

Atlas of Anatomy

Third Edition

Edited by
Anne M. Gilroy
Brian R. MacPherson

Based on the work of
Michael Schuenke
Erik Schulte
Udo Schumacher

Illustrations by
Markus Voll
Karl Wesker

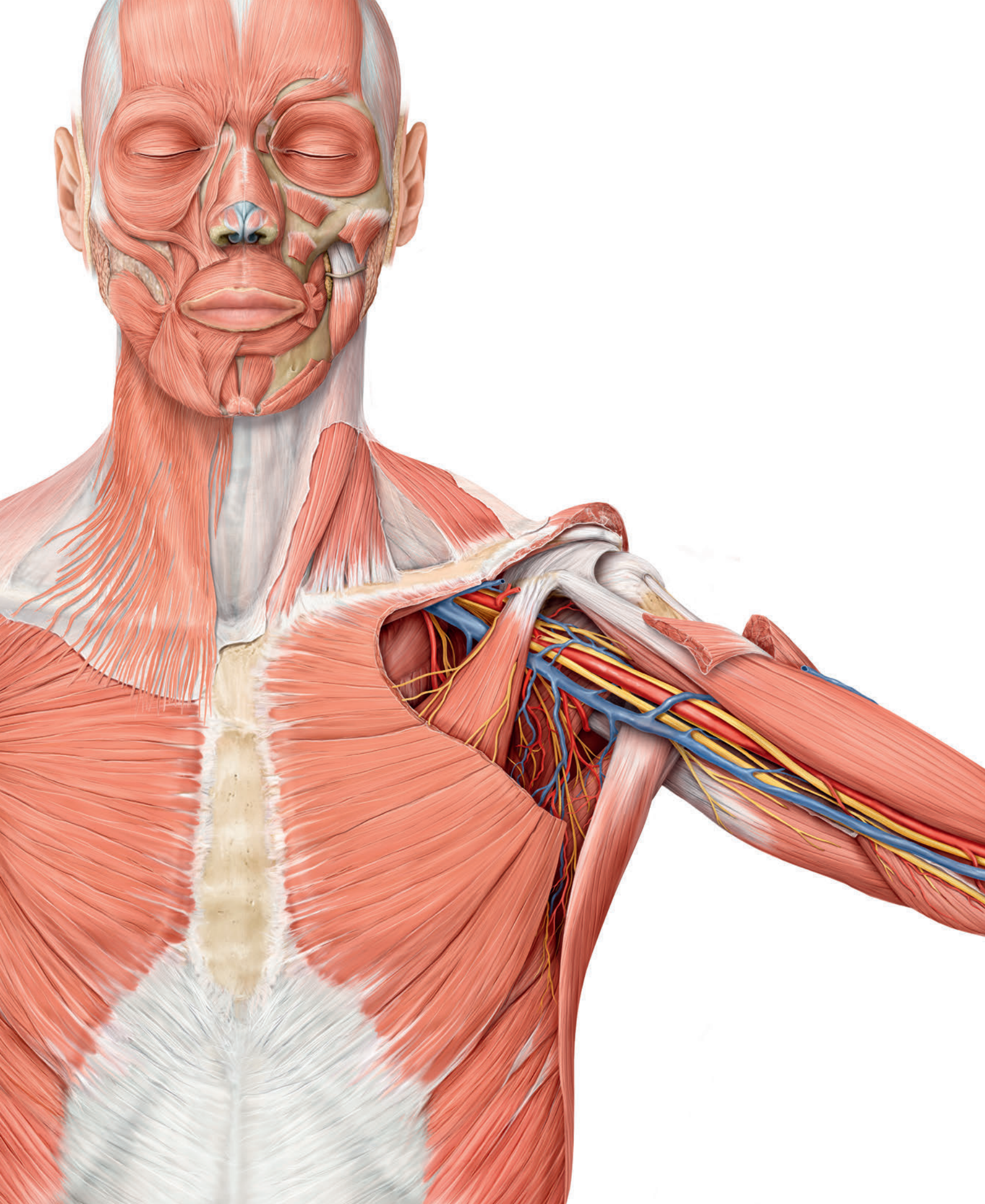


Includes online
self-testing tool!
www.winkingskull.com



Thieme

To access additional material or resources available with this e-book, please visit <http://www.thieme.com/bonuscontent>. After completing a short form to verify your e-book purchase, you will be provided with the instructions and access codes necessary to retrieve any bonus content.



Atlas of Anatomy

Third Edition

Edited by

Anne M. Gilroy, MA

Associate Professor

Department of Radiology

University of Massachusetts Medical School

Worcester, Massachusetts

Brian R. MacPherson, PhD

Professor and Vice-Chair

Department of Anatomy and Neurobiology

University of Kentucky College of Medicine

Lexington, Kentucky

Based on the work of

Michael Schuenke, MD, PhD

Institute of Anatomy

Christian Albrecht University Kiel

Kiel, Germany

Erik Schulte, MD

Department of Functional and Clinical Anatomy

University Medicine

Johannes Gutenberg University

Mainz, Germany

Udo Schumacher, MD, FRCPath, CBiol, FSB, DSc

Institute of Anatomy and Experimental Morphology

Center for Experimental Medicine

University Cancer Center

University Medical Center Hamburg-Eppendorf

Hamburg, Germany

Illustrations by

Markus Voll

Karl Wesker

1935 illustrations

Thieme

New York · Stuttgart · Delhi · Rio de Janeiro

Editorial Director, Educational Products: Anne M. Sydor
Developmental Editor: Julie O'Meara
Editorial Assistant: Tony Paese
Director, Editorial Services: Mary Jo Casey
International Production Director: Andreas Schabert
Vice President, Editorial and E-Product Development: Vera Spillner
International Marketing Director: Fiona Henderson
International Sales Director: Louisa Turrell
Director of Sales, North America: Mike Roseman
Senior Vice President and Chief Operating Officer: Sarah Vanderbilt
President: Brian D. Scanlan
Illustrations: Markus Voll and Karl Wesker
Production Editor: Barbara Chernow
Compositor: Carol Pierson, Chernow Editorial Services, Inc.

Library of Congress Cataloging-in-Publication Data

Names: Gilroy, Anne M., editor. | MacPherson, Brian R., editor. | Voll, Markus M., illustrator. | Wesker, Karl, illustrator. | Schuenke, Michael. Thieme atlas of anatomy. Based on (work):
Title: Atlas of anatomy / edited by Anne M. Gilroy, Brian R. MacPherson ; based on the work of Michael Schuenke, Erik Schulte, Udo Schumacher ; illustrations by Markus Voll, Karl Wesker.
Other titles: Atlas of Anatomy (Gilroy)
Description: Third edition. | New York : Thieme, [2016] | Includes index.
Identifiers: LCCN 2015051118 (print) | LCCN 2016001057 (ebook) | ISBN 9781626232525 | ISBN 9781626232532 (eISBN) | ISBN 9781626232532 ()
Subjects: | MESH: Anatomy | Atlases
Classification: LCC QM25 (print) | LCC QM25 (ebook) | NLM QS 17 | DDC 611.0022/2--dc23
LC record available at <http://lcn.loc.gov/2015051118>

Copyright ©2016 by Thieme Medical Publishers, Inc.
Thieme Publishers New York
333 Seventh Avenue, New York, NY 10001 USA
+1 800 782 3488, customerservice@thieme.com

Thieme Publishers Stuttgart
Rüdigerstrasse 14, 70469 Stuttgart, Germany
+49 [0]711 8931 421, customerservice@thieme.de

Thieme Publishers Delhi
A-12, Second Floor, Sector-2, Noida-201301
Uttar Pradesh, India
+91 120 45 566 00, customerservice@thieme.in

Thieme Publishers Rio de Janeiro, Thieme Publicações Ltda.
Edifício Rodolpho de Paoli, 25º andar
Av. Nilo Peçanha, 50 – Sala 2508
Rio de Janeiro 20020-906 Brasil
+55 21 3172 2297

Printed in Canada by Transcontinental, Quebec

5 4 3 2 1

ISBN 978-1-62623-252-5

Also available as an e-book:
eISBN 978-1-62623-253-2

Important note: Medicine is an ever-changing science undergoing continual development. Research and clinical experience are continually expanding our knowledge, in particular our knowledge of proper treatment and drug therapy. Insofar as this book mentions any dosage or application, readers may rest assured that the authors, editors, and publishers have made every effort to ensure that such references are in accordance with **the state of knowledge at the time of production of the book**.

Nevertheless, this does not involve, imply, or express any guarantee or responsibility on the part of the publishers in respect to any dosage instructions and forms of applications stated in the book. **Every user is requested to examine carefully** the manufacturers' leaflets accompanying each drug and to check, if necessary in consultation with a physician or specialist, whether the dosage schedules mentioned therein or the contraindications stated by the manufacturers differ from the statements made in the present book. Such examination is particularly important with drugs that are either rarely used or have been newly released on the market. Every dosage schedule or every form of application used is entirely at the user's own risk and responsibility. The authors and publishers request every user to report to the publishers any discrepancies or inaccuracies noticed. If errors in this work are found after publication, errata will be posted at www.thieme.com on the product description page.

Some of the product names, patents, and registered designs referred to in this book are in fact registered trademarks or proprietary names even though specific reference to this fact is not always made in the text. Therefore, the appearance of a name without designation as proprietary is not to be construed as a representation by the publisher that it is in the public domain.

This book, including all parts thereof, is legally protected by copyright. Any use, exploitation, or commercialization outside the narrow limits set by copyright legislation without the publisher's consent is illegal and liable to prosecution. This applies in particular to photostat reproduction, copying, mimeographing or duplication of any kind, translating, preparation of microfilms, and electronic data processing and storage.

Dedication



We dedicate this third edition of the *Atlas of Anatomy* to the memory of Lawrence ("Larry") McIvor Ross, 1938–2015. Larry was an outstanding anatomist and cherished mentor and colleague. He started his academic career in 1968 as a faculty member in the Department of Anatomy at UTMB – Galveston. After six years he accepted an appointment in the Department of Anatomy at Michigan State University (MSU) and remained there until he retired in

2000. Larry was passionate about making a difference in the lives of his students, however, and continued to teach as a visiting professor at St. George's University on Grenada in the West Indies for nine years and as an adjunct professor in the Department of Neurobiology and Anatomy at the University of Texas Medical School – Houston until 2014. Fellow anatomists admired his dedication as a member of the American Association of Clinical Anatomists where he served the association in every position on the Executive Council. In 2015 he was honored for his service to the association with the *R. Benton Adkins Jr. Distinguished Service Award*.

As an academician, Larry was a true multidisciplinary anatomist, teaching histology, neuroanatomy, gross anatomy, and embryology to thousands of medical and graduate students as well as numerous non-medical groups. As an author, he will be remembered best for his work with Thieme Publishers. From 2005 to 2007 he co-edited the English translation of all three volumes of *Prometheus: Atlas of Anatomy*. Following the critical success of the three-volume atlas in English-speaking countries, he was instrumental in helping Thieme create the concept for the single-volume *Atlas of Anatomy*. This atlas, now in its third edition, is highly acclaimed in its own right and is distributed worldwide and translated in over 14 languages. As his co-authors, we are most grateful to Larry for his mentorship. He was responsible for bringing us onto the project and into the world of medical publications. We feel personally indebted for all he did for us, and will fondly remember him as a great mentor, friend, and colleague.

