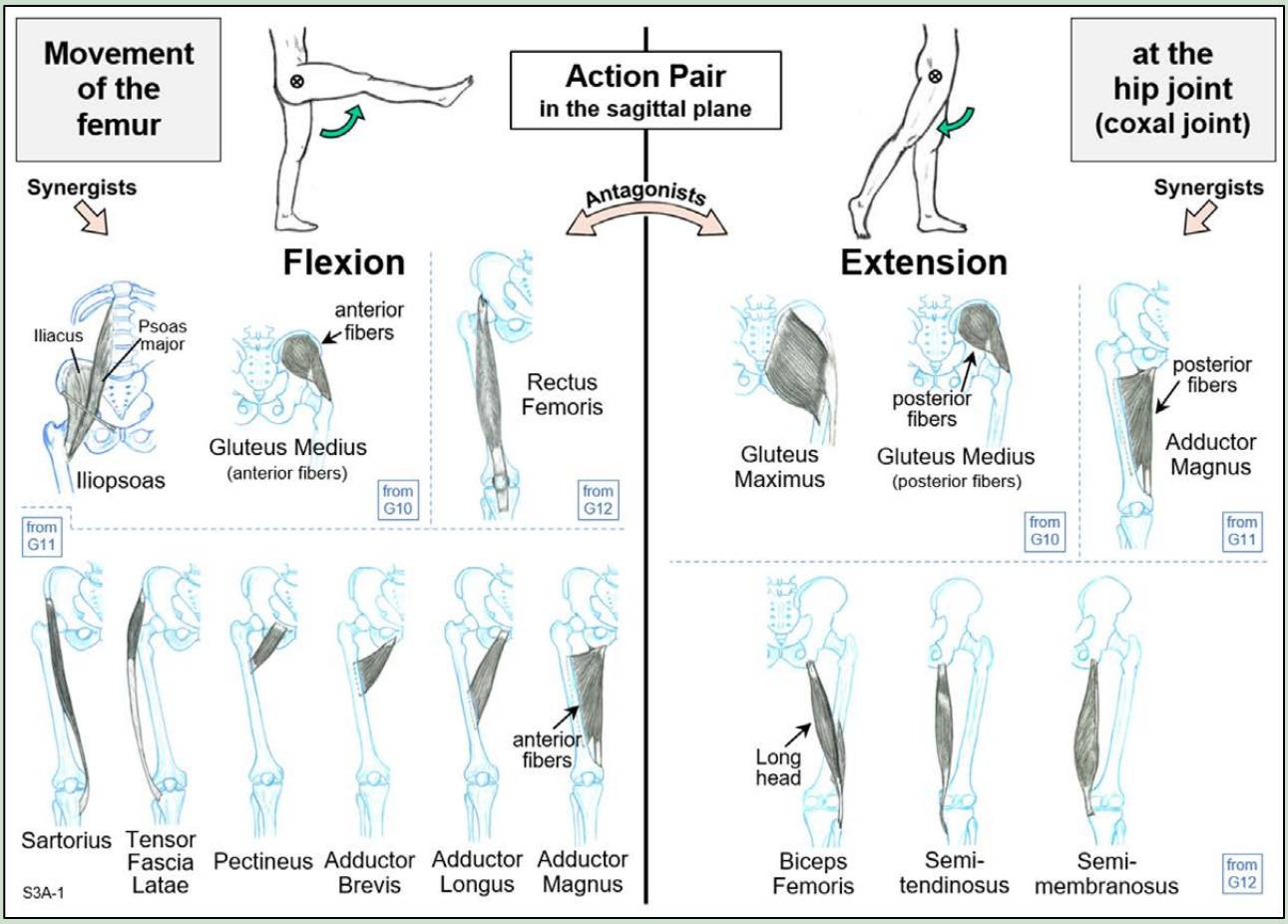
back to Table 11 (B)

Appendix 2 TOC



Action Pair Cards for Table 11 (B) - Hip Joint (Part 2)

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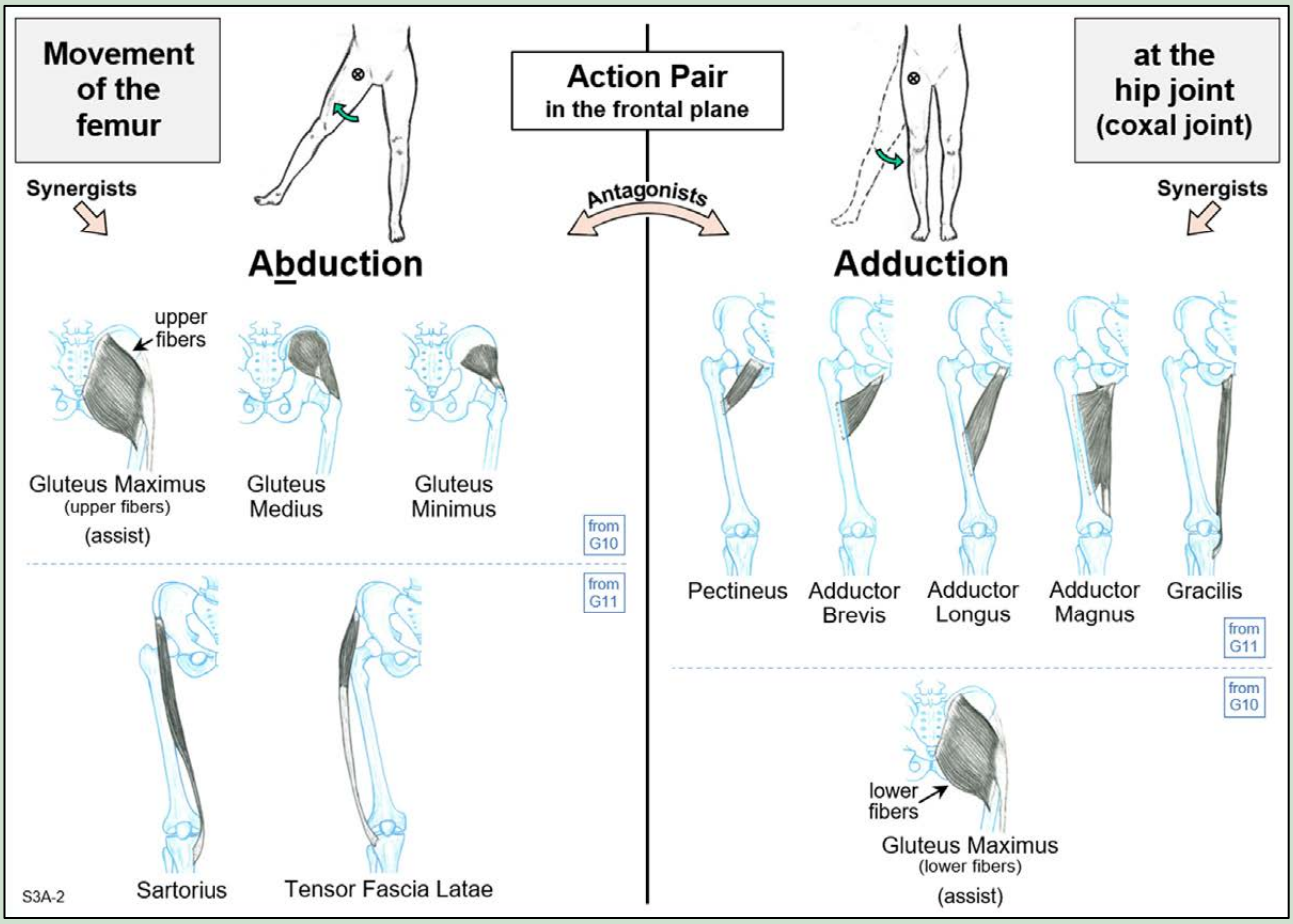
back to Table 11 (B)
Appendix 2 TOC



Action Pair Cards for Table 11 (B) - Hip Joint (Part 2)

