

SECOND EDITION

Christy J. Cael

MS, LMT, CSCS

Functional Anatomy

*Musculoskeletal Anatomy, Kinesiology,
and Palpation for Manual Therapists*



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World Headquarters

Jones & Bartlett Learning
25 Wall Street
Burlington, MA 01803
978-443-5000
info@jblearning.com
www.jblearning.com

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For my students past, present, and future.

Thank you for taking this journey of discovery.

You have challenged me, guided me, and willingly taken
a leap of faith with good humor, practical skepticism,
and boundless curiosity.

You inspire me, and I am forever grateful.



Brief Contents

Preface	x
Acknowledgments	xv

Chapter 1	Introduction to the Human Body	1
Chapter 2	Osteology and Arthrology	29
Chapter 3	Myology	54
Chapter 4	The Shoulder	84
Chapter 5	The Elbow, Forearm, Wrist, and Hand	134
Chapter 6	Head, Neck, and Face	199
Chapter 7	Trunk	257
Chapter 8	Pelvis, Thigh, and Knee	321
Chapter 9	Leg, Ankle, and Foot	382
Glossary		429
Index		437

Contents

Preface	x	Short Bones	32
Acknowledgments	xv	Flat Bones	32
Chapter 1 Introduction to the Human Body	1	Irregular Bones	35
Communicating about the Body	2	Bony Landmarks	35
Regional Terms	2	Depressions and Openings	35
Anatomical Position	2	Projections That Form Joints	42
Directional Terms	3	Attachment Sites	42
Planes of Movement	3	Joints of the Human Skeleton	42
Axes	4	Naming Joints	42
Joint Movements	5	Joint Structure	42
Structures of the Human Body	6	Joint Function	43
Tissue Types in the Body	6	Structure and Function of Synovial Joints	45
Body Structures Involved in Human Movement	8	Synovial Joint Anatomy	45
Bone	9	Synovial Joint Types	45
Ligament	11	Accessory Motions	45
Muscle	12	Roll	47
Tendon	13	Glide	47
Fascia	14	Spin	49
Special Structures	16	For Review	50
Skin	16	Multiple Choice	50
Blood Vessels	17	Matching	50
Lymphatic Vessels and Nodes	19	Short Answer	51
Nerves	19	Chapter 3 Myology	54
Cartilage	23	Types of Muscle Tissue	55
Bursae	24	Smooth Muscle	55
For Review	26	Cardiac Muscle	56
Multiple Choice	26	Skeletal Muscle	56
Matching	26	Skeletal Muscle Functions	56
Short Answer	27	Motion	56
Chapter 2 Osteology and Arthrology	29	Posture	56
Bones of the Human Skeleton	30	Protection	56
Functions of Bone	30	Thermogenesis	57
Bone Tissue	30	Vascular Pump	57
The Human Skeleton	32	Fiber Direction and Naming Muscles	57
Shapes of Bones	32	Parallel Arrangements	57
Long Bones	32	Pennate Arrangements	58
		Naming Muscles	59
		Skeletal Muscle Properties	60
		Extensibility	60

Elasticity 60
 Excitability 60
 Conductivity 60
 Contractility 60
Anatomy of Skeletal Muscle Tissue 61
 Macroscopic Anatomy 61
 Microscopic Anatomy 61
Physiology of Muscle Contraction 61
 Events at the Neuromuscular Junction 61
 Sliding Filament Theory 63
 Factors Affecting Force Production 65
Skeletal Muscle Fiber Types 67
 Slow Twitch Fibers 67
 Fast Twitch Fibers 67
 Intermediate Fibers 67
 Distribution of Fiber Types 68
Types of Muscle Contractions 68
 Isometric Contractions 68
 Isotonic Contractions 68
 Integrating Contraction Types
 in Human Movement 69
Muscle Relationships 69
 Agonists 69
 Synergists 72
 Antagonists 72
Levers in the Human Body 72
 Components of a Lever 72
 Types of Levers 72
Proprioception 74
 Muscle Spindles 74
 Golgi Tendon Organs 74
 Other Proprioceptors 76
Range of Motion 76
 Active Range of Motion 76
 Passive Range of Motion 77
 Resisted Range of Motion 77
For Review 80
 Multiple Choice 80
 Sequencing 81
 Short Answer 81