Anne and Brian

Table of Contents

Acknowledgments	xiii
Foreword	xiv
Preface	xv
Preface to the First Edition	xvii



1 Surface Anatomy

Surface Anatomy	2
-----------------------	---

2 Bones, Ligaments & Joints

Vertebral Column: Overview	4
Vertebral Column: Elements	6
Cervical Vertebrae	8
Thoracic & Lumbar Vertebrae	10
Sacrum & Coccyx	12
Intervertebral Disks	14
Joints of the Vertebral Column: Overview	16
Joints of the Vertebral Column: Craniovertebral Region	18
Vertebral Ligaments: Overview & Cervical Spine	20
Vertebral Ligaments: Thoracolumbar Spine	22

3 Muscles

Muscles of the Back: Overview	24
Intrinsic Muscles of the Cervical Spine	26
Intrinsic Muscles of the Back	28
Muscle Facts (I)	30
Muscle Facts (II)	32
Muscle Facts (III)	34

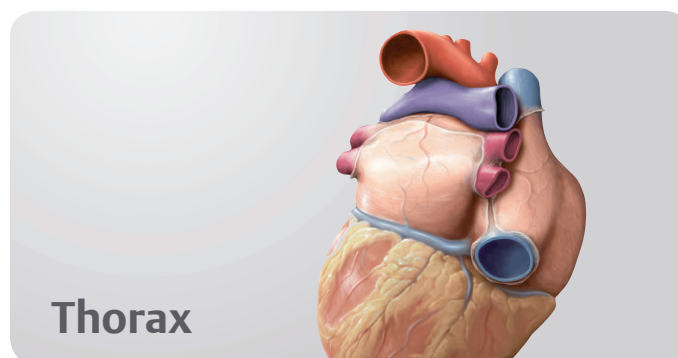
4 Neurovasculature

Arteries & Veins of the Back	36
Nerves of the Back	38

Spinal Cord	40
Spinal Cord Segments & Spinal Nerves	42
Arteries & Veins of the Spinal Cord	44
Neurovascular Topography of the Back	46

5 Sectional & Radiographic Anatomy

Radiographic Anatomy of the Back (I)	48
Radiographic Anatomy of the Back (II)	50



6 Surface Anatomy

Surface Anatomy	54
-----------------------	----

7 Thoracic Wall

Thoracic Skeleton	56
Sternum & Ribs	58
Joints of the Thoracic Cage	60
Thoracic Wall Muscle Facts	62
Diaphragm	64
Neurovasculature of the Diaphragm	66
Arteries & Veins of the Thoracic Wall	68
Nerves of the Thoracic Wall	70
Neurovascular Topography of the Thoracic Wall	72
Female Breast	74
Lymphatics of the Female Breast	76

8 Thoracic Cavity

Divisions of the Thoracic Cavity	78
Arteries of the Thoracic Cavity	80
Veins of the Thoracic Cavity	82
Lymphatics of the Thoracic Cavity	84
Nerves of the Thoracic Cavity	86

9 Mediastinum

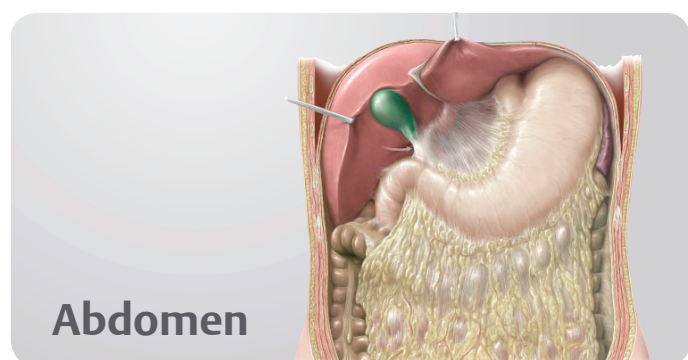
Mediastinum: Overview	88
Mediastinum: Structures	90
Heart: Functions and Relations	92
Pericardium	94
Heart: Surfaces & Chambers	96
Heart: Valves	98
Arteries & Veins of the Heart	100
Conduction & Innervation of the Heart	102
Pre- & Postnatal Circulation	104
Esophagus	106
Neurovasculature of the Esophagus	108
Lymphatics of the Mediastinum	110

10 Pulmonary Cavities

Pulmonary Cavities	112
Pleura: Subdivisions, Recesses & Innervation	114
Lungs	116
Bronchopulmonary Segments of the Lungs	118
Trachea & Bronchial Tree	120
Respiratory Mechanics	122
Pulmonary Arteries & Veins	124
Neurovasculature of the Tracheobronchial Tree	126
Lymphatics of the Pleural Cavity	128

11 Sectional & Radiographic Anatomy

Sectional Anatomy of the Thorax	130
Radiographic Anatomy of the Thorax (I)	132
Radiographic Anatomy of the Thorax (II)	134
Radiographic Anatomy of the Thorax (III)	136



12 Surface Anatomy

Surface Anatomy	140
-----------------------	-----

13 Abdominal Wall

Bony Framework for the Abdominal Wall	142
Muscles of the Anterolateral Abdominal Wall	144

Muscles of the Posterior Abdominal Wall & Diaphragm ...	146
Abdominal Wall Muscle Facts	148
Inguinal Region & Canal	150
Spermatic Cord, Scrotum & Testis	152
Anterior Abdominal Wall & Inguinal Hernias	154

14 Abdominal Cavity & Spaces

Divisions of the Abdominopelvic Cavity	156
Peritoneal Cavity & Greater Sac	158
Omental Bursa, or Lesser Sac	160
Mesenteries & Posterior Wall	162

15 Internal Organs

Stomach	164
Duodenum	166
Jejunum & Ileum	168
Cecum, Appendix & Colon	170
Liver: Overview	172
Liver: Lobes & Segments	174
Gallbladder & Bile Ducts	176
Pancreas & Spleen	178
Kidneys & Suprarenal Glands (I)	180
Kidneys & Suprarenal Glands (II)	182

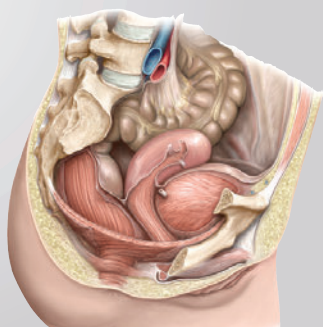
16 Neurovasculature

Arteries of the Abdomen	184
Abdominal Aorta & Renal Arteries	186
Celiac Trunk	188
Superior & Inferior Mesenteric Arteries	190
Veins of the Abdomen	192
Inferior Vena Cava & Renal Veins	194
Portal Vein	196
Superior & Inferior Mesenteric Veins	198
Lymphatics of the Abdominal Organs	200
Lymph Nodes of the Posterior Abdominal Wall	202
Lymph Nodes of the Supracolic Organs	204
Lymph Nodes of the Infracolic Organs	206
Nerves of the Abdominal Wall	208
Autonomic Innervation: Overview	210
Autonomic Plexuses	212
Innervation of the Abdominal Organs	214
Innervation of the Intestines	216

17 Sectional & Radiographic Anatomy

Sectional Anatomy of the Abdomen	218
Radiographic Anatomy of the Abdomen (I)	220
Radiographic Anatomy of the Abdomen (II)	222

Pelvis & Perineum



18 Surface Anatomy

Surface Anatomy	226
-----------------	-----

19 Bones, Ligaments & Muscles

Pelvic Girdle	228
Female & Male Pelvis	230
Female & Male Pelvic Measurements	232
Pelvic Ligaments	234
Muscles of the Pelvic Floor & Perineum	236
Pelvic Floor & Perineal Muscle Facts	238

20 Spaces

Contents of the Pelvis	240
Peritoneal Relationships	242
Pelvis & Perineum	244

21 Internal Organs

Rectum & Anal Canal	246
Ureters	248
Urinary Bladder & Urethra	250
Overview of the Genital Organs	252
Uterus & Ovaries	254
Ligaments & Fascia of the Deep Pelvis	256
Vagina	258
Female External Genitalia	260
Penis, Testis & Epididymis	262
Male Accessory Sex Glands	264

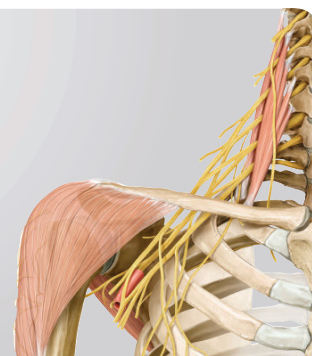
22 Neurovasculature

Arteries & Veins of the Pelvis	266
Arteries & Veins of the Rectum & Genitalia	268
Lymph Nodes of the Abdomen & Pelvis	270
Lymph Nodes of the Genitalia	272
Autonomic Plexuses of the Pelvis	274
Autonomic Innervation: Urinary & Genital Organs & Rectum	276
Neurovasculature of the Female Perineum & Genitalia	278
Neurovasculature of the Male Perineum & Genitalia	280

23 Sectional & Radiographic Anatomy

Sectional Anatomy of the Pelvis & Perineum	282
Radiographic Anatomy of the Female Pelvis	284
Radiographic Anatomy of the Male Pelvis	286

Upper Limb



24 Surface Anatomy

Surface Anatomy	290
-----------------	-----

25 Shoulder & Arm

Bones of the Upper Limb	292
Clavicle & Scapula	294
Humerus	296
Joints of the Shoulder	298
Joints of the Shoulder: Glenohumeral Joint	300
Subacromial Space & Bursae	302
Anterior Muscles of the Shoulder & Arm (I)	304
Anterior Muscles of the Shoulder & Arm (II)	306
Posterior Muscles of the Shoulder & Arm (I)	308
Posterior Muscles of the Shoulder & Arm (II)	310
Muscle Facts (I)	312
Muscle Facts (II)	314
Muscle Facts (III)	316
Muscle Facts (IV)	318

26 Elbow & Forearm

Radius & Ulna	320
Elbow Joint	322
Ligaments of the Elbow Joint	324
Radioulnar Joints	326
Muscles of the Forearm: Anterior Compartment	328
Muscles of the Forearm: Posterior Compartment	330
Muscle Facts (I)	332
Muscle Facts (II)	334
Muscle Facts (III)	336

27 Wrist & Hand

Bones of the Wrist & Hand	338
The Carpal Bones	340
Joints of the Wrist & Hand	342

Ligaments of the Hand	344
Ligaments and Compartments of the Wrist	346
Ligaments of the Fingers	348
Muscles of the Hand: Superficial & Middle Layers	350
Muscles of the Hand: Middle & Deep Layers	352
Dorsum of the Hand	354
Muscle Facts (I)	356
Muscle Facts (II)	358

28 Neurovasculature

Arteries of the Upper Limb	360
Veins & Lymphatics of the Upper Limb	362
Nerves of the Upper Limb: Brachial Plexus	364
Supraclavicular Branches & Posterior Cord	366
Posterior Cord: Axillary & Radial Nerves	368
Medial & Lateral Cords	370
Median & Ulnar Nerves	372
Superficial Veins & Nerves of the Upper Limb	374
Posterior Shoulder & Arm	376
Anterior Shoulder	378
Axilla	380
Anterior Arm & Cubital Region	382
Anterior and Posterior Forearm	384
Carpal Region	386
Palm of the Hand	388
Dorsum of the Hand	390

29 Sectional & Radiographic Anatomy

Sectional Anatomy of the Upper Limb	392
Radiographic Anatomy of the Upper Limb (I)	394
Radiographic Anatomy of the Upper Limb (II)	396
Radiographic Anatomy of the Upper Limb (III)	398



30 Surface Anatomy

Surface Anatomy	402
-----------------------	-----

31 Hip & Thigh

Bones of the Lower Limb	404
Femur	406
Hip Joint: Overview	408
Hip Joint: Ligaments & Capsule	410
Anterior Muscles of the Hip, Thigh & Gluteal Region (I) ...	412

Anterior Muscles of the Hip, Thigh & Gluteal Region (II) ..	414
Posterior Muscles of the Hip, Thigh & Gluteal Region (I) ..	416
Posterior Muscles of the Hip, Thigh & Gluteal Region (II) ..	418
Muscle Facts (I)	420
Muscle Facts (II)	422
Muscle Facts (III)	424