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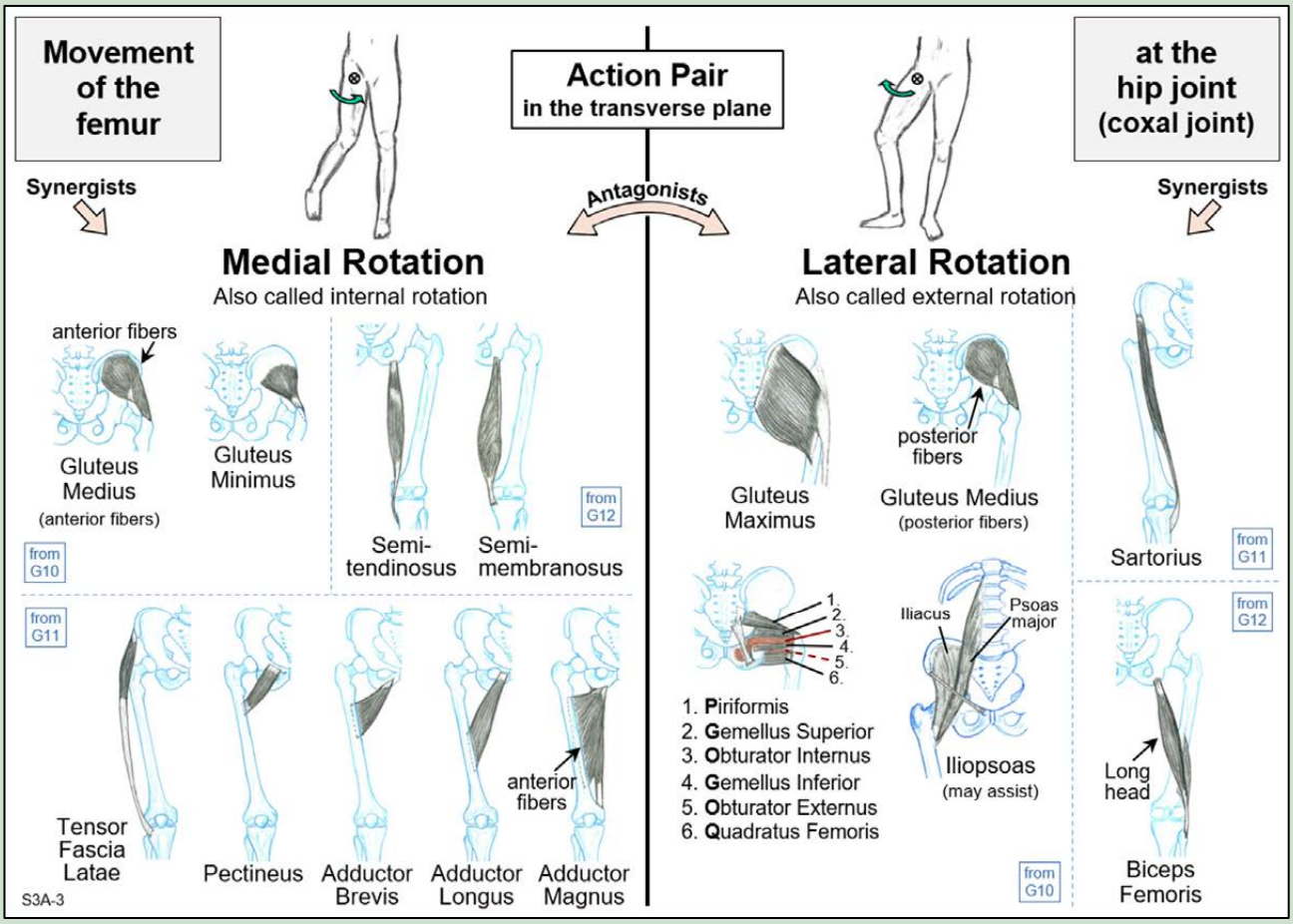

Action Pair Cards for Table 11 (B) - Hip Joint (Part 2)

back to Table 11 (B)
Appendix 2 TOC

Note

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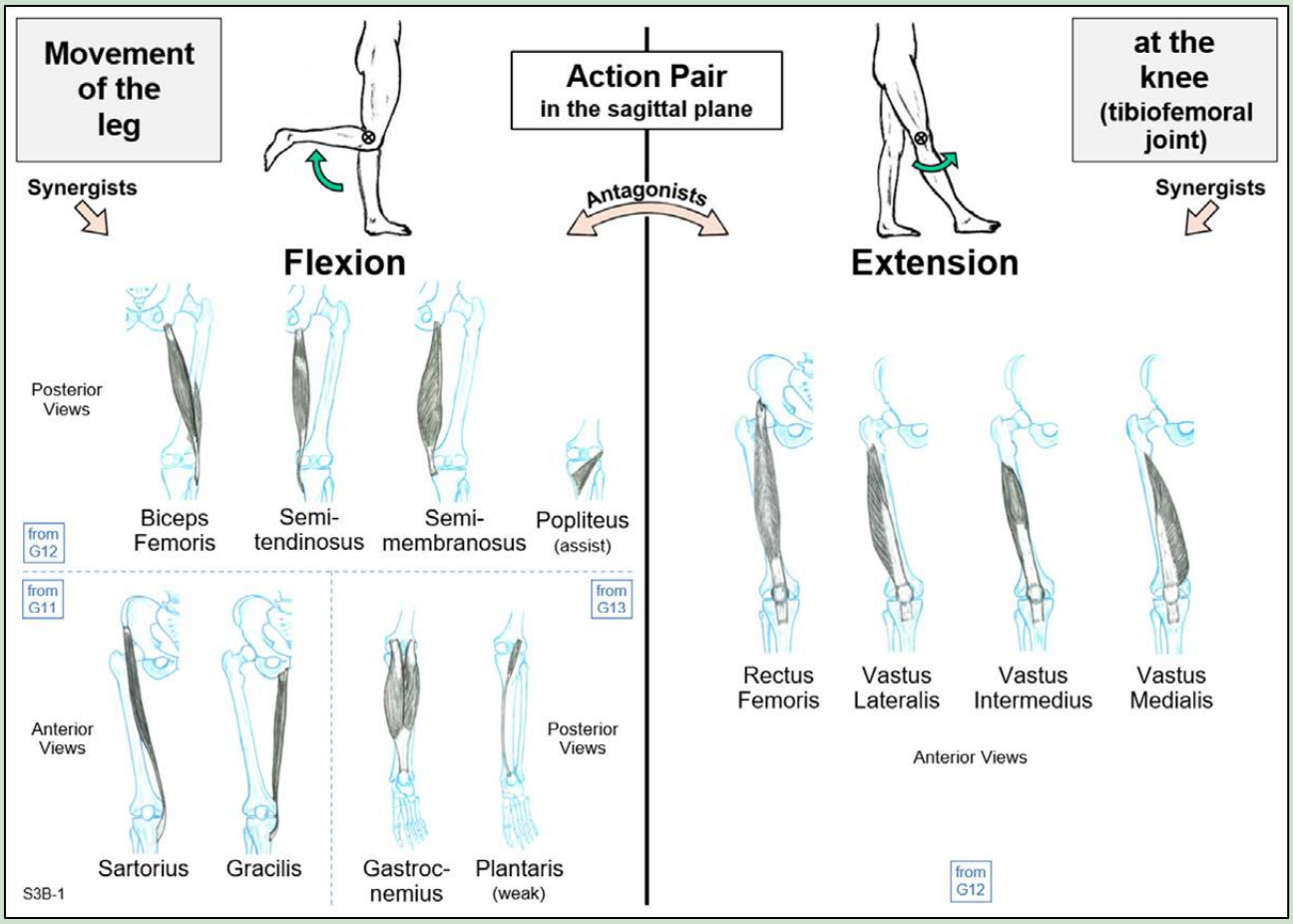

back to Table 11 (B)
Appendix 2 TOC

Action Pair Cards for Table 11 (B) - Hip Joint (Part 2)