Chapter 4 The Shoulder 84

Overview of the Region 85
 Surface Anatomy of the Shoulder 85
 Skeletal Structures of the Shoulder 87
 Bony Landmarks of the Shoulder 89
 Muscle Attachment Sites 92
 Ligaments of the Shoulder 94

Superficial Muscles of the Shoulder 96
Deep Muscles of the Shoulder 97
Special Structures of the Shoulder 98
Posture of the Shoulder 99
**Movements Available: Scapulothoracic
 Joint 100**
**Movements Available: Glenohumeral
 Joint 101**
Passive Range of Motion 102
Resisted ROM 104
 Resisted ROM: Scapula 104
 Resisted ROM: Shoulder 105
Muscle Profiles 106
 Deltoid 106
 Pectoralis Major 108
 Coracobrachialis 110
 Biceps Brachii 111
 Pectoralis Minor 112
 Subclavius 113
 Trapezius 114
 Levator Scapulae 116
 Rhomboid Major and Minor 117
 Latissimus Dorsi 118
 Teres Major 120
 Serratus Anterior 121
 Supraspinatus 122
 Infraspinatus 123
 Teres Minor 124
 Subscapularis 125
 Triceps Brachii 126
Functional Aspects 127
 Synergists/Antagonists: Scapula 127
 Synergists/Antagonists: Shoulder 128
 Putting It In Motion 129
For review 130
 Multiple Choice 130
 Matching 131
 Short Answer 132

**Chapter 5 The Elbow, Forearm, Wrist,
 and Hand 134**

Overview of the Region 135
 Surface Anatomy of the Elbow, Forearm,
 Wrist, and Hand 136
 Skeletal Structures of the Elbow, Forearm, Wrist,
 and Hand 139
 Bony Landmarks of the Elbow, Forearm,
 Wrist, and Hand 141