32 Knee & Leg

Tibia & Fibula	426
Knee Joint: Overview	428
Knee Joint: Capsule, Ligaments & Bursae	430
Knee Joint: Ligaments & Menisci	432
Cruciate Ligaments	434
Knee Joint Cavity	436
Muscles of the Leg: Anterior & Lateral Compartments ...	438
Muscles of the Leg: Posterior Compartment	440
Muscle Facts (I)	442
Muscle Facts (II)	444

33 Ankle & Foot

Bones of the Foot	446
Joints of the Foot (I)	448
Joints of the Foot (II)	450
Joints of the Foot (III)	452
Ligaments of the Ankle & Foot	454
Plantar Vault & Arches of the Foot	456
Muscles of the Sole of the Foot	458
Muscles & Tendon Sheaths of the Foot	460
Muscle Facts (I)	462
Muscle Facts (II)	464

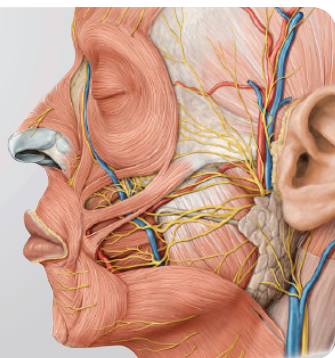
34 Neurovasculature

Arteries of the Lower Limb	466
Veins & Lymphatics of the Lower Limb	468
Lumbosacral Plexus	470
Nerves of the Lumbar Plexus	472
Nerves of the Lumbar Plexus: Obturator & Femoral Nerves	474
Nerves of the Sacral Plexus	476
Nerves of the Sacral Plexus: Sciatic Nerve	478
Superficial Nerves & Vessels of the Lower Limb	480
Topography of the Inguinal Region	482
Topography of the Gluteal Region	484
Topography of the Anterior, Medial & Posterior Thigh ...	486
Topography of the Posterior Compartment of the Leg & Foot	488
Topography of the Lateral & Anterior Compartments of the Leg and Dorsum of the Foot	490
Topography of the Sole of the Foot	492

35 Sectional & Radiographic Anatomy

Sectional Anatomy of the Lower Limb	494
Radiographic Anatomy of the Lower Limb (I)	496
Radiographic Anatomy of the Lower Limb (II)	498
Radiographic Anatomy of the Lower Limb (III)	500

Head & Neck



36 Surface Anatomy

Surface Anatomy	504
-----------------------	-----

37 Bones of the Head

Anterior & Lateral Skull	506
Posterior Skull & Calvaria	508
Base of the Skull	510
Neurovascular Pathways Exiting or Entering the Cranial Cavity	512
Ethmoid & Sphenoid Bones	514

38 Muscles of the Skull & Face

Muscles of Facial Expression & of Mastication	516
Muscle Origins & Insertions on the Skull	518
Muscle Facts (I)	520
Muscle Facts (II)	522

39 Cranial Nerves

Cranial Nerves: Overview	524
CN I & II: Olfactory & Optic Nerves	526
CN III, IV & VI: Oculomotor, Trochlear & Abducent Nerves	528
CN V: Trigeminal Nerve	530
CN VII: Facial Nerve	532
CN VIII: Vestibulocochlear Nerve	534
CN IX: Glossopharyngeal Nerve	536
CN X: Vagus Nerve	538
CN XI & XII: Accessory & Hypoglossal Nerves	540
Autonomic Innervation	542

40 Neurovasculature of the Skull & Face

Innervation of the Face	544
Arteries of the Head & Neck	546
External Carotid Artery:	
Anterior, Medial & Posterior Branches	548
External Carotid Artery: Terminal Branches	550
Veins of the Head & Neck	552
Meninges	554
Dural Sinuses	556
Topography of the Superficial Face	558
Topography of the Parotid Region & Temporal Fossa	560
Topography of the Infratemporal Fossa	562
Topography of the Pterygopalatine Fossa	564

41 Orbit & Eye

Bones of the Orbit	566
Muscles of the Orbit	568
Neurovasculature of the Orbit	570
Topography of the Orbit	572
Orbit & Eyelid	574
Eyeball	576
Cornea, Iris & Lens	578

42 Nasal Cavity & Nose

Bones of the Nasal Cavity	580
Paranasal Air Sinuses	582
Neurovasculature of the Nasal Cavity	584

43 Temporal Bone & Ear

Temporal Bone	586
External Ear & Auditory Canal	588
Middle Ear: Tympanic Cavity	590
Middle Ear: Ossicular Chain & Tympanic Membrane	592
Arteries of the Middle Ear	594
Inner Ear	596

44 Oral Cavity & Pharynx

Bones of the Oral Cavity	598
Temporomandibular Joint	600
Teeth	602
Oral Cavity Muscle Facts	604
Innervation of the Oral Cavity	606
Tongue	608
Topography of the Oral Cavity & Salivary Glands	610
Tonsils & Pharynx	612
Pharyngeal Muscles	614
Neurovasculature of the Pharynx	616

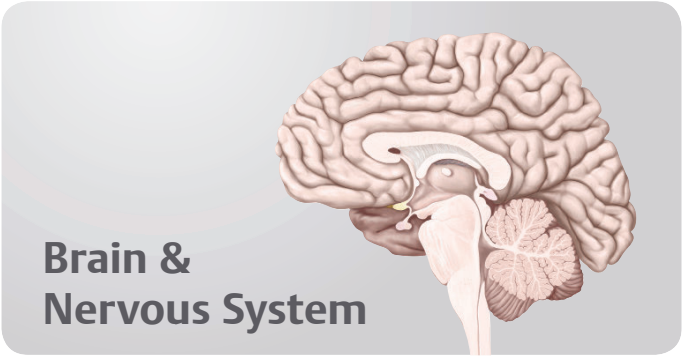
45 Neck

Muscle Facts (I)	618
Muscle Facts (II)	620
Muscle Facts (III)	622
Arteries & Veins of the Neck	624
Lymphatics of the Neck	626
Innervation of the Neck	628
Larynx: Cartilage & Structure	630
Larynx: Muscles & Levels	632
Neurovasculature of the Larynx, Thyroid & Parathyroids	634
Topography of the Neck: Regions & Fascia	636
Topography of the Anterior Cervical Region	638
Topography of the Anterior & Lateral Cervical Regions	640
Topography of the Lateral Cervical Region	642
Topography of the Posterior Cervical Region	644

46 Sectional & Radiographic Anatomy

Sectional Anatomy of the Head & Neck (I)	646
Sectional Anatomy of the Head & Neck (II)	648

Sectional Anatomy of the Head & Neck (III) 650
Sectional Anatomy of the Head & Neck (IV)..... 652
Sectional Anatomy of the Head & Neck (V) 654
Radiographic Anatomy of the Head & Neck (I)..... 656
Radiographic Anatomy of the Head & Neck (II) 658
Radiographic Anatomy of the Head & Neck (III)..... 660



47 Brain
Nervous System: Overview 664
Brain, Macroscopic Organization 666

Diencephalon 668
Brainstem & Cerebellum 670
Ventricles & CSF Spaces 672

48 Blood Vessels of the Brain

Veins and Venous Sinuses of the Brain 674
Arteries of the Brain 676

49 Functional Systems

Anatomy & Organization of the Spinal Cord..... 678
Sensory & Motor Pathways 680

50 Autonomic Nervous System

Autonomic Nervous System (I): Overview 682
Autonomic Nervous System (II) 684

51 Sectional & Radiographic Anatomy

Sectional Anatomy of the Nervous System 686
Radiographic Anatomy of the Nervous System 688

Index..... 691

Acknowledgments

We would like to thank the authors of the original award-winning *Thieme Atlas of Anatomy* three-volume series, Michael Schuenke, Erik Schulte, and Udo Schumacher, and the illustrators, Karl Wesker and Marcus Voll, for their work over the course of many years.

We thank the many instructors and students who have pointed out to us what we have done well and brought to our attention errors, ambiguities, and new information, or have suggested how we could present a topic more effectively. This input, combined with our experience teaching with the Atlas, have guided our work on this edition.

We again cordially thank the members of the first edition Advisory Board for their contributions:

- Bruce M. Carlson, MD, PhD
University of Michigan
Ann Arbor, Michigan
- Derek Bryant (Class of 2011)
University of Toronto Medical School
Burlington, Ontario
- Peter Cole, MD
Glamorum Healing Centre
Orangeville, Ontario
- Michael Droller, MD
The Mount Sinai Medical Center
New York, New York
- Anthony Firth, PhD
Imperial College London
London
- Mark H. Hankin, PhD
University of Virginia, School of Medicine
Charlottesville, Virginia
- Katharine Hudson (Class of 2010)
McGill Medical School
Montreal, Quebec
- Christopher Lee (Class of 2010)
Harvard Medical School
Cambridge, Massachusetts
- Francis Liuzzi, PhD
Lake Erie College of Osteopathic Medicine
Bradenton, Florida
- Graham Louw, PhD
University of Cape Town Medical School
University of Cape Town
- Estomih Mtui, MD
Weill Cornell Medical College
New York, New York
- Srinivas Murthy, MD
Harvard Medical School
Boston, Massachusetts
- Jeff Rihn, MD
The Rothman Institute
Philadelphia, Pennsylvania
- Lawrence Rizzolo, PhD
Yale University
New Haven, Connecticut
- Mikel Snow, PhD
University of Southern California
Los Angeles, California
- Kelly Wright (Class of 2010)
Wayne State University School of Medicine
Detroit, Michigan

Foreword

This *Atlas of Anatomy*, in my opinion, is the finest single-volume atlas of human anatomy that has ever been created. Two factors make it so: the images and the way they have been organized.

The artists, Markus Voll and Karl Wesker, have created a new standard of excellence in anatomical art. Their graceful use of transparency and their sensitive representation of light and shadow give the reader an accurate three-dimensional understanding of every structure.

The authors have organized the images so that they give just the flow of information a student needs to build up a clear mental image of the human body. Each two-page spread is a self-contained lesson that unobtrusively shows the hand of an experienced and thoughtful teacher. I wish I could have held this book in my hands when I was a student; I envy any student who does so now.

Robert D. Acland, 1941–2016
Louisville, Kentucky

December 2015

Preface

It is with a mix of pride and humility that we offer our 3rd edition of the *Atlas of Anatomy*. As with the previous editions, we have tried to respond to the requests, comments, and criticisms of our readers. Although this edition was prepared without the contributions of our friend and co-author, Lawrence Ross, who passed away in 2015, we have tried to maintain the same quality of excellence and attention to detail that he helped bring to the previous editions.

In this latest edition we focused our attention on three major tasks. The first reflects an understanding that anatomy is a changing science. Our readers understand that it is a dynamic part of clinical medicine, itself a science undergoing constant evolution. Concepts and terminology change accordingly and we feel a responsibility to pass on to our readers the most accurate and current information available.

Our second task was to add additional examples of sectional and radiographic images to help students apply their knowledge of anatomic structure and relationships to comparable clinical representations. While radiology as a clinical discipline is a specialty that requires expertise in diagnoses and treatment (and as such is not addressed here), the topographic interpretation of radiographic images is a natural companion to the study of anatomy. To this end, we have moved some images that were previously integrated into earlier chapters and added many new images to create a new *Sectional and Radiographic Anatomy* chapter in each unit.

Finally, we have expanded areas that deserved greater attention. A newly titled *Brain and Nervous System* unit replaces the former Neuro-

anatomy unit. Here, the reader will find a greater focus on the gross anatomy of the brain and peripheral nervous system. We've also added new spreads on the autonomic nervous system, a topic that needed to be expanded. In the *Pelvis and Perineum* unit, some images were removed and others revised to illustrate current anatomic theory. In addition, new art that better demonstrates the complex pelvic anatomy has been added throughout the unit.