Note

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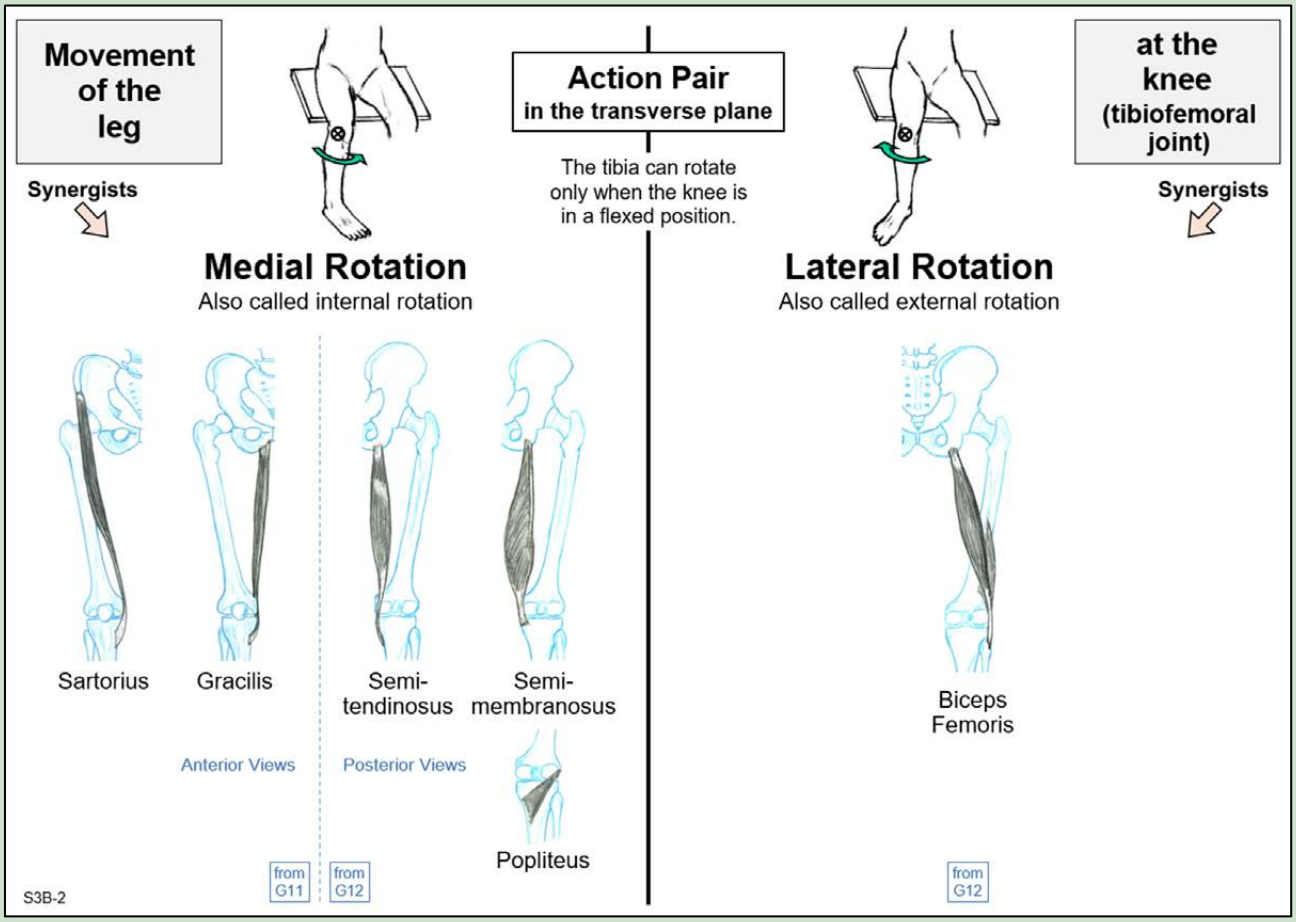
back to Table 11 (B)
Appendix 2 TOC



Action Pair Cards for Table 11 (B) - Hip Joint (Part 2)

Note

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Appendix 2 TOC

Action Pair Cards

Muscle Group 12 muscles that move the **Knee (& Hip Joint, Part 3)** **G12**

Group 12: Knee=Tibiofemoral joint (TF jt.), ✓=Muscle creates the action, N=Nerve

Muscles Acting On **Knee** (& Hip Joint, Part 3)	Flexion @ Knee	Extension @ Knee	Medial rotate / Lateral rotate Rotation @ Knee	Flexion @ Hip jt.	Extension @ Hip jt.	Medial Rotation @ Hip jt.	Lateral Rotation @ Hip jt.	Other	Innervation	L2	L3	L4	L5	S1	S2	S3
1. **Rectus Femoris** (Quadricep)		✓		✓				Tight Rectus Femoris can cause anterior pelvic tilt.	Femoral N. (L2, L3, L4)	N	N	N				
2. **Vastus Lateralis** (Quadricep)		✓						Makes up all of the lateral thigh. It is deep to the iliotibial tract.	Femoral N. (L2, L3, L4)	N	N	N				
3. **Vastus Intermedius** (Quadricep)		✓						It is deep to the other 3 quads.	Femoral N. (L2, L3, L4)	N	N	N				
4. **Vastus Medialis** (Quadricep)		✓						Distal part (VMO) pulls patella medially so it tracks properly.	Femoral N. (L2, L3, L4)	N	N	N				
5. **Biceps Femoris** (Hamstring)	✓		✓ *(lateral rotation)*		✓ (long head)		✓ (long head)	This is the lateral hamstring. It has two heads (long & short).	Long head: Tibial part of sciatic N. (S1, S2, S3) Short hd: Peroneal part of sciatic N. (L5, S1, S2)				N	N	N	N
6. **Semitendinosus** (Hamstring)	✓		✓ *(medial rotation)*		✓	✓		Tight hamstrings can cause posterior pelvic tilt.	Tibial part of the sciatic nerve (L5, S1, S2)				N	N	N	
7. **Semimembranosus** (Hamstring)	✓		✓ *(medial rotation)*		✓	✓		Semimemb. is broad, flat, bipennate, deep to Semitend.	Tibial part of the sciatic nerve (L5, S1, S2)				N	N	N	
8. **Popliteus**	✓ may assist		✓ *(medial rotation)*					When weight bearing: Lateral rotation of femur, to unlock knee.	Tibial N. (L4, L5, S1)			N	N	N		
(More muscles for the action) ---->	see also Groups 11,13			see also Groups 10,11	see also Groups 10,11	see also Groups 10,11	see also Groups 10,11		**Innervation** B3							

5 cards →

Action Pair Cards for Table 12 (B) - Knee (and Hip Joint, Part 3)

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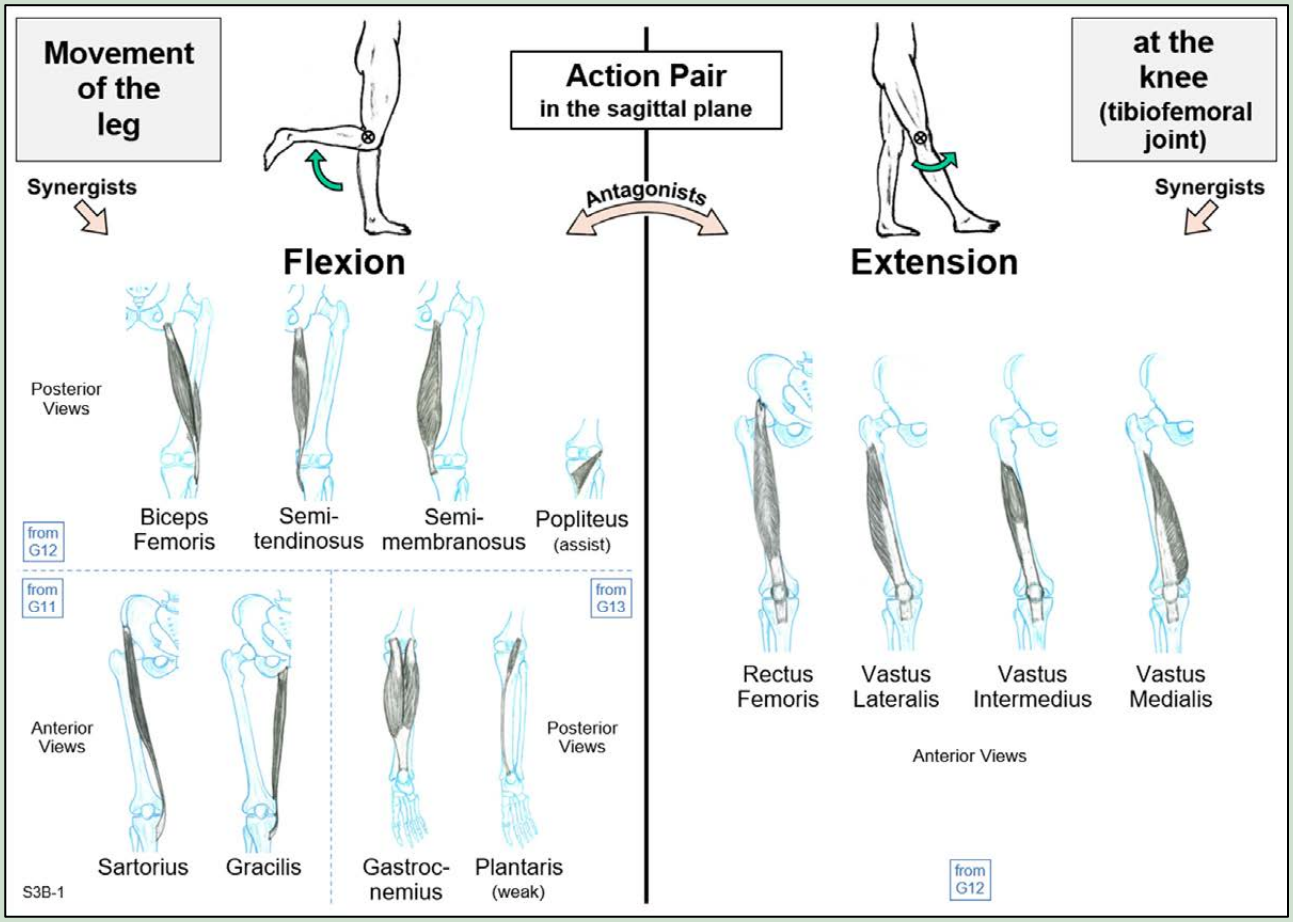