Muscle Attachment Sites 146

Ligaments of the Elbow, Forearm, Wrist,
and Hand 148

Superficial Muscles of the Elbow, Forearm,
Wrist, and Hand 151

Deep Muscles of the Elbow, Forearm, Wrist,
and Hand 153

Special Structures of the Elbow, Forearm,
Wrist, and Hand 155

Posture of the Elbow, Wrist, and Hand 159

Movements Available: Elbow and Wrist 160

Movements Available: Hand 161

Movements Available: Thumb 162

Passive Range of Motion 163

Resisted Range of Motion 166

Muscle Profiles 170

 Brachialis 170

 Brachioradialis 171

 Flexor Carpi Radialis 172

 Palmaris Longus 173

 Flexor Carpi Ulnaris 174

 Flexor Digitorum Superficialis 175

 Flexor Digitorum Profundus 176

 Flexor Pollicis Longus 177

 Pronator Teres 178

 Pronator Quadratus 179

 Supinator 180

 Anconeus 181

 Extensor Carpi Radialis Longus 182

 Extensor Carpi Radialis Brevis 183

 Extensor Carpi Ulnaris 184

 Extensor Digitorum 185

 Extensor Indicis 186

 Extensor Digiti Minimi 187

 Abductor Pollicis Longus 188

 Extensor Pollicis Brevis 189

 Extensor Pollicis Longus 190

Functional Aspects 191

 Intrinsic Muscles of the Hand 191

 Synergists/Antagonists: Elbow and Wrist 193

 Synergists/Antagonists: Hand 194

 Putting It In Motion 195

For Review 196

 Multiple Choice 196

 Matching 197

 Short Answer 197

Chapter 6 Head, Neck, and Face 199

Overview of the Region 200

Surface Anatomy of the Head, Neck, and Face 200

Skeletal Structures of the Head, Neck, and Face . . . 202

Bony Landmarks of the Head, Neck, and Face 206

Muscle Attachment Sites 209

Ligaments of the Head, Neck, and Face 212

Superficial Muscles of the Head and Neck 215

Intermediate Muscles of the Head and Neck 216

Deep Muscles of the Head and Neck 217

Muscles of the Face 218

Special Structures of the Head, Neck, and Face . . . 219

Posture of the Head and Neck 223

Movements Available: Neck 224

Movements Available: Jaw 225

Facial Expression 226

Passive Range of Motion 227

Resisted Range of Motion 228

Muscle Profiles 230

 Sternocleidomastoid 230

 Scalenes 231

 Platysma 232

 Longus Colli 233

 Longus Capitis 234

 Suprahyoids 235

 Digastric 236

 Infrahyoids 237

 Splenius Capitis 238

 Splenius Cervicis 239

 Semispinalis 240

 Rectus Capitis Posterior Major 241

 Rectus Capitis Posterior Minor 242

 Obliquus Capitis Superior 243

 Obliquus Capitis Inferior 244

 Rectus Capitis Anterior 245

 Rectus Capitis Lateralis 246

 Temporalis 247

 Masseter 248

 Medial Pterygoid 249

 Lateral Pterygoid 250

Functional Aspects 251

 Synergists/Antagonists: Head and Neck 251

 Synergists/Antagonists: Jaw 252

 Putting It In Motion 253

For Review 254

 Multiple Choice 254

 Matching 255

 Short Answer 256

Chapter 7 Trunk 257

Overview of the Region 258

Surface Anatomy of the Trunk 258

Skeletal Structures of the Trunk	260	Superficial Muscles of the Pelvis, Thigh, and Knee	333
Bony Landmarks of Skeletal Structures	268	Deep Muscles of the Pelvis, Thigh, and Knee	336
Muscle Attachment Sites	271	Special Structures of the Pelvis, Thigh, and Knee.	339
Ligaments of the Trunk	273	Posture of the Hip and Knee	342
Superficial Muscles of the Trunk	275	Movements Available: Hip.	343
Intermediate Muscles of the Trunk	277	Movements Available: Knee	344
Deep Muscles of the Trunk	279	Passive Range of Motion	345
Muscles of Breathing	281	Resisted Range of Motion	347
Special Structures of the Trunk	282	Muscle Profiles	349
Posture of the Trunk	288	Psoas.	349
Movements Available: Trunk	291	Iliacus	350
Movements Available: Breathing	292	Rectus Femoris	351
Resisted Range of Motion	293	Sartorius	352
Muscle Profiles	295	Tensor Fasciae Latae	353
Rectus Abdominis	295	Vastus Lateralis	355
External Oblique.	296	Vastus Medialis	356
Internal Oblique	297	Vastus Intermedius	357
Transverse Abdominis	298	Pectineus	358
Diaphragm	299	Adductor Brevis	359
External Intercostals	300	Adductor Longus	360
Internal Intercostals.	301	Gracilis	361
Iliocostalis	302	Adductor Magnus	362
Longissimus	303	Gluteus Maximus	363
Spinalis.	304	Gluteus Medius	364
Quadratus Lumborum	305	Gluteus Minimus	365
Serratus Posterior Superior	307	Piriformis	366
Serratus Posterior Inferior	308	Superior Gemellus	367
Semispinalis	309	Inferior Gemellus	368
Multifidi	310	Obturator Internus	369
Rotatores	311	Obturator Externus	370
Interspinalis	312	Quadratus Femoris	371
Intertransversarii	313	Biceps Femoris	372
Functional Aspects.	315	Semimembranosus	373
Synergists/Antagonists: Trunk.	315	Semitendinosus	374
Synergists/Antagonists: Breathing.	316	Popliteus	375
Putting It In Motion.	317	Functional Aspects.	376
For Review.	318	Synergists/Antagonists: Hip.	376
Multiple Choice.	318	Synergists/Antagonists: Knee	377
Matching.	319	Putting It In Motion.	378
Short Answer.	319	For Review.	379
Chapter 8 Pelvis, Thigh, and Knee	321	Multiple Choice.	379
Overview of the Region	322	Matching.	380
Surface Anatomy of the Pelvis, Thigh, and Knee	322	Short Answer.	380
Skeletal Structures of the Pelvis, Thigh, and Knee.	324	Chapter 9 Leg, Ankle, and Foot	382
Bony Landmarks of Skeletal Structures	326	Overview of the Region	383
Muscle Attachment Sites	330	Surface Anatomy of the Leg, Ankle, and Foot	384
Ligaments of the Pelvis, Thigh, and Knee	331		