As always, we thank reviewers, colleagues, and students who commented on previous editions and have suggested appropriate corrections.

We recognize that our efforts, though important, are just one part of the process that brings this textbook to your desk. Support from the entire Thieme Publishers team has been essential in creating the third edition. We are especially grateful to Julie O'Meara, Developmental Editor; Tony Paese, Editorial Assistant; Anne M. Sydor, PhD, Editorial Director, Educational Products; Barbara Chernow, PhD, Production Manager; and Carol Pierson, compositor, for excellence in their individual areas of expertise and their unwavering confidence in our ability to produce a quality manuscript.

Anne M. Gilroy
Worcester, Massachusetts

Brian R. MacPherson
Lexington, Kentucky

December 2015

Preface to the First Edition

Each of the authors was amazed and impressed with the extraordinary detail, accuracy, and beauty of the illustrations that were created for the *Thieme Atlas of Anatomy*. We feel these images are one of the most significant additions to anatomical education in the past 50 years. It was our intent to use these exceptional illustrations as the cornerstone of our effort in creating a concise single volume *Atlas of Anatomy* for the curious and eager health science student.

Our challenge was first to select from this extensive collection those images that are most instructive and illustrative of current dissection approaches. Along the way, however, we realized that creating a single-volume atlas was much more than choosing images: each image has to convey a significant amount of detail while the appeal and labeling need to be clean and soothing to the eye. Therefore, hundreds of illustrations were drawn new or modified to fit the approach of this new atlas. In addition, key schematic diagrams and simplified summary-form tables were added wherever needed. Dozens of applicable radiographic images and important clinical correlates have been added where appropriate. Additionally, surface anatomy illustrations are accompanied by questions designed to direct the student's attention to anatomic detail that is most relevant in conducting the physical exam. Elements from each of these features are arranged in a regional format to facilitate common dissection approaches. Within each region, the various components are examined systemically, followed by topographical images to tie the systems together within the region. In all of this, a clinical perspective on the anatomical structures is taken. The unique two facing pages "spread" format focuses the user to the area/topic being explored.

We hope these efforts — the results of close to 100 combined years experience teaching the discipline of anatomy to bright, enthusiastic students — has resulted in a comprehensive, easy-to-use resource and reference.

We would like to thank our colleagues at Thieme Publishers who so professionally facilitated this effort. We cannot thank enough Cathrin E. Schulz, MD, Editorial Director, Educational Products, who so graciously reminded us of deadlines, while always being available to "trouble shoot" problems. More importantly, she encouraged, helped, and complimented our efforts.

We also wish to extend very special thanks and appreciation to Bridget Queenan, Developmental Editor, who edited and developed the manuscript with an outstanding talent for visualization and intuitive flow of information. We are very grateful to her for catching many details along the way while always patiently responding to requests for artwork and labeling changes.

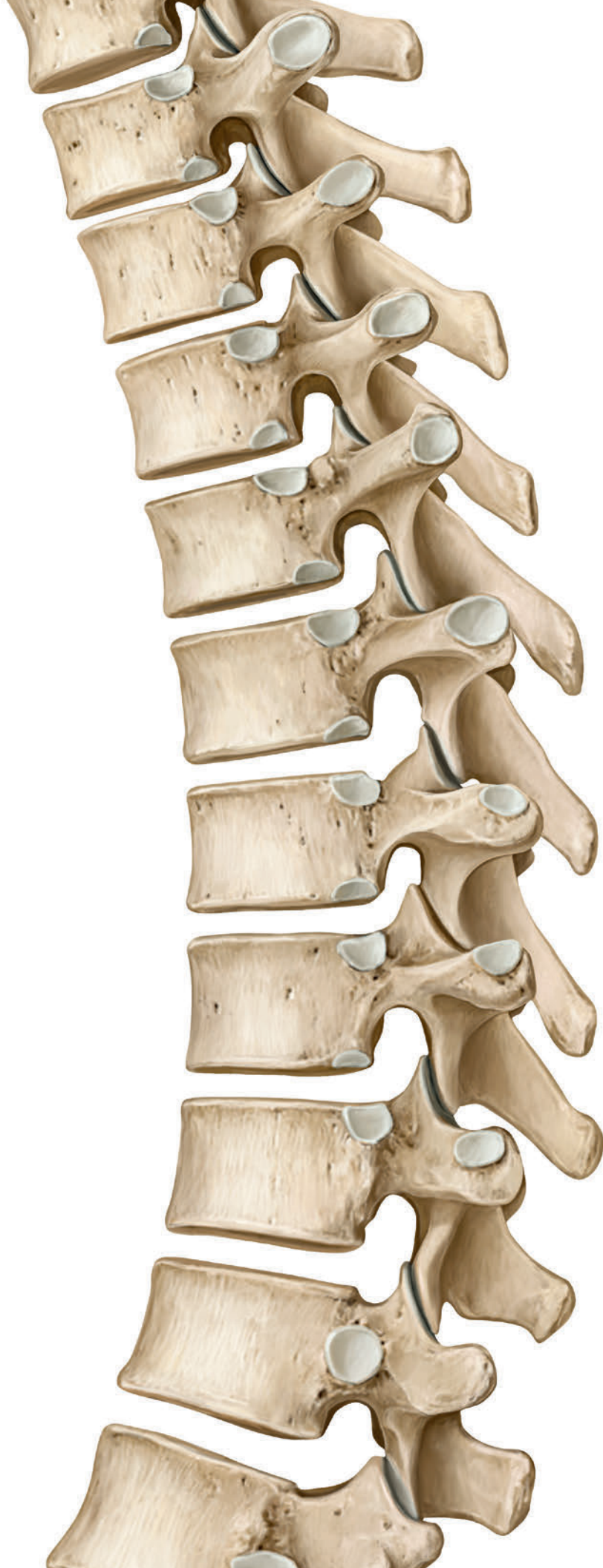
Cordial thanks to Elsie Starbecker, Senior Production Editor, who with great care and speed produced this atlas with its over 2,200 illustrations. Finally, thanks to Rebecca McTavish, Developmental Editor, for joining the team in the correction phase. So very much of their hard work has made the *Atlas of Anatomy* a reality.

Anne M. Gilroy
Worcester, Massachusetts

Brian R. MacPherson
Lexington, Kentucky

Lawrence M. Ross
Houston, Texas

March 2008



Back

1 Surface Anatomy

Surface Anatomy	2
---------------------------	---

2 Bones, Ligaments & Joints

Vertebral Column: Overview	4
Vertebral Column: Elements	6
Cervical Vertebrae	8
Thoracic & Lumbar Vertebrae	10
Sacrum & Coccyx	12
Intervertebral Disks	14
Joints of the Vertebral Column: Overview	16
Joints of the Vertebral Column: Craniovertebral Region	18
Vertebral Ligaments: Overview & Cervical Spine	20
Vertebral Ligaments: Thoracolumbar Spine	22

3 Muscles

Muscles of the Back: Overview	24
Intrinsic Muscles of the Cervical Spine	26
Intrinsic Muscles of the Back	28
Muscle Facts (I)	30
Muscle Facts (II)	32
Muscle Facts (III)	34

4 Neurovasculature

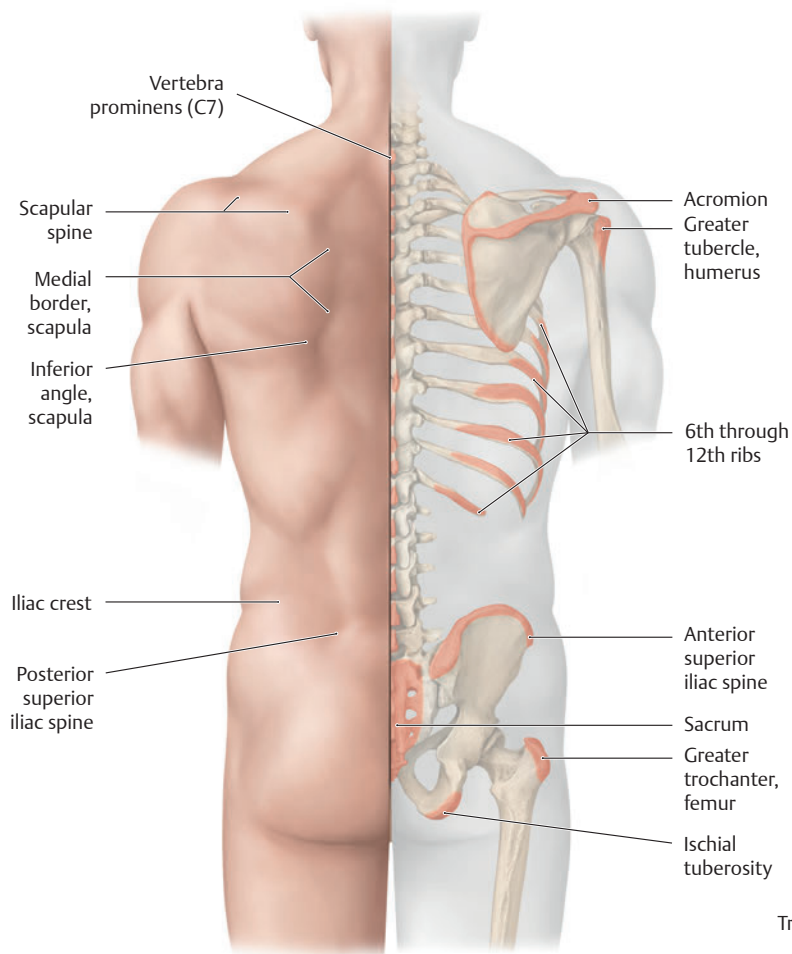
Arteries & Veins of the Back	36
Nerves of the Back	38
Spinal Cord	40
Spinal Cord Segments & Spinal Nerves	42
Arteries & Veins of the Spinal Cord	44
Neurovascular Topography of the Back	46

5 Sectional & Radiographic Anatomy

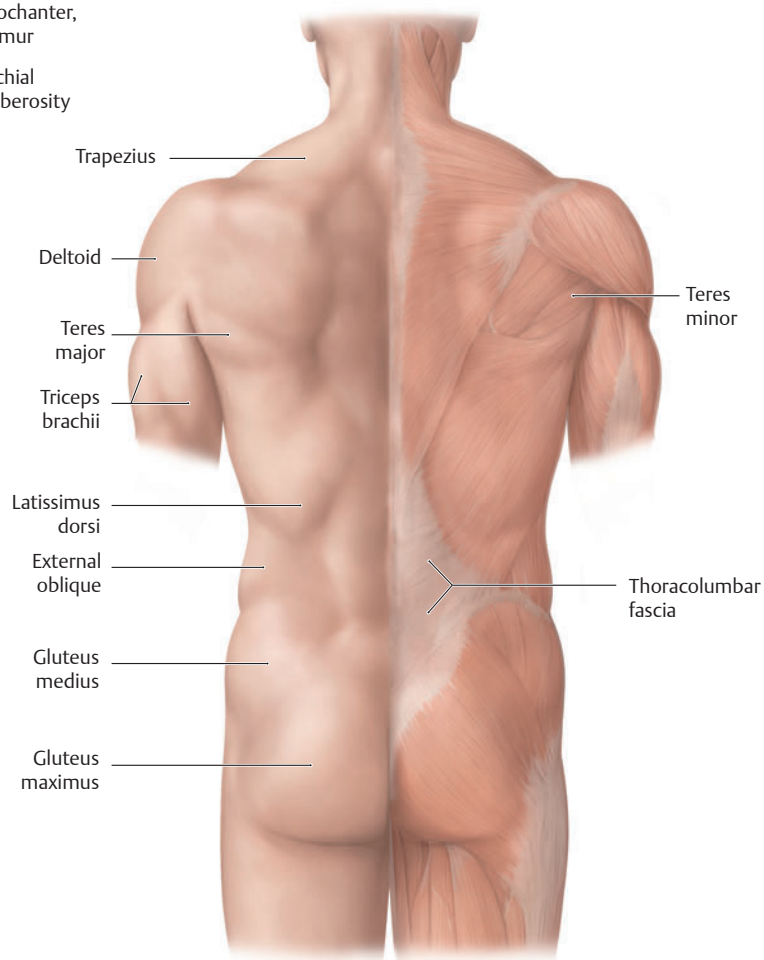
Radiographic Anatomy of the Back (I)	48
Radiographic Anatomy of the Back (II)	50

Surface Anatomy

Fig. 1.1 Palpable structures of the back
Posterior view.