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Appendix 2 TOC

Action Pair Cards for Table 12 (B) - Knee (and Hip Joint, Part 3)

Note

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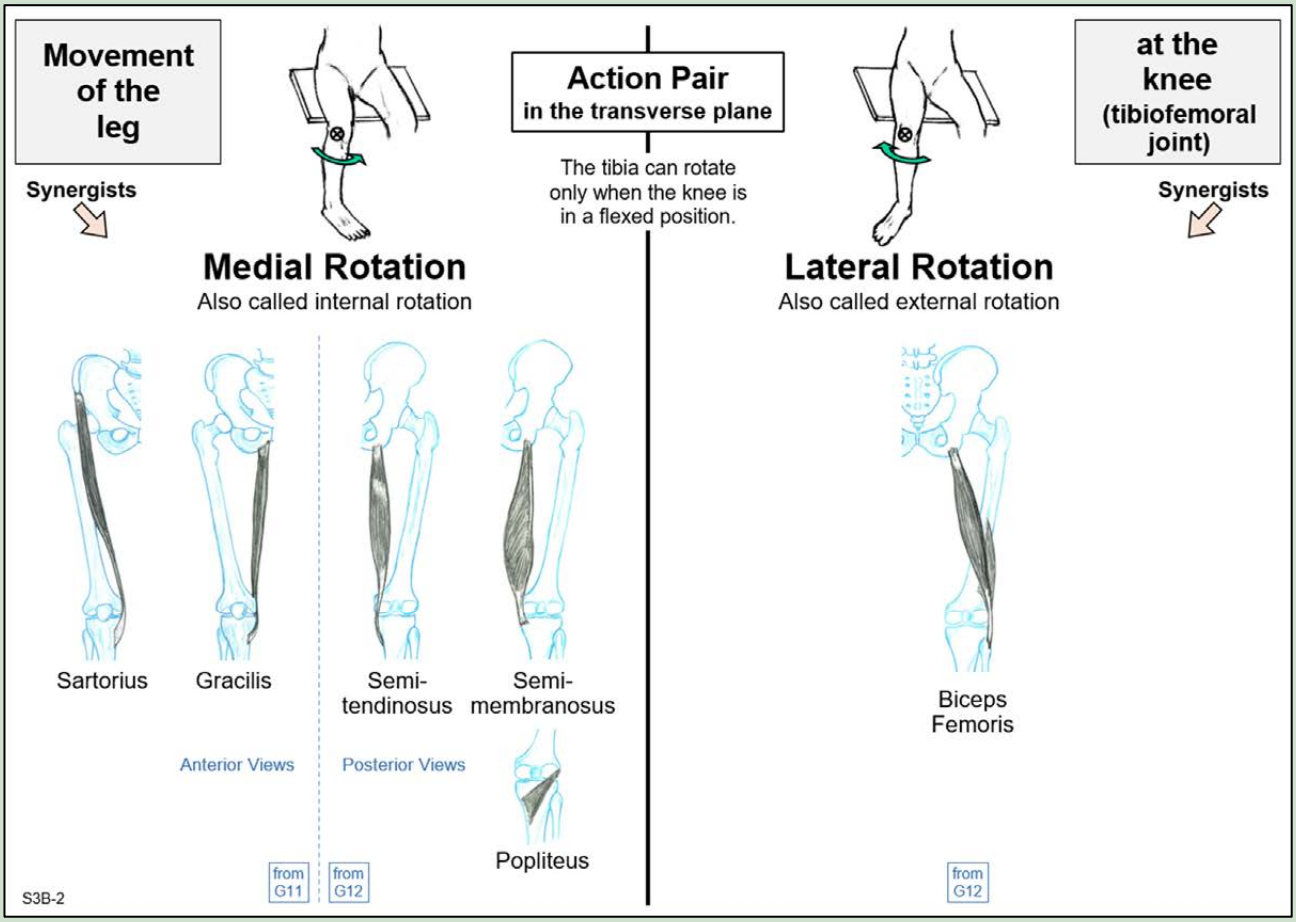

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Action Pair Cards for Table 12 (B) - Knee (and Hip Joint, Part 3)

Note

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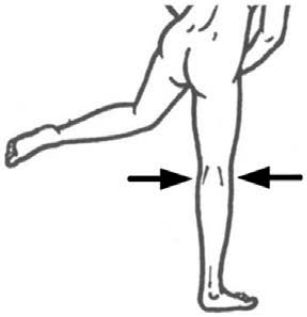
Appendix 2 TOC

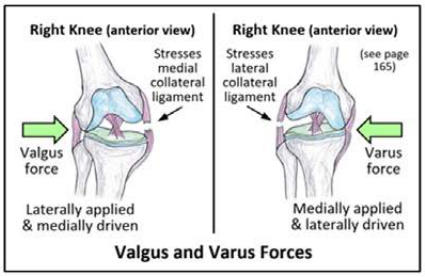
Movement of the leg

Stabilization at the knee

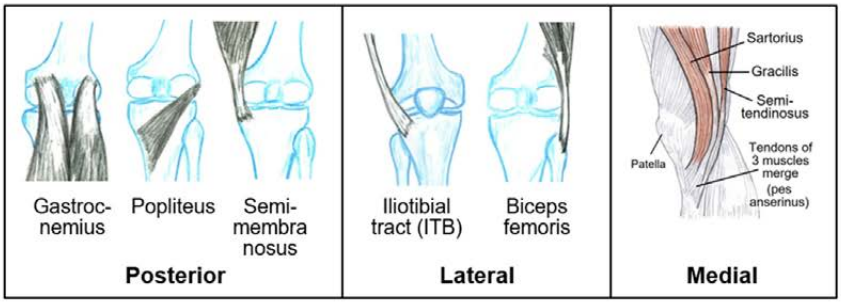
at the knee (tibiofemoral joint)

Muscles and ligaments around the knee work together to stabilize the femur on the tibial plateau. These keep the knee from collapsing medially or laterally (valgus force and varus force), and from twisting or hyperextending too much.

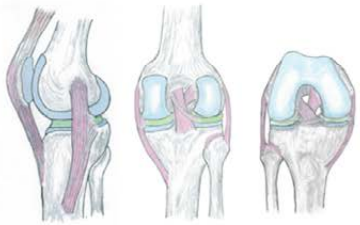




Valgus and Varus Forces



Dynamic Stabilization



Ligaments
(see page 165)

S3B-3

Action Pair Cards for Table 12 (B) - Knee (and Hip Joint, Part 3)