Skeletal Structures of Leg, Ankle, and Foot	385	Fibularis Longus	411
Bony Landmarks of Skeletal Structures	387	Fibularis Brevis	412
Muscle Attachment Sites	392	Fibularis Tertius	413
Ligaments of the Leg, Ankle, and Foot	393	Gastrocnemius	414
Superficial Muscles of the Leg, Ankle, and Foot	395	Soleus	415
Deep Muscles of the Leg, Ankle, and Foot	397	Plantaris	416
Special Structures of the Leg, Ankle, and Foot	398	Tibialis Posterior	417
Posture of the Ankle and Foot	400	Flexor Digitorum Longus	418
Movements Available: Ankle	401	Flexor Hallucis Longus	419
Posture of the Ankle and Foot	401	Functional Aspects	423
Movements Available: Foot	402	Synergists/Antagonists: Ankle and Foot	423
Gait	403	Putting It In Motion	424
Passive Range of Motion	404	For Review	425
Resisted Range of Motion	406	Multiple Choice	425
Muscle Profiles	408	Matching	426
Tibialis Anterior	408	Short Answer	426
Extensor Digitorum Longus	409	Glossary	429
Extensor Hallucis Longus	410	Index	437



Preface

Today’s massage, bodywork, and fitness professionals are essential members of the healthcare team. These professionals collaborate with physicians, physical therapists, occupational therapists, chiropractors, nurse care managers, attorneys, insurance companies, and other healthcare providers. Professionals must have a clear understanding of muscle and joint function beyond simple actions. This allows them to communicate clearly, maintain credibility, and obtain reimbursement for therapeutic work. The emerging requirement for “outcome-based” justification of treatments further supports the need for a thorough understanding of the body in motion.

Functional Anatomy: Musculoskeletal Anatomy, Kinesiology, and Palpation for Manual Therapists, Second Edition was written to help students of human movement and bodywork understand how anatomical structures work together to create motion. Developing an understanding of the body in all of its complex synchronicity is critical for students of health, fitness, and bodywork. These careers require the therapist to create concise and effective treatment plans. Fitness and sports professionals are routinely called upon to analyze complex movement patterns in order to maximize the athlete’s performance and prevent injury.

Beyond these pragmatic benefits, an understanding of functional anatomy develops heightened intellectual and artistic appreciation of the human body in motion. With a deep understanding of structure–function relationships, we begin to see the client’s body as a living, breathing, *moving* marvel. This text can assist you in exploring the structures and anatomical relationships responsible for movements such as walking, running, lifting, and throwing. You will be guided through activities that involve inspecting, touching, and moving these structures, enabling you to create a solid, three-dimensional image of the human body and its movement potential.

Organization and Content

The chapters in *Functional Anatomy, Second Edition* are organized to build anatomical regions “from the

ground up.” This means deeper structures are identified first, and then structural layers are added. This organization helps readers understand the relationship between static structures such as bones, ligaments, and joint capsules and dynamic functions of muscles. Muscles are presented from superficial to deep to develop systematic palpation skills. Muscles are grouped together functionally. For example, the latissimus dorsi and teres major are located next to each other in the body, have a common insertion, and perform similar actions. Because of this, they are considered sequentially in Chapter 4.

The first three chapters in the book describe how the body is put together and how it achieves movement. In Chapter 1, the basic structures and systems of the body, the text’s organization of the layers of the human body, and the language of anatomy and movement are discussed and explored. Chapter 2 provides an in-depth investigation of bones and joints, including their basic structure, various shapes and functions, classification, and location of the different types in the body. Chapter 3 delves into skeletal muscles, including their functions, properties, fiber directions and types, the different types of contractions they create, and how they are regulated. After studying these introductory chapters, you should understand the basic structures of the body and methods for creating movement. You will also have developed a language for discussing these concepts.

Each of the remaining six chapters explores a specific region of the body. These chapters follow a consistent template, with the same type of information occurring at the same place in each chapter. This predictability will help you locate any topic within a given chapter quickly and easily.