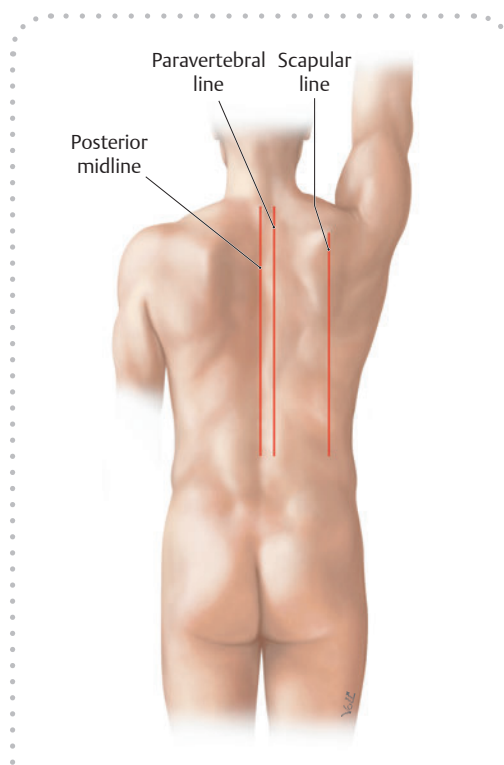
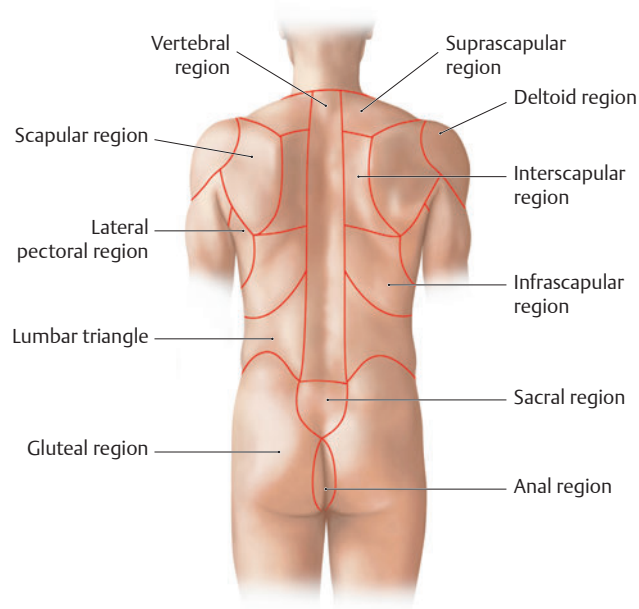
A Bony prominences.



B Musculature.

Fig. 1.2 Regions of the back and buttocks

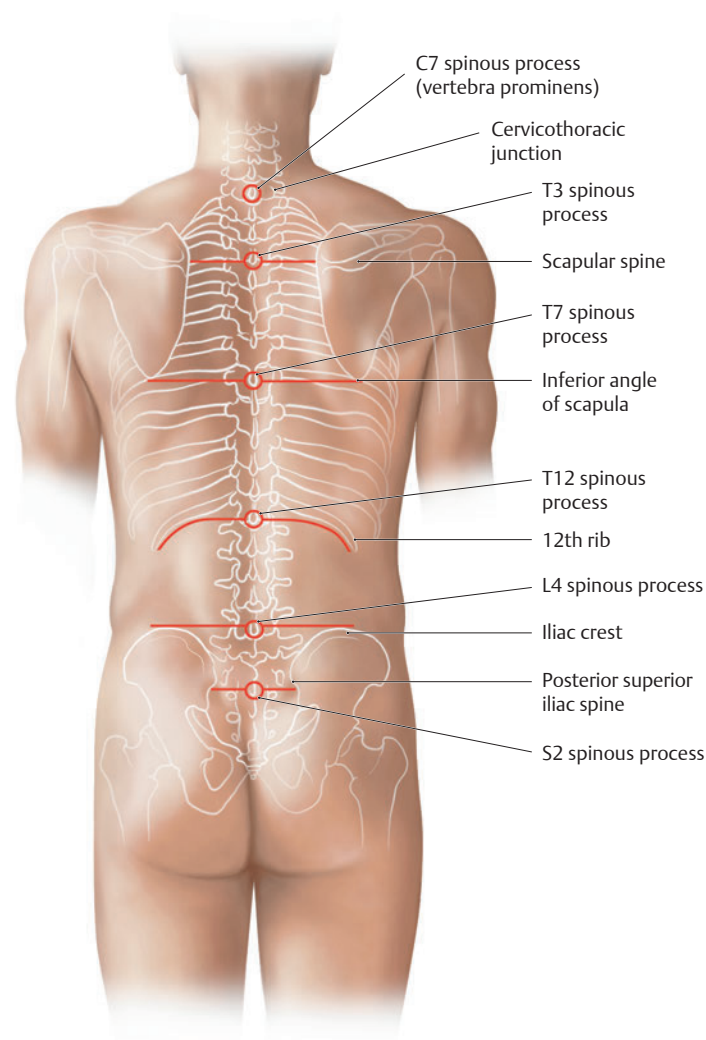
Posterior view.

**Table 1.1****Reference lines of the back**

Posterior midline	Posterior trunk midline at the level of the spinous processes
Paravertebral line	Line at the level of the transverse processes
Scapular line	Line through the inferior angle of the scapula

Fig. 1.3 Spinous processes and landmarks of the back

Posterior view.

**Table 1.2****Spinous processes that provide useful posterior landmarks**

Vertebral spinous process	Posterior landmark
C7	Vertebra prominens (the projecting spinous process of C7 is clearly visible and palpable)
T3	The scapular spine
T7	The inferior angle of the scapula
T12	Just below the 12th rib
L4	The summit of the iliac crest
S2	The posterior superior iliac spine (recognized by small skin depressions directly over the iliac spines)

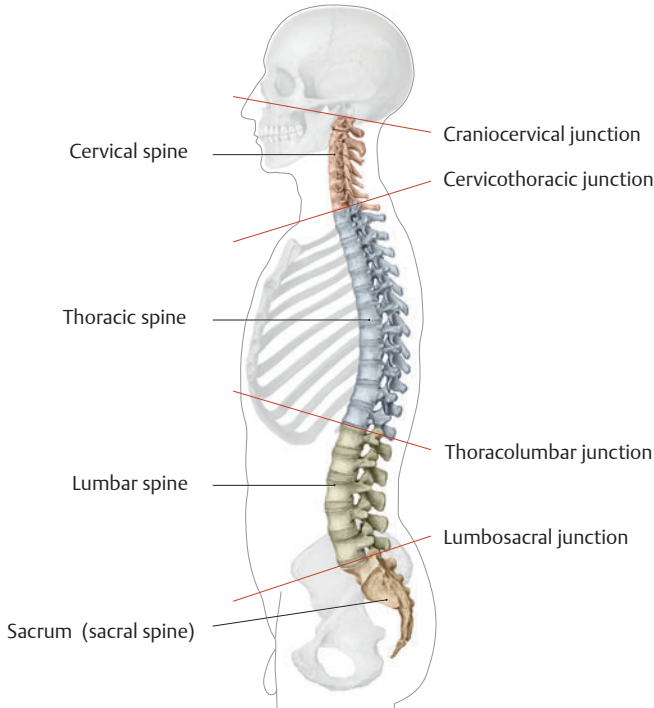
Vertebral Column: Overview



The vertebral column (spine) is divided into four regions: the cervical, thoracic, lumbar, and sacral spines. Both the cervical

and lumbar spines demonstrate lordosis (inward curvature); the thoracic and sacral spines demonstrate kyphosis (outward curvature).

Fig. 2.1 Vertebral column
Left lateral view.



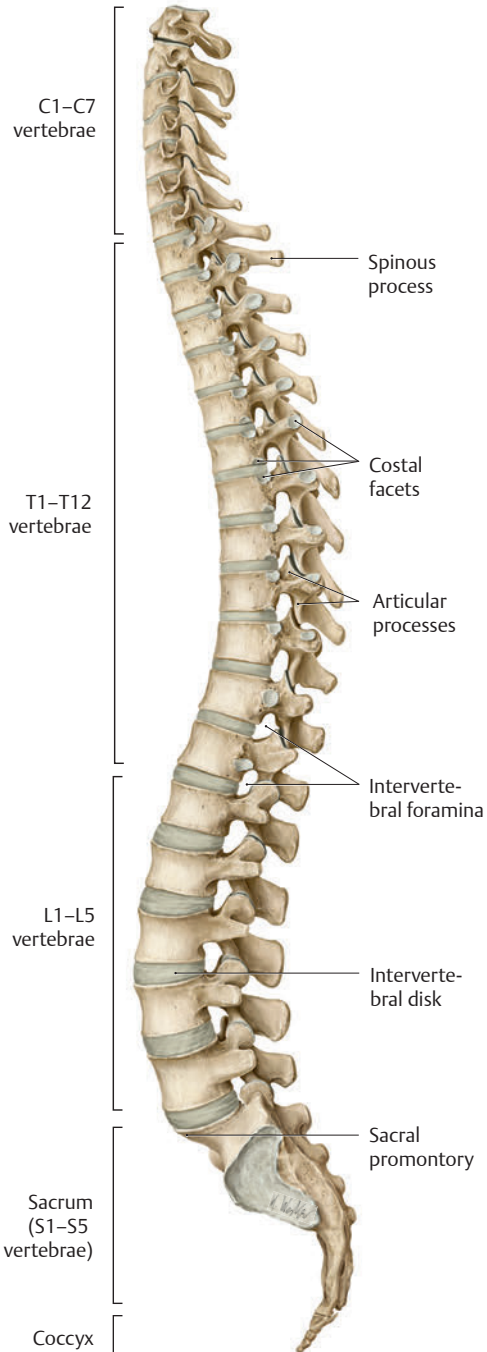
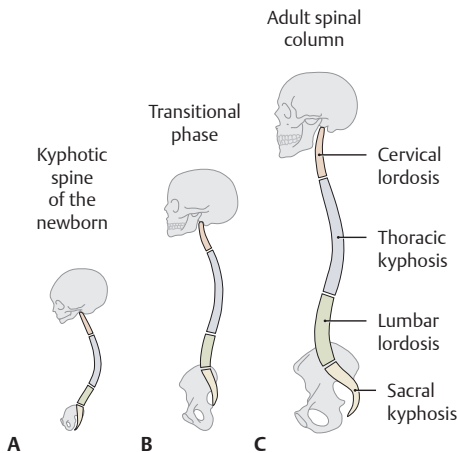
A Regions of the spine.