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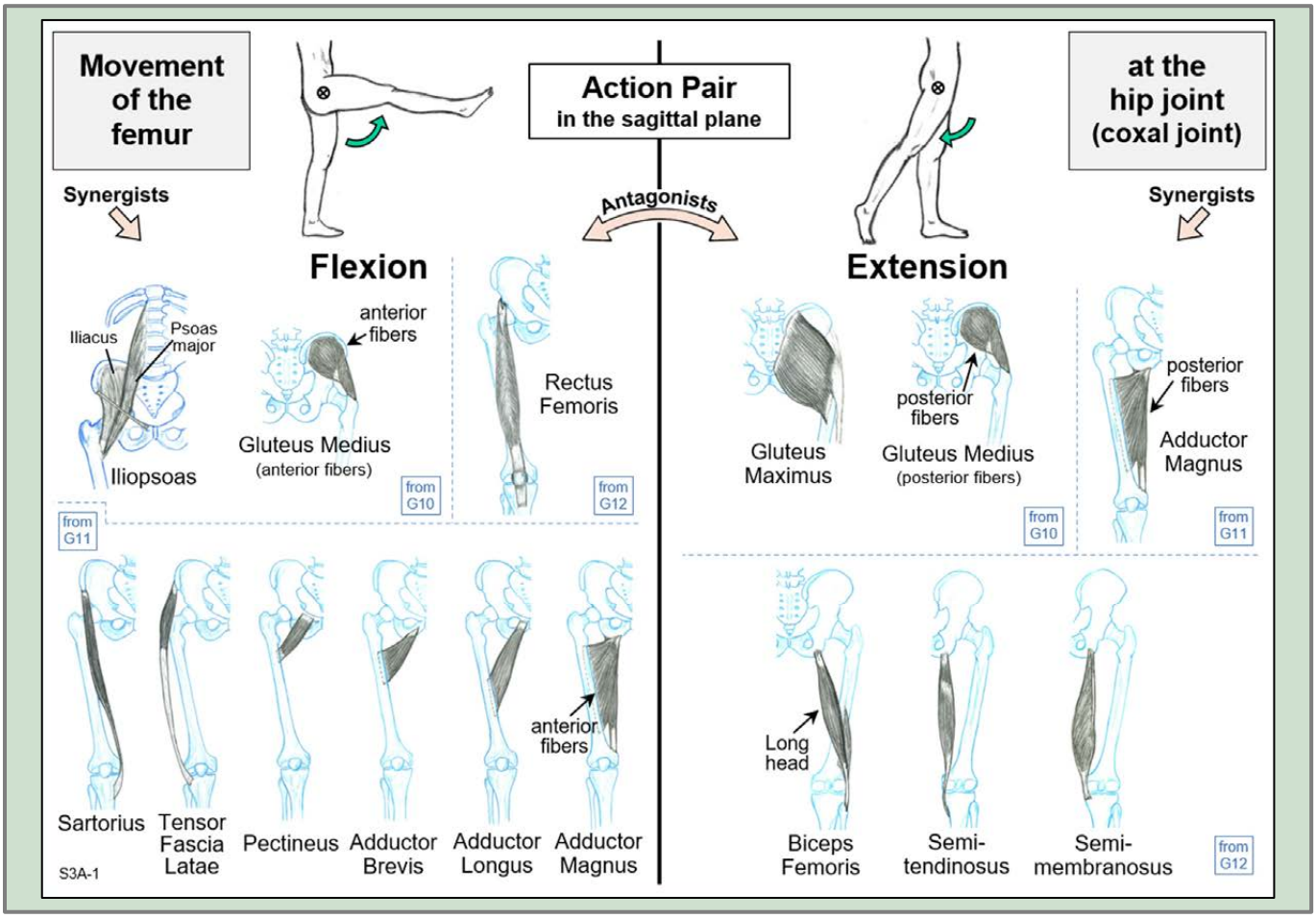
back to Table 12 (B)



Action Pair Cards for Table 12 (B) - Knee (and Hip Joint, Part 3)

Appendix 2 TOC

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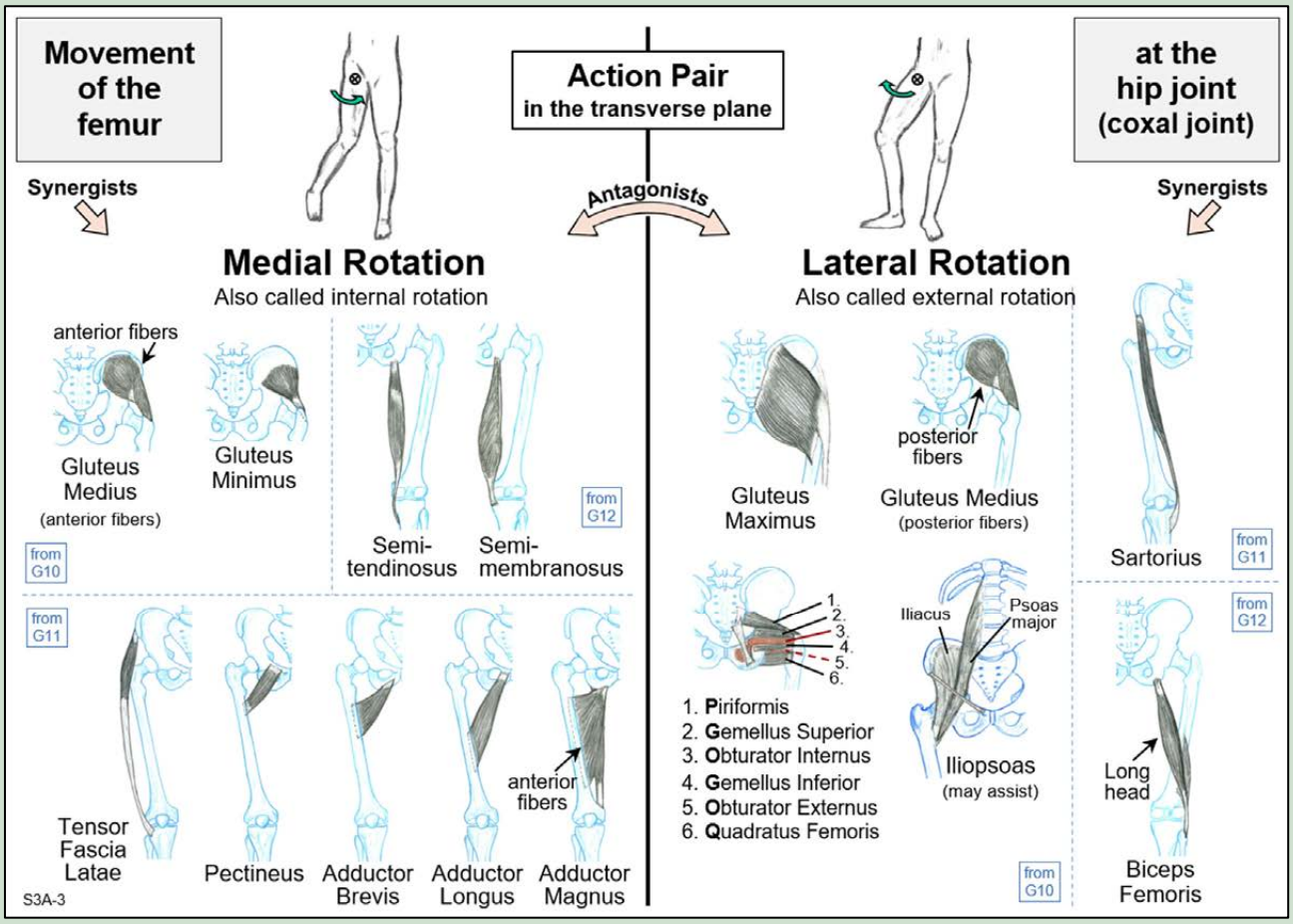

Action Pair Cards for Table 12 (B) - Knee (and Hip Joint, Part 3)

back to Table 12 (B)

Appendix 2 TOC

Note

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Action Pair Cards

Muscle Group 13 muscles that move the **Ankle, Foot, Toes** **G13**

Group 13: #1-#5 toes (1=big toe, 5=little toe), Ankle=Talocrural joint (TC jt.), Knee=Tibiofemoral joint (TF jt.). ✓ =Muscle creates the action, N=Nerve

Muscles Acting On Ankle, Foot, Toes	 Plantar flexion (=flexion) @ Ankle	 Dorsiflexion (=extension) @ Ankle	 Inversion (@ Subtalar joint)	 Eversion (@ Subtalar joint)	 Flexion of Toes	 Extension of Toes	 Flexion @ Knee	 Stabilization	Innervation	L4	L5	S1	S2
1. Gastrocnemius	✓						✓	Stabilizes knee	Tibial N. (S1, S2)			N	N
2. Plantaris	✓ may assist		✓ may assist				✓ may assist		Tibial N. (L4, L5, S1)	N	N	N	
3. Soleus	✓								Tibial N. (S1, S2)			N	N
4. Tibialis Posterior	✓		✓					Stabilizer of ankle/foot	Tibial N. (L5, S1)		N	N	
5. Flexor Digitorum Longus	✓		✓		✓ #2-5				Tibial N. (L5, S1)		N	N	
6. Flexor Hallucis Longus	✓		✓		✓ #1 (hallux)				Tibial N. (L5, S1, S2)		N	N	N
7. Fibularis Brevis (Peroneus Brevis)	✓ assist			✓				Helps stabilize foot	Superficial fibular N. * (L4, L5, S1)	N	N	N	
8. Fibularis Longus (Peroneus Longus)	✓ assist			✓				PL and TA form "Anatomical stirrup"…	Superficial fibular N. (L4, L5, S1)	N	N	N	
9. Tibialis Anterior		✓	✓					…helping to maintain balance & stabilize foot	Deep fibular N. (L4, L5, S1)	N	N	N	
10. Extensor Digitorum Longus		✓		✓		✓ #2-5			Deep fibular N. (L4, L5, S1)	N	N	N	
11. Extensor Hallucis Longus		✓	✓ may assist			✓ #1 (hallux)			Deep fibular N. (L4, L5, S1)	N	N	N	
(More muscles for the action) ——>							see also Groups 11,12		Innervation B4				

* fibular N. = peroneal N.