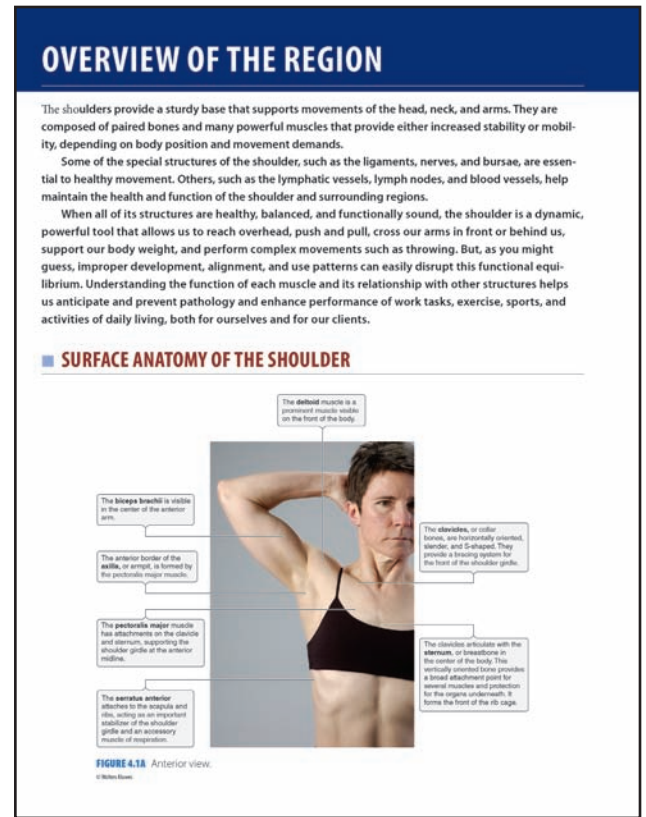
The recurring elements in the first half of each chapter include, in order:

- competency-based objectives
- overview of the region
- surface anatomy
- skeletal structures
- bony landmark palpation
- muscle attachment sites



- joints and ligaments
- superficial muscles of the region
- deep muscles of the region
- special structures located in the region (other than bones, ligaments, and muscles)
- movements allowed by the region's joints
- passive and resisted range of motion techniques

This opening section is followed by a set of one- or two-page profile of each muscle pertinent to that region. Profiles include an illustration of the muscle showing its origin, insertion, and fiber arrangement and direction. Text descriptions of the muscle attachments, actions, and innervations are located next to this image. The profile also includes a description of the muscle's functional anatomy; that is, the relationships it has with other muscles, how it works in the body beyond its actions, and common imbalances or dysfunctions associated with it. Finally, the profile explains in simple, easy-to-follow steps how to palpate and engage the muscle against resistance. A photograph shows proper positioning of the practitioner and client, as well as the pertinent bony landmarks and muscle features. The simple, consistent design of each



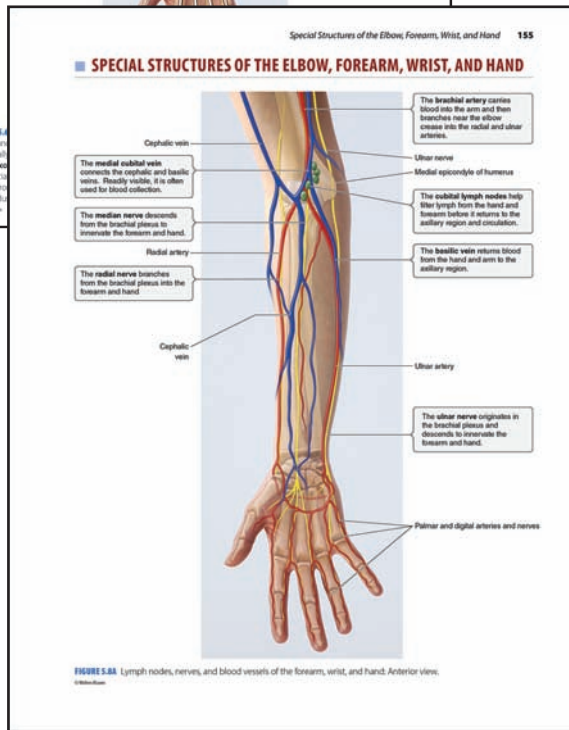
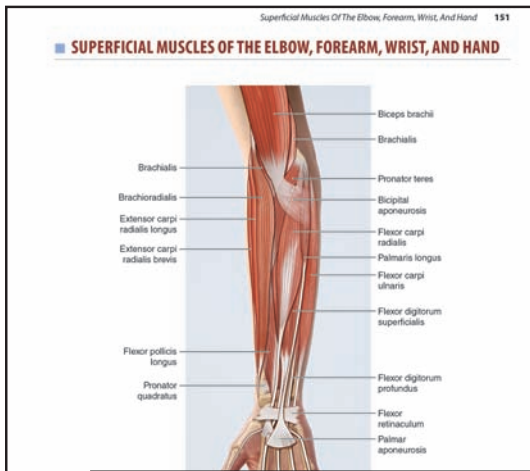
muscle profile ensures ease of use in the classroom or lab, as well as for studying and quick reference.