Clinical box 2.1

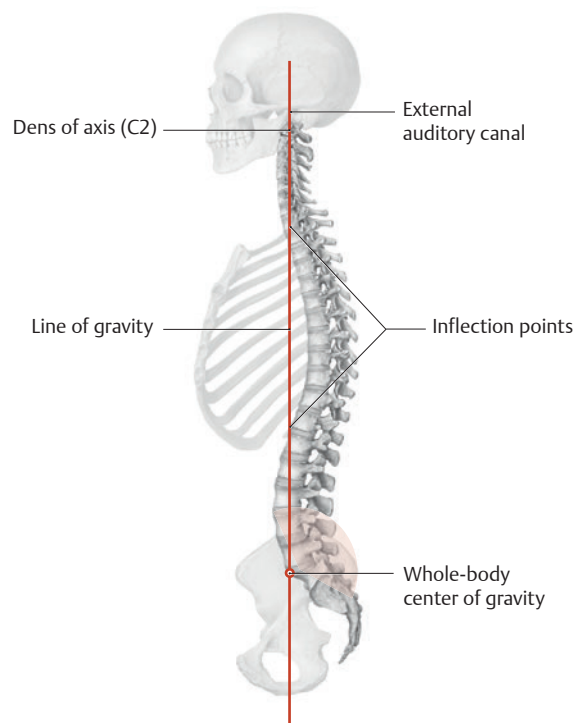
Spinal development

The characteristic curvatures of the adult spine appear over the course of postnatal development, being only partially present in a newborn. The newborn has a “kyphotic” spinal curvature (**A**); lumbar lordosis develops later and becomes stable at puberty (**C**).

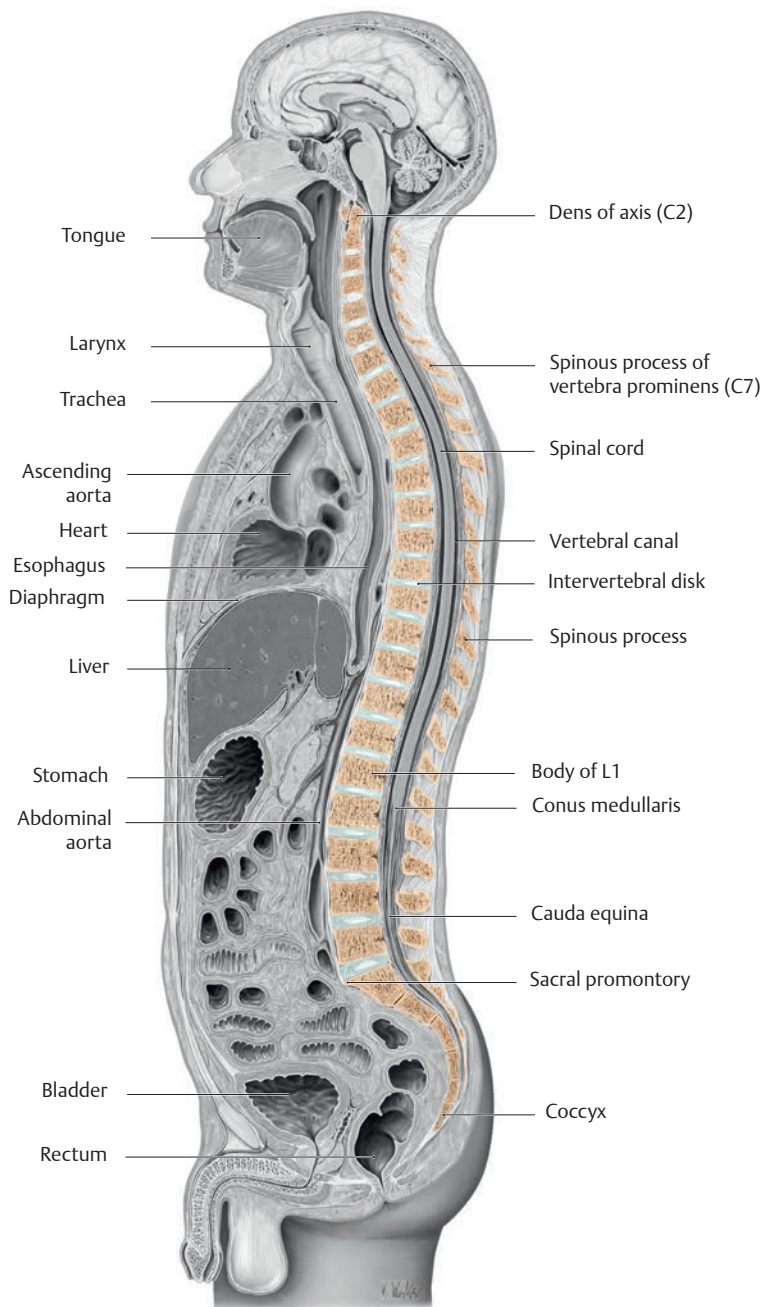


B Bony vertebral column.

Fig. 2.2 Normal anatomical position of the spine
Left lateral view.



A Line of gravity. The line of gravity passes through certain anatomical landmarks, including the inflection points at the cervicothoracic and thoracolumbar junctions. It continues through the center of gravity (anterior to the sacral promontory) before passing through the hip joint, knee, and ankle.



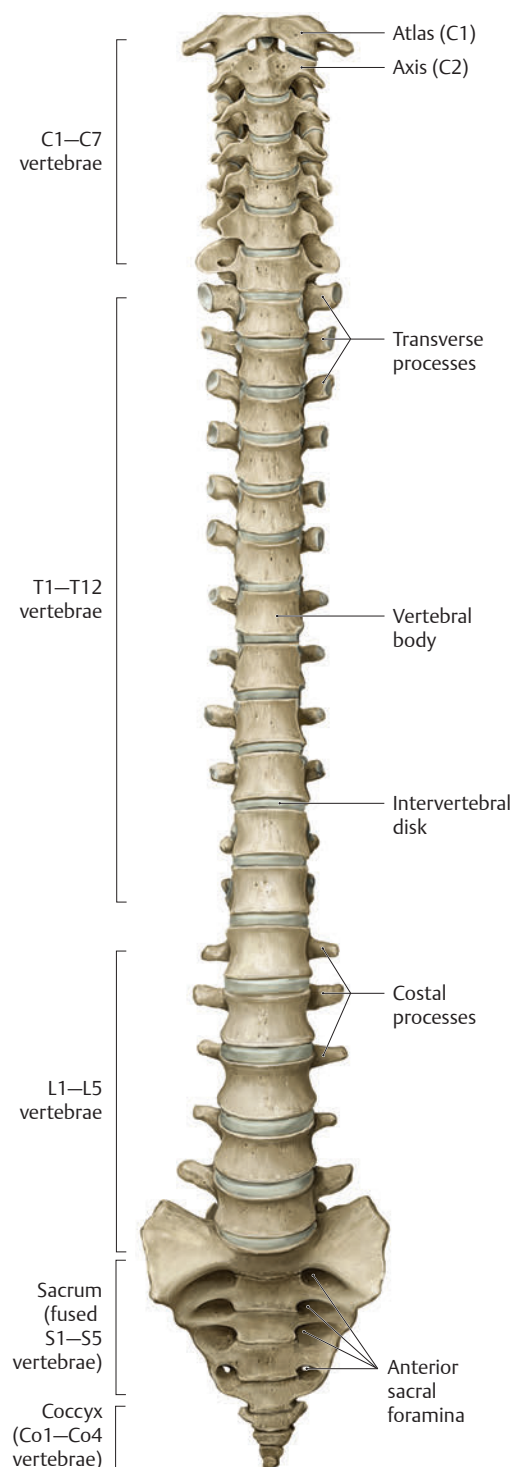
B Midsagittal section through an adult male.

Vertebral Column: Elements

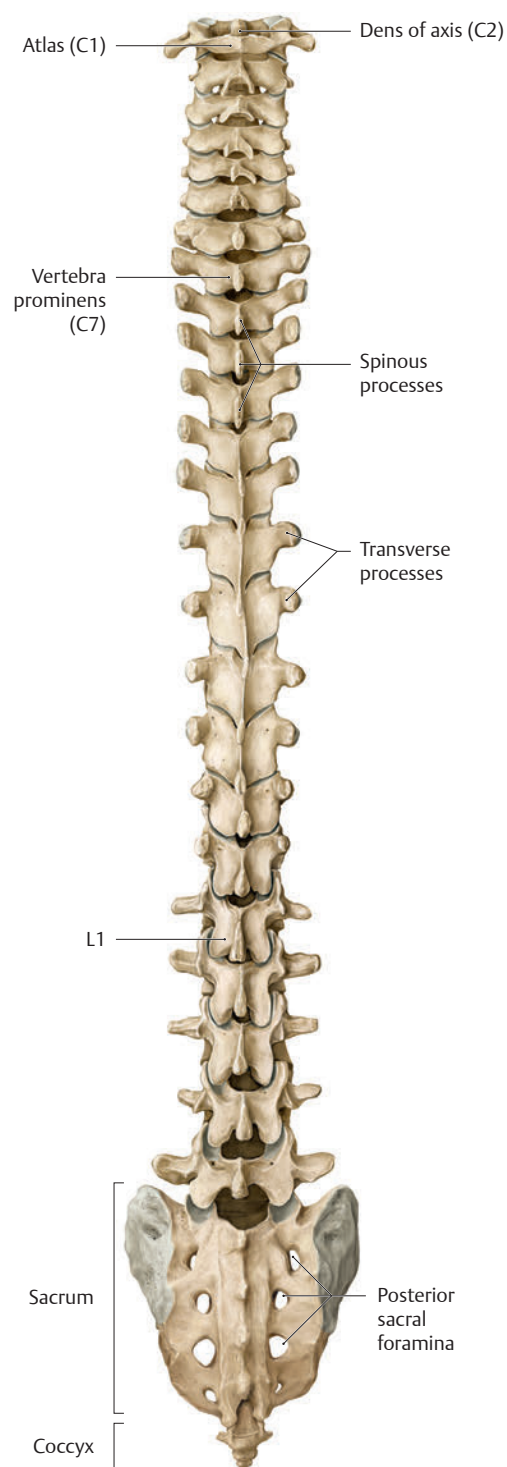
Back

Fig. 2.3 Bones of the vertebral column

The transverse processes of the lumbar vertebrae are originally rib rudiments and so are named costal processes.



A Anterior view.



B Posterior view.

Fig. 2.4 Structural elements of a vertebra

Left posterosuperior view. With the exception of the atlas (C1) and axis (C2), all vertebrae consist of the same structural elements.

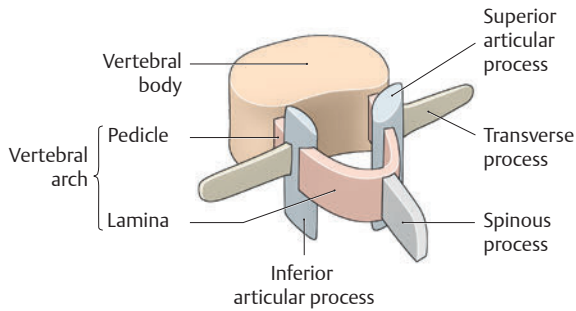
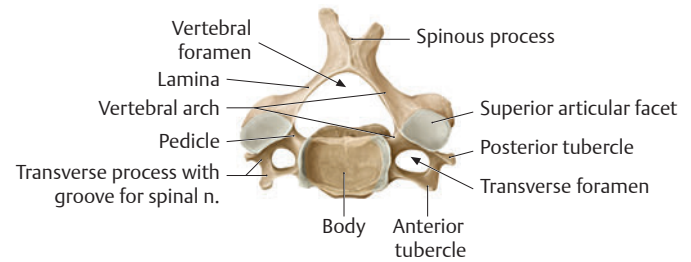
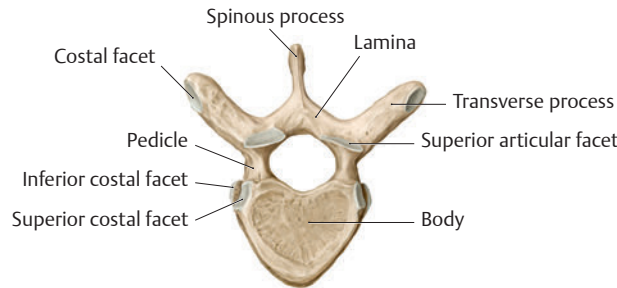


Fig. 2.5 Typical vertebrae

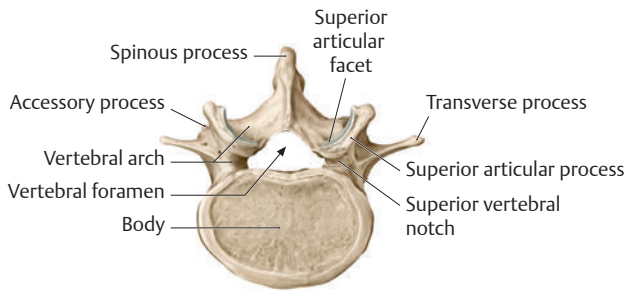
Superior view.