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Appendix 2 TOC

5 cards

Action Pair Cards for Table 13 (B) - Ankle, Foot, Toes

Note

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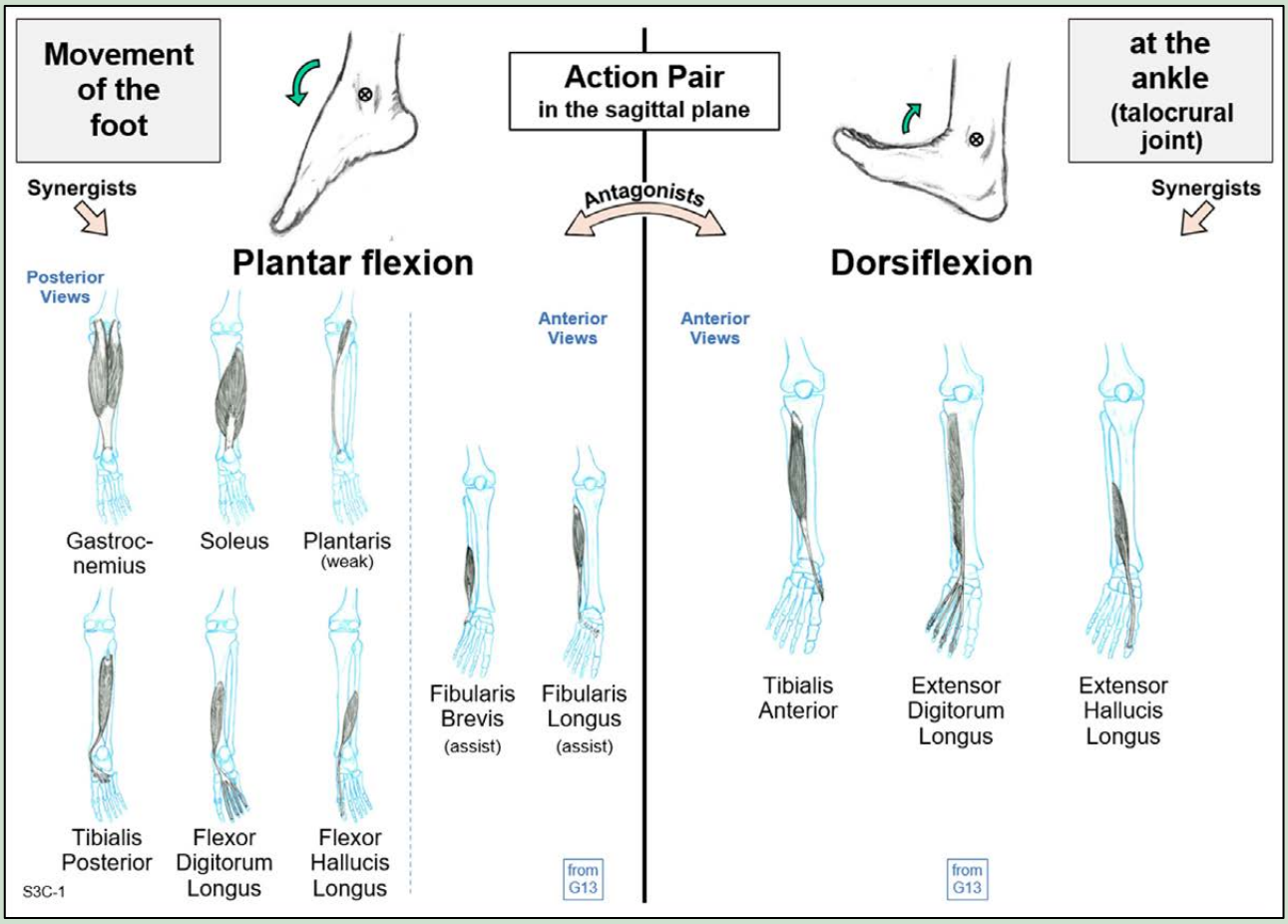

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Appendix 2 TOC

Action Pair Cards for Table 13 (B) - Ankle, Foot, Toes

Note

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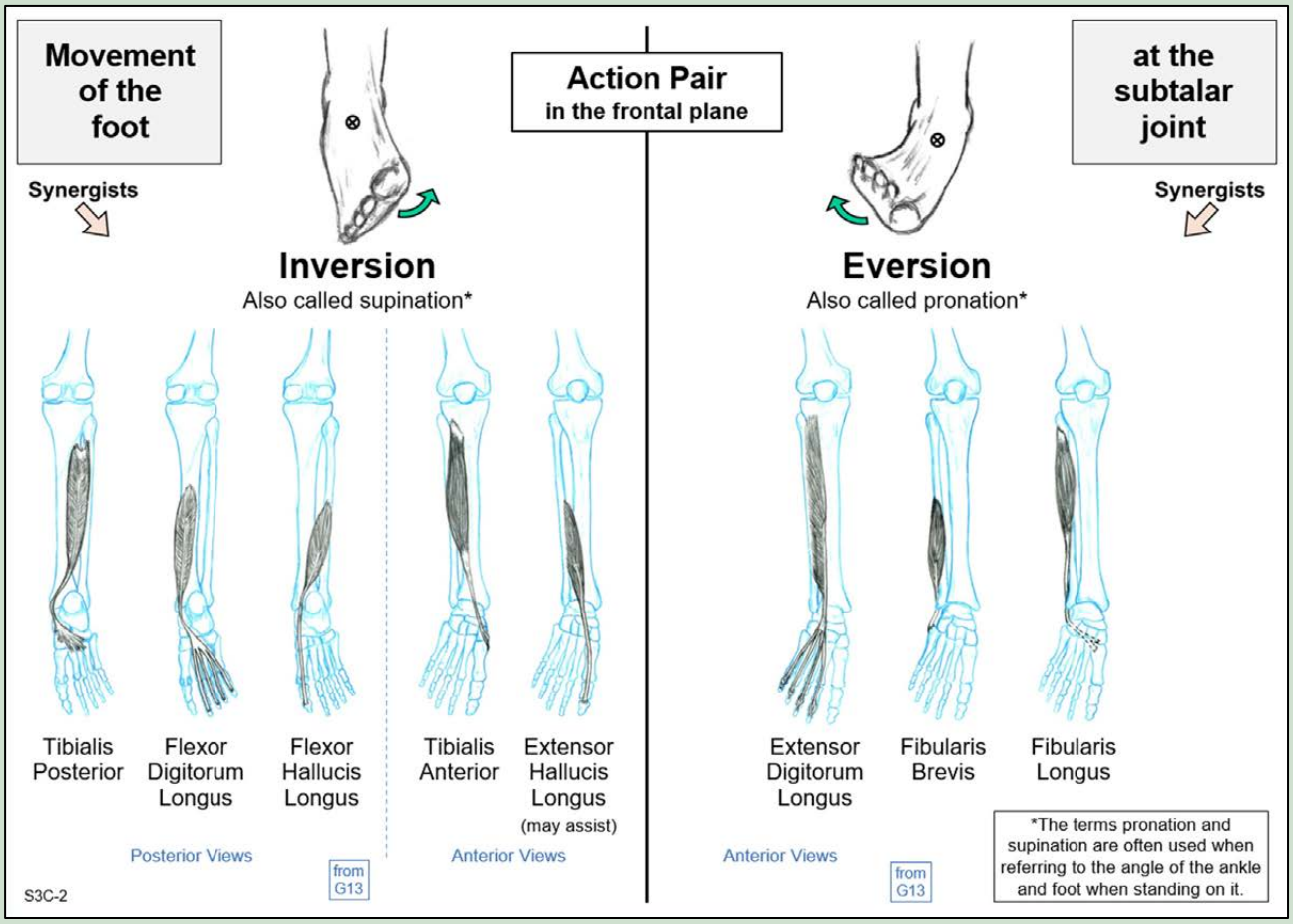