A section discussing the functional aspects of the body region follows the muscle profiles. This section includes information on synergist and antagonist relationships and a photo essay called *Putting It in Motion*, which explores the structure–function relationships involved during activities of daily living and sport.

Every chapter of the book closes with a concise summary, review questions, and study activities. The latter includes specific exercises aimed at kinesthetically engaging the covered material.

Features

Functional Anatomy, Second Edition will guide you to a deeper understanding of the structure and function of the human body by engaging not only your mind, but also your other senses. Features include dynamic, colorful visuals, kinesthetic exercises to enhance your palpatory skills, and individual and group activities. Each region of the body is explored from the inside out to enhance understanding of structural relationships and movement possibilities. Simple, easy-to-follow instructions for palpation of bony landmarks and each muscle profiled are provided.



Functional Anatomy, Second Edition recognizes that you may be experiencing the challenges of learning a new language. To help you in acquiring this new language, we include within each muscle profile a guide to correct pronunciation of the muscle name. The Navigate Advantage Access also includes an Audio Glossary so you can hear proper pronunciation of each muscle profiled.

MUSCLE PROFILES

Deltoid

del'toyd • "delta" Greek the letter delta "oid" Latin resemblance

Attachments
 O: Lateral one-third of the clavicle, acromion process, and spine of the scapula
 I: Deltoid tuberosity of the humerus

Innervation
 ■ Axillary nerve
 ■ C5–C6

Blood Supply
 ■ Thoracoacromial artery

Actions
 ■ Abducts the shoulder (all fibers)
 ■ Flexes, internally rotates, and horizontally adducts the shoulder (anterior fibers)
 ■ Extends, externally rotates, and horizontally abducts the shoulder (posterior fibers)

FIGURE 4.17 Deltoid (anterior view).

FIGURE 4.18 Deltoid (posterior view).

44 Chapter 4 The Shoulder

SYNERGISTS/ANTAGONISTS: SHOULDER

Shoulder Motion	Muscles Involved	Shoulder Motion	Muscles Involved
<p>Flexion</p>	Deltoid (anterior fibers) Pectoralis major (clavicular fibers) Coracobrachialis Biceps brachii	<p>Extension</p>	Deltoid (posterior fibers) Latissimus dorsi Teres major Pectoralis major (costal fibers)
<p>Abduction</p>	Deltoid (all fibers) Supraspinatus Pectoralis major (overhead)	<p>Adduction</p>	Pectoralis major Latissimus dorsi Teres major Coracobrachialis Biceps brachii (short head)
<p>Internal Rotation</p>	Deltoid (anterior fibers) Pectoralis major Latissimus dorsi Teres major Subscapularis	<p>External Rotation</p>	Deltoid (posterior fibers) Infraspinatus Teres minor
<p>Horizontal Abduction</p>	Deltoid (posterior fibers) Infraspinatus Latissimus dorsi Teres minor	<p>Horizontal Adduction</p>	Pectoralis major Deltoid (anterior fibers)

A *Synergist/Antagonist* table is included in each regional chapter. A photograph of a specific body motion, such as flexion or extension, is accompanied by a list of all muscles that contribute to that motion. Each motion is paired with its opposite in order to help you appreciate balanced muscle relationships.

Each regional chapter also discusses and illustrates passive and resisted range of motion procedures for assessing normal joint function. This is included to help you physically access the specific structures identified in this text.

As mentioned earlier, each regional chapter contains a section called *Putting It In Motion*, which identifies and explains specific actions that contribute to motions we use in daily activity or in sports. The photographs of these movements are enhanced to show the pertinent muscle groups driving the action. This feature is linked to the animations on the Navigate Advantage Access student resource site, which further explore some of these movements.

Putting It in Motion 253

■ PUTTING IT IN MOTION



Hitting a header. Soccer is a sport that requires the head and neck to perform powerful forward movements. The deep muscles such as rectus capitis anterior, longus capitis, and longus colli angle the forehead and stabilize the spine. Superficial muscles on the front of the neck such as anterior scalene, sternocleidomastoid, and platysma drive the movement.



Tuning in. Cocking the head to one side activates several muscles on the front and back of the neck. The small, deep rectus capitis lateralis and obliquus capitis superior tip the head while the semispinalis, splenii, longus colli, scalenes, sternocleidomastoid, and trapezius muscles create larger movements at the head and neck.