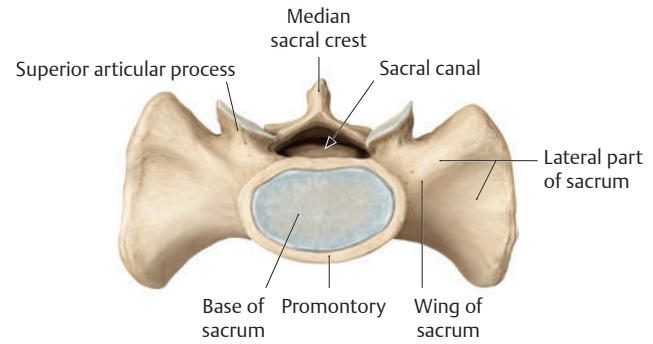
A Cervical vertebra (C4).



B Thoracic vertebra (T6).



C Lumbar vertebra (L4).



D Sacrum.

Table 2.1

Structural elements of vertebrae

Vertebrae	Body	Vertebral foramen	Transverse processes	Articular processes	Spinous process
Cervical vertebrae C3*–C7	Small (kidney-shaped)	Large (triangular)	Small (may be absent on C7); anterior and posterior tubercles enclose transverse foramen	Superoposteriorly and inferoanteriorly; oblique facets; most nearly horizontal	Short (C3–C5); bifid (C3–C6); long (C7)
Thoracic vertebrae T1–T12	Medium (heart-shaped); includes costal facets	Small (circular)	Large and strong; length decreases T1–T12; costal facets (T1–T10)	Posteriorly (slightly laterally) and anteriorly (slightly medially); facets in coronal plane	Long, sloping postero-inferiorly; tip extends to level of vertebral body below
Lumbar vertebrae L1–L5	Large (kidney-shaped)	Medium (triangular)	Called costal processes, long and slender; accessory process on posterior surface	Posteromedially (or medially) and anterolaterally (or laterally); facets nearly in sagittal plane; mammillary process on posterior surface of each superior articular process	Short and broad
Sacral vertebrae (sacrum) S1–S5 (fused)	Decreases from base to apex	Sacral canal	Fused to rudimentary rib (ribs, see pp. 56–59)	Superoposteriorly (S1) superior surface of lateral sacrum-auricular surface	Median sacral crest

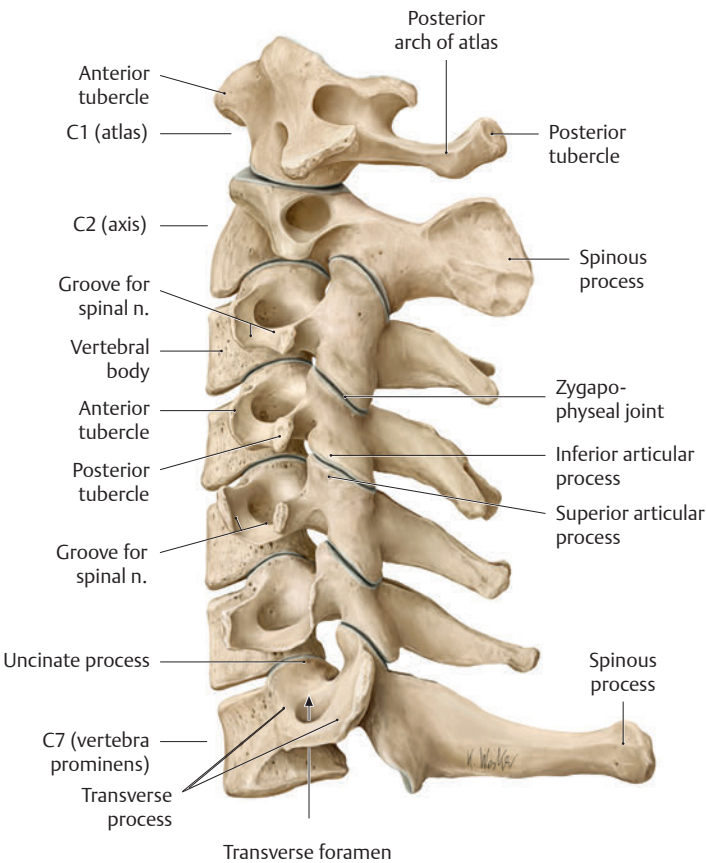
*C1 (atlas) and C2 (axis) are considered atypical (see pp. 8–9).

Cervical Vertebrae

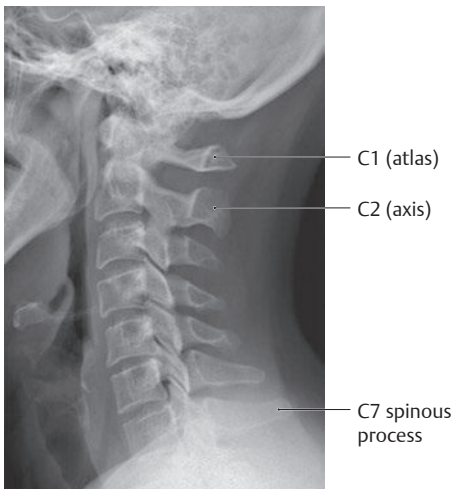
The seven vertebrae of the cervical spine differ most conspicuously from the common vertebral morphology. They are specialized to bear the weight of the head and allow the neck to move in

all directions. C1 and C2 are known as the atlas and axis, respectively. C7 is called the vertebra prominens for its long, palpable spinous process.

Fig. 2.6 Cervical spine
Left lateral view.

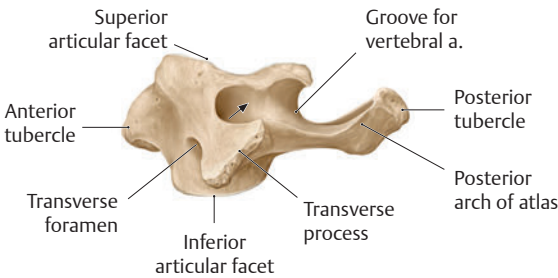


A Bones of the cervical spine, left lateral view.



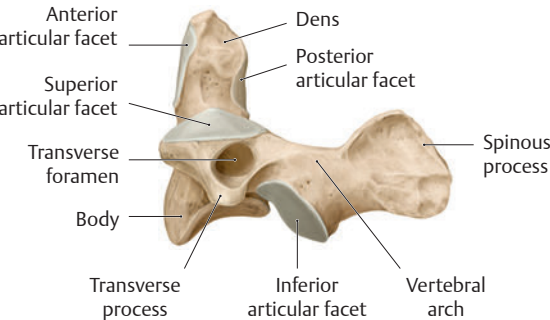
B Radiograph of the cervical spine, left lateral view.

Fig. 2.7 Atlas (C1)



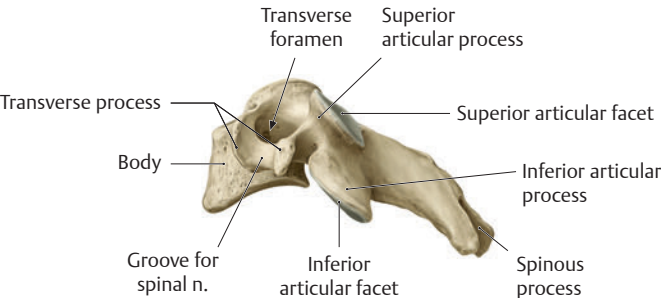
A Left lateral view.

Fig. 2.8 Axis (C2)



A Left lateral view.

Fig. 2.9 Typical cervical vertebra (C4)



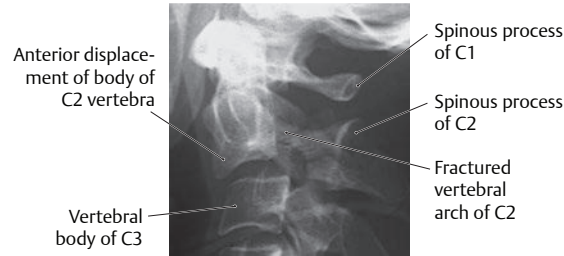
A Left lateral view.



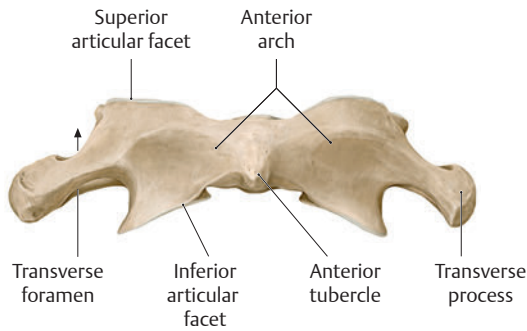
Clinical box 2.2

Injuries in the cervical spine

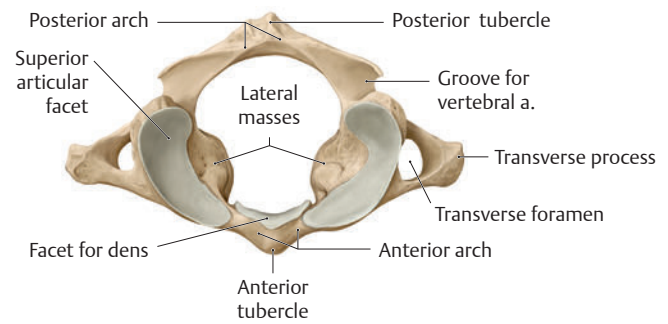
The cervical spine is prone to hyperextension injuries, such as “whiplash,” which can occur when the head extends back much farther than it normally would. The most common injuries of the cervical spine are fractures of the dens of the axis, traumatic spondylolisthesis (anterior slippage of a vertebral body), and atlas fractures. Patient prognosis is largely dependent on the spinal level of the injuries (see p. 42).



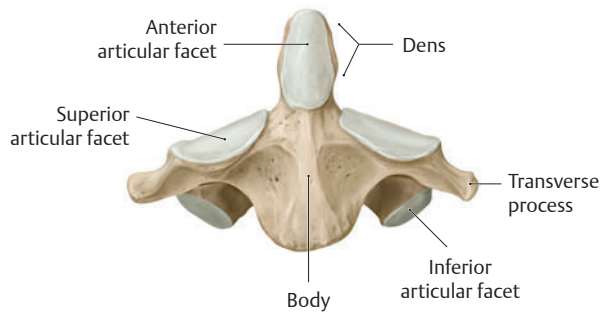
This patient hit the dashboard of his car while not wearing a seat belt. The resulting hyperextension caused the traumatic spondylolisthesis of C2 (axis) with fracture of the vertebral arch of C2, as well as tearing of the ligaments between C2 and C3. This injury is often referred to as “hangman’s fracture.”



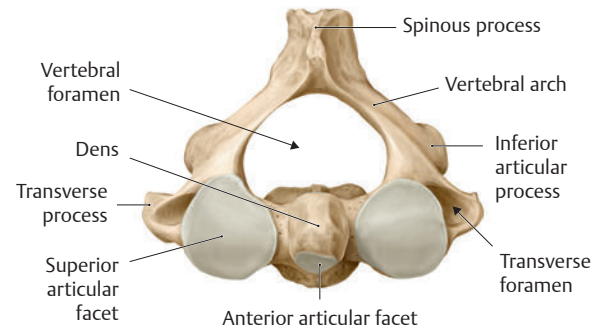
B Anterior view.



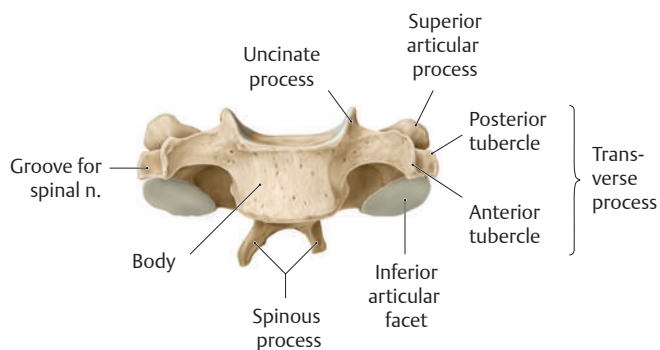
C Superior view.



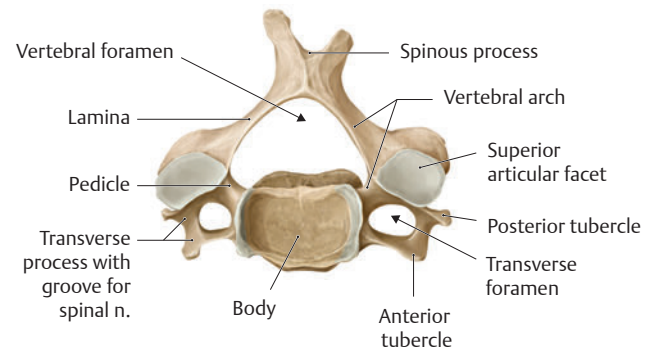
B Anterior view.



C Superior view.



B Anterior view.



C Superior view.

Thoracic & Lumbar Vertebrae

Back

Fig. 2.10 Thoracic spine
Left lateral view.

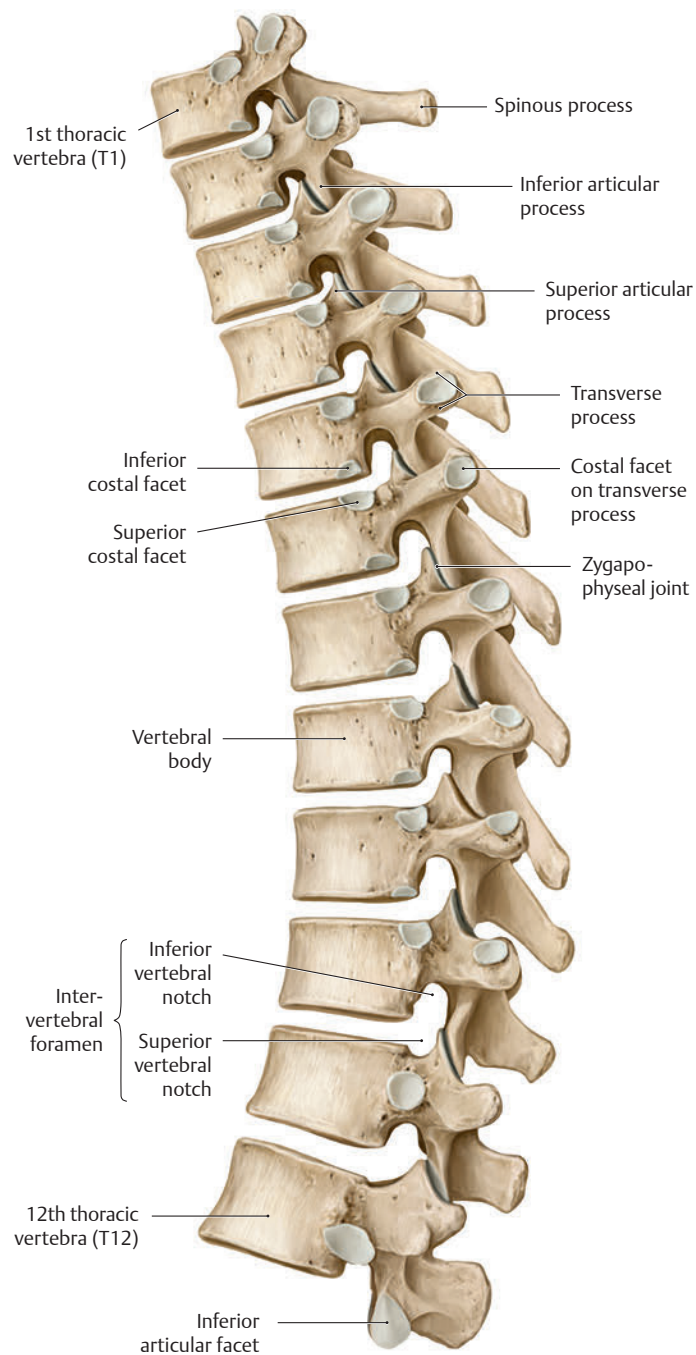
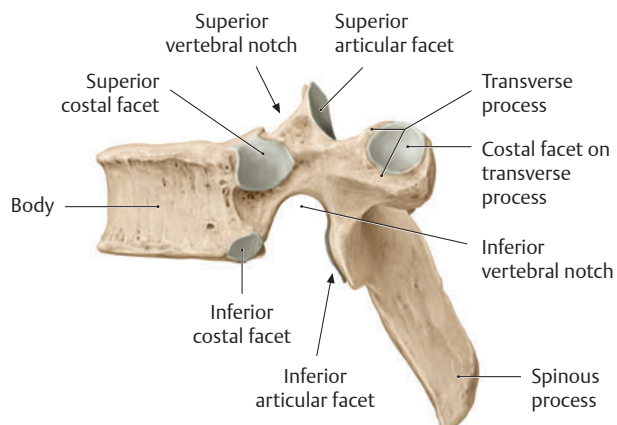
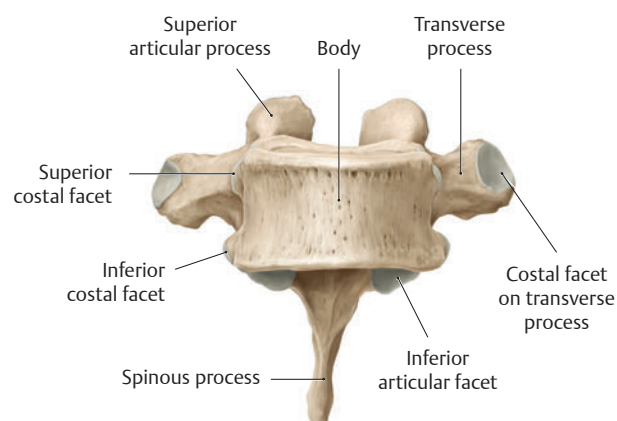


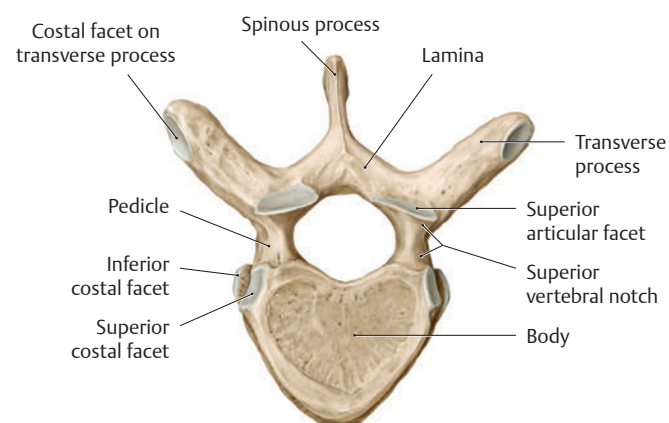
Fig. 2.11 Typical thoracic vertebra (T6)



A Left lateral view.



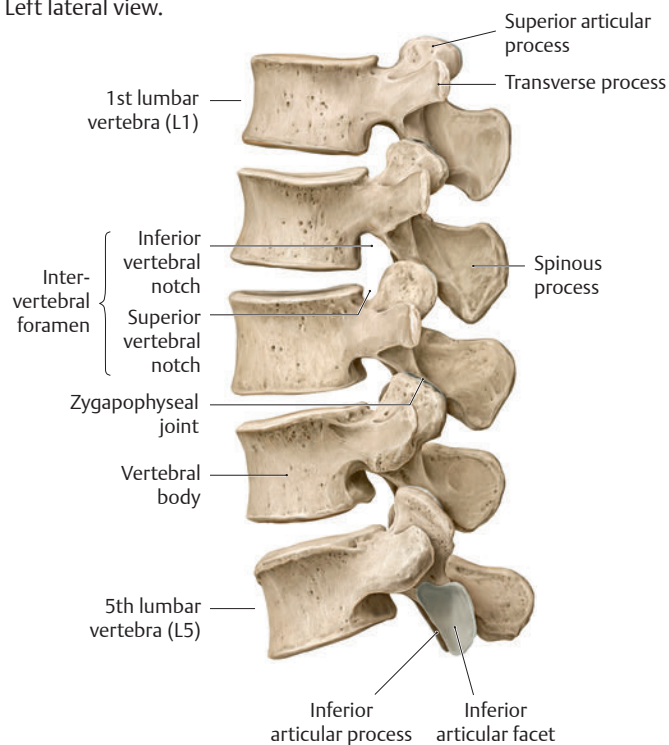
B Anterior view.



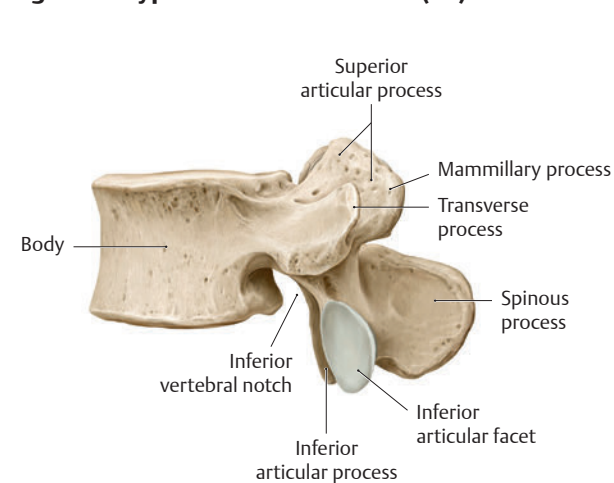
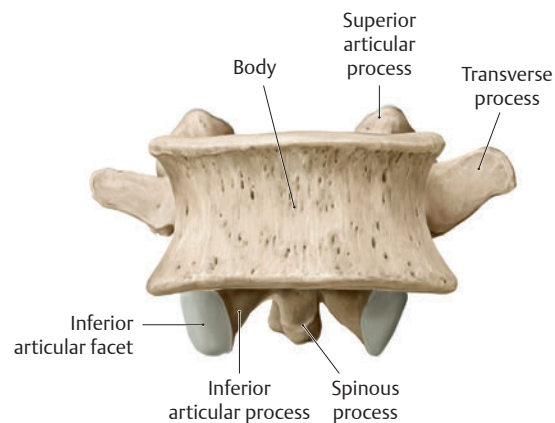