Action Pair Cards for Table 13 (B) - Ankle, Foot, Toes

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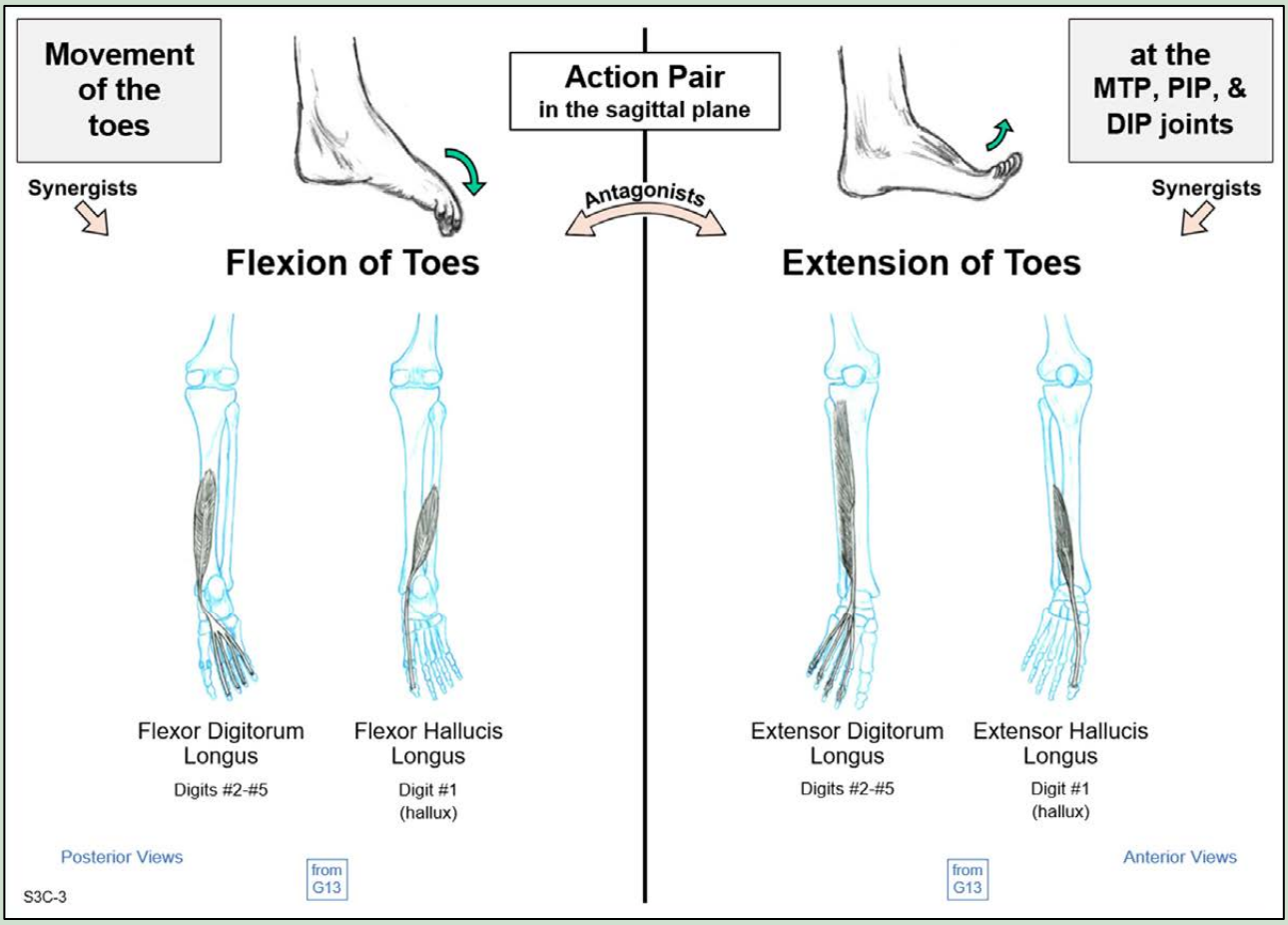

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Action Pair Cards for Table 13 (B) - Ankle, Foot, Toes

Note

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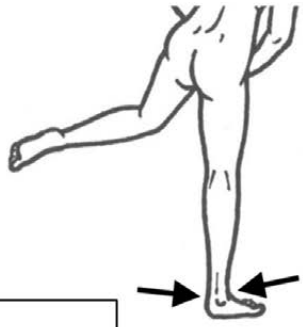
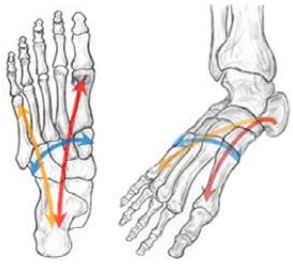
Appendix 2 TOC

Movement of the foot

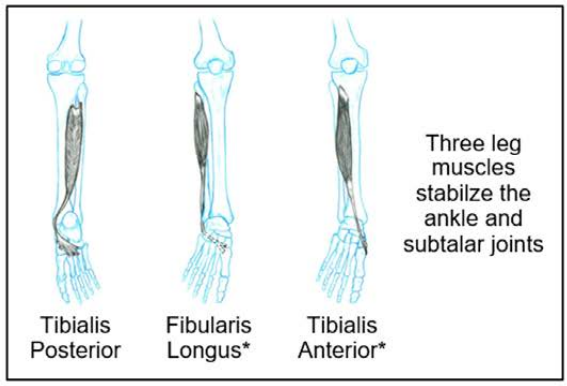
Stabilization
of the ankle/foot

Muscles and ligaments work together to stabilize the ankle and foot while weight bearing. These keep the ankle from deviating medially or laterally too far, and maintain the arch of the foot.



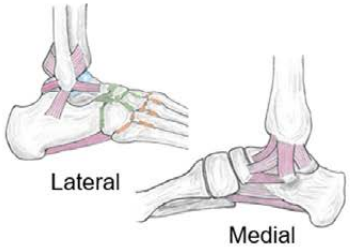


Tripod arches of the foot



Three leg muscles stabilze the ankle and subtalar joints

Dynamic Stabilization



Ligaments
(see page 166)

*Fibularis longus and tibialis anterior meet under the foot to form the "anatomical stirrup".

S3C-4

Action Pair Cards for Table 13 (B) - Ankle, Foot, Toes

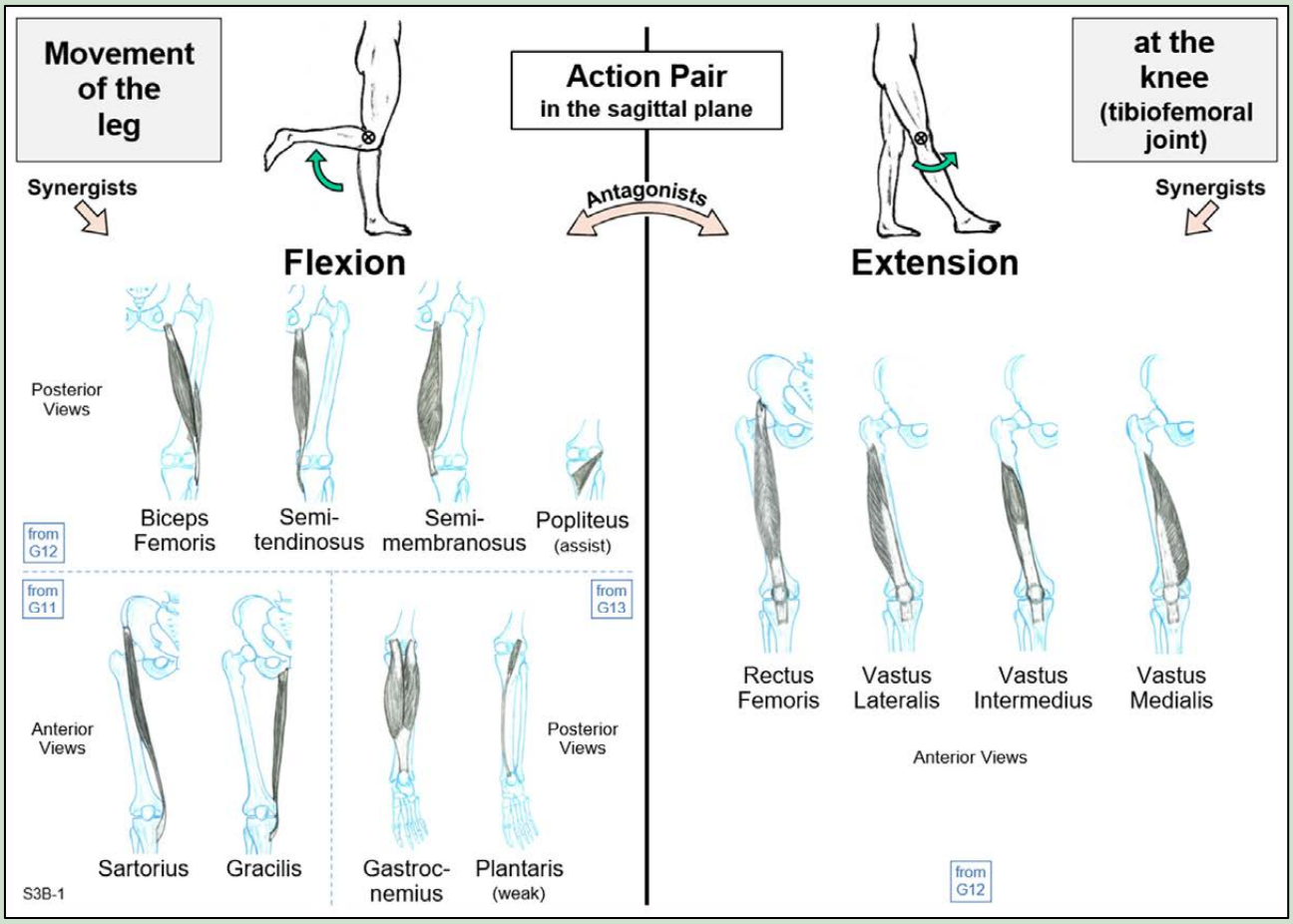
Note

This was originally a landscape-oriented page.
It has been converted to portrait for the e-book.