Looking up. Coordinated efforts of the deep, intermediate, and superficial muscles on the back of the neck enable us to look up. Deep muscles, such as the suboccipitals, angle the head while the intermediate semispinalis and splenii muscles bend the neck back and stabilize the vertebrae. Superficial muscles such as the levator scapula and trapezius connect the head and shoulder girdle.



Rotating the head. Turning your head to look over your shoulder is a critical movement when driving or taking a breath when swimming. The deep suboccipitals help pivot the head while semispinalis and splenii muscles govern gross neck rotation. The scalenes, levator scapula, sternocleidomastoid, and trapezius anchor the head and neck to the ribcage and shoulder girdle during these movements, levering the head from these stable structures.

46 **Chapter 4** The Shoulder



Push-Ups. Because the hands are planted on the ground, activities such as push-ups require fixation of the scapulae on the thorax while the glenohumeral joint moves through its range of motion. The trapezius, rhomboids, pectoralis minor, and serratus anterior anchor the scapula while the anterior deltoid and pectoralis major move the body up and down.

Wrap-Up

Summary

- Six bones contribute to the shoulders. These include the paired clavicles, the scapulae, and the right and left humerus.
- The two main divisions of the shoulder are the shoulder girdle and the glenohumeral joint. The shoulder girdle is made up of the clavicle and scapula, which articulate at the acromioclavicular joint. The medial ends of the clavicles meet the manubrium of the sternum, a bone of the thorax. The glenohumeral joint is the articulation of the glenoid fossa of the scapula with the head of the humerus, the bone of the upper arm. This joint is also commonly called the shoulder joint.
- The scapulothoracic joint is not a true joint, as there is no bony articulation between the scapula and the thoracic cage. Instead, the scapula glides on thoracic musculature.
- Muscles that attach to the scapula enable several motions including elevation, depression, retraction, protraction, upward rotation, and downward rotation.
- The potential movements of the glenohumeral joint include flexion, extension, abduction, adduction, internal rotation, external rotation, horizontal abduction, and horizontal adduction.
- Passive ROM helps establish the health and function of inert structures, such as the glenohumeral joint capsule and the ligaments of the glenohumeral, acromioclavicular, and sternoclavicular joints. It also allows you to evaluate the relative movements between the scapulothoracic and glenohumeral joints.
- Resisted ROM helps establish the health and function of the dynamic stabilizers and prime

■ For Review

Multiple Choice

1. The bones that make up the acromioclavicular joint are:
 - A. the scapula and the sternum
 - B. the scapula and the clavicle
 - C. the clavicle and the sternum
 - D. none of the above
2. The glenohumeral joint is a:
 - A. hinge joint
 - B. gliding joint
 - C. immovable joint
 - D. ball and socket joint

movers of the scapulothoracic and glenohumeral joints. Evaluating functional strength and endurance helps you to identify balance and potential imbalance between the muscles that steer the scapula, stabilize the humeral head, and move the humerus.

- The deeper, smaller muscles in the shoulder region, such as the rotator cuff muscles, tend to stabilize the joints. The larger, more superficial muscles, such as the pectoralis major, create powerful movements.
- Coordinated movement of the muscles of the shoulder girdle and glenohumeral joint is called scapulohumeral rhythm.
- Muscles of the shoulder girdle and glenohumeral joint must work in harmony to create movements such as throwing, reaching, lifting, and pushing.

TRY THIS!

Activity 1: Find a partner. Study the person's standing posture from the side. Write down or draw what you observe about their postural alignment paying special attention to their shoulder girdle and upper extremity. Repeat this process, this time looking from the front and back. If you notice any deviations, use your knowledge of muscle functions and relationships to determine which muscles might be out of balance. See if you can figure out which muscles are tight. Switch partners and repeat the process. Compare your findings.

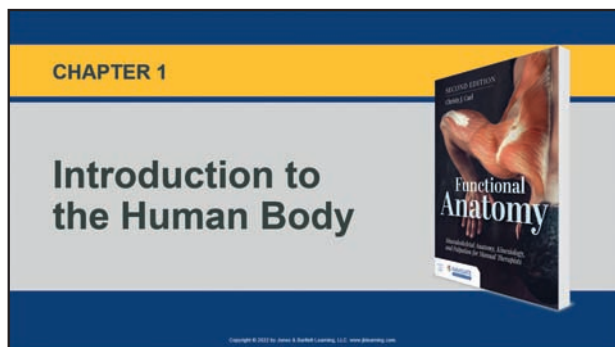
Activity 2: Find a partner and have them perform one of the skills identified in the *Putting It in Motion* segment. Identify the specific actions of the shoulder that make up this skill. Write them down. Use the synergist list to identify which muscles work together to create this movement. Make sure you put the actions in the correct sequence. See if you can discover which muscles are stabilizing or steering the joint into position and which are re-ponsible for powering the movement.

Suggestions: Switch partners and perform a different skill from *Putting It in Motion*. Repeat the steps above. Confirm your findings with the *Putting It in Motion* segment on the Navigate2 digital offering included with your textbook. To further your understanding, practice this activity with skills not identified in *Putting It in Motion*.

The *Try This!* activity located at the end of each chapter includes a simple, kinesthetic activity that engages one or more key concepts identified in the chapter. Easy-to-follow steps are listed, as well as any special equipment that may be needed. For example, the *Try This!* in Chapter 1 instructs

readers to verbally position or move a partner in ways described on cards they create. This activity engages multiple senses and encourages correct use of anatomical terms and concepts.

Digital Resources: Navigate Advantage Access



The online resource site for this text, Navigate Advantage, is designed to be used alongside this text in order to ensure strong connections between the special features of the book, student study materials, and teacher resources. The text is greatly enhanced by the Navigate Advantage Access, which comes as an access code with the purchase of each new textbook, and also is available for sale separately as a standalone access code. Features of the digital offering include:

- Workbook in writeable PDF format
- Activity flashcards
- Terminology flashcards
- Video footage of palpation of various regions of the body
- Animations that correspond with the *Putting It In Motion* segment in each regional chapter. These animations sequentially reveal muscle functions during common activities such as walking, jogging, standing, and throwing.
- An audio glossary of the muscles profiled
- An interactive eBook with knowledge check questions and quizzes.
- Anatomy and Physiology Review Module

In addition to the student resources, the following are available to qualified instructors:

- Slides in PowerPoint format
- Lesson plans
- Test Bank available in LMS-compatible formats

Design

The design of *Functional Anatomy, Second Edition* creates a user-friendly, predictable, and interactive experience for readers. The text and art are arranged to allow quick reference for study as well as maximum usability during classroom activities such as guided palpation exercises. Specific icons identify where these activities are located and when they are linked to the ancillary materials. All of these features will help you develop competency in the key skills identified in each of the chapter objectives.



Final Note

I hope that *Functional Anatomy* helps you discover new and exciting things about the human body. It is intended to enhance your personal and classroom experience and engage you in exploring how the body works. I encourage you to try as many of the activities as possible, utilize the learning tools provided, and embark upon your educational journey with wonder and curiosity.

Please contact me at christy_cael@hotmail.com with any comments or suggestions about this book. My students have always been both an inspiration and my toughest critics, and I wish for that to continue. Your perceptions, responses, and experiences with this text are valuable, and I am interested in what you have to share. In the meantime, thank you and enjoy.

– Christy J. Cael



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Producing *Functional Anatomy: Musculoskeletal Anatomy, Kinesiology, and Palpation for Manual Therapists, Second Edition* has been a journey requiring the effort, enthusiasm, and patience of many. I would like to thank those who have believed in me and this project, contributed their vast knowledge and expertise, and tolerated my distraction, as well as my single-minded immersion. Creating this new edition has been a joy as well as a challenge and I want to thank everyone at Jones & Bartlett Learning. You are all amazing and have made what can be a difficult process smooth and exciting. I especially appreciate the commitment you have shown to accessibility and inclusivity for all types of learners and abilities. Special thanks to Carol Guerrero for being my touchstone throughout and throwing me a lifeline when I lost sight of shore.

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Reviewers

Timothy J. Demchak PhD, ATC, GTS
Professor
Department of Applied Medicine and
Rehabilitation
Indiana State University
Terre Haute, Indiana

Julie Estes OTD/OTR
Northeastern State University
Muskogee, Oklahoma

Sharon Montgomery, OTD, OTR/L, CHT, CEAS
Assistant Professor
Department of Occupational Science and
Occupational Therapy
Frances M. Maguire School of Nursing and Health
Professions
Gwynedd Mercy University
Gwynedd Valley, Pennsylvania