It is intended to be viewed with the e-reader set to "Fit to width".

back to Table 13 (B)

Appendix 2 TOC



Action Pair Cards for Table 13 (B) - Ankle, Foot, Toes

Note

This was originally a landscape-oriented page.
It has been converted to portrait for the e-book.

It is intended to be viewed with the e-reader set to “Fit to width”.

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Muscles – List by Group

Muscles are placed in groups based on the bones and joints they *move* as they contract.

----- Upper Extremity -----
(Chapter 4)

Group 1 – Scapula / Clavicle
p. 75-82
Trapezius
Levator scapula
Rhomboid major & minor
Serratus anterior
Pectoralis minor
Subclavius

Group 2 – Shoulder Joint
p. 83-90
Deltoid
Supraspinatus
Infraspinatus
Teres minor
Subscapularis
Pectoralis major
Coracobrachialis
Latissimus dorsi
Teres major

Group 3 – Elbow, Forearm
p. 91-98
Biceps brachii
Brachialis
Brachioradialis
Pronator teres
Pronator quadratus
Triceps brachii
Anconeus
Supinator

Group 4 – Wrist, Ha… …r
99-106
Flexor carpi radialis
Palmaris longus
Flexor carpi ulnaris
Flexor digitorum superf…
Flexor digitorum prof…
Extensor carpi radia… …gus
Extensor carpi rad… …revis
Extensor carpi u…
Extensor digit…
Extensor inc…

Group 5 – Thumb
p. 107-113
Flexor pollicis longus
Flexor pollicis brevis
Opponens pollicis
Adductor pollicis
Abductor pollicis brevis
Abductor pollicis longus
Extensor pollicis longus
Extensor pollicis brevis

Bonus Group
p. 114-115
Intrinsic muscles of the hand

----- Axial Body -----
(Chapter 5)

Group 6 – Face, Jaw
p. 127-134
Masseter
Temporalis
Lateral pterygoid
Medial pterygoid
Occipitofrontalis
Platysma
Suprahyoids Group
  Geniohyoid, Mylohyoid, Stylohyoid, Digastric
Infrahyoids Group
  Sternohyoid, Sternothyroid, Omohyoid, Thyrohyoi…
Muscles of facial expr…

Group 7 – Neck …d
p. 135-142
Sternocleidomas…
Scalenes grou…
Long… capi… …ongus colli
S… …cipi… …ap
…as posterior major
…cr… …s posterior minor
…Jr… …apitis superior
… …capitis inferior
S… …s capitis
… …ius cervicis
… …nispinalis capitis
…evator scapula*
Trapezius, upper fibers*
  *(revisited for reversed O/I actions)

Group 8 – Spine
p. 143-150
Spinalis
Longissimus
Iliocostalis
Semispinalis
Multifidus
Rotatores
Quadratus lumborum
Interspinales & Intertransversarii

Group 9 – Thorax, Abdomen, Breathing
p. 151-157
Rectus abdominis
External oblique
Internal oblique
Transverse abdominis
Diaphragm
External intercostals
Internal intercostals
Serratus posterior superior
Serratus posterior inferior
Levator costae
Transversus Thoracis

Bonus Group
p. 158-159
Muscles of the pelvic floor and perineum

----- Lower Extremity -----
(Chapter 6)

Group 10 – Hip Joint (Part 1)
p. 167-174
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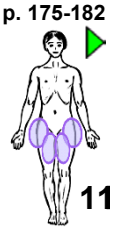
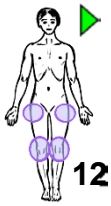
Gluteus medius
Gluteus minimus
Piriformis (1st lateral rotator)
The other 5 lateral rotators
  Gemellus superior
  Obturator internus
  Gemellus inferior
  Obturator externus
  Quadratus femoris
Iliopsoas
  (Iliacus & Psoas major)

Group 11 – Hip Joint (Part 2)
p. 175-182
Sartorius
Tensor fascia latae
Pectineus
Adductor brevis
Adductor longus
Adductor magnus
Gracilis

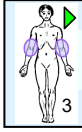


Group 12 – Knee (& Hip Joint, Part 3)
p. 183-190
Rectus femoris
Vastus lateralis
Vastus intermedius
Vastus medialis
Biceps femoris
Semitendinosus
Semimembranosus
Popliteus



Group 13 – Ankle, Foot, Toes
p. 191-197
Gastrocnemius
Plantaris
Soleus
Tibialis posterior
Flexor digitorum longus
Flexor hallucis longus
Fibularis longus (peroneus)
Fibularis brevis (peroneus)
Tibialis anterior
Extensor digitorum longus
Extensor hallucis longus

Bonus Group
p. 198-199
Intrinsic muscles of the foot



Click an icon to go to that Muscle Group

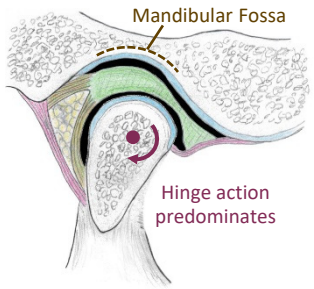
Muscles – Alphabetical Index

Don't just memorize muscles…

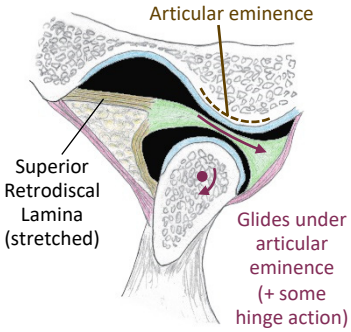
The innovative design of this book provides a ***brain-friendly*** environment for learning the muscles, bones, joints, and movements of the human body.

- Promotes learning from many directions – visual, verbal, relational
- Clearly models how to study, compare, and contrast the information
- Accelerates the learning process and enhances long-term functional memory
- Facilitates easy, repetitive self-testing while studying

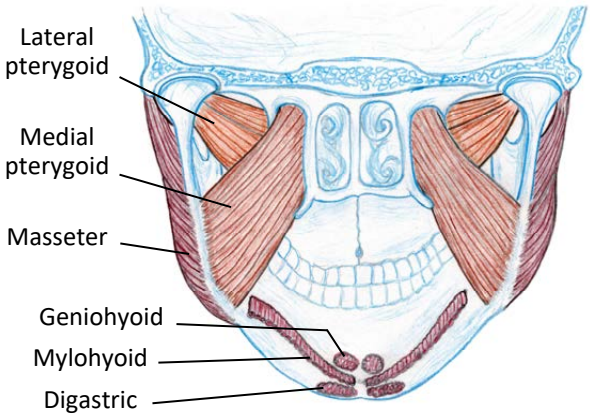
… master them!

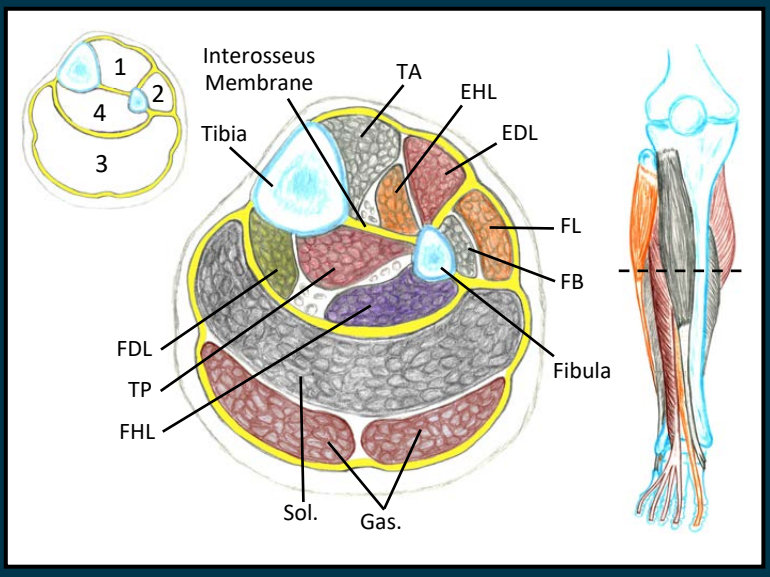


Early phase of opening



Later phase of opening





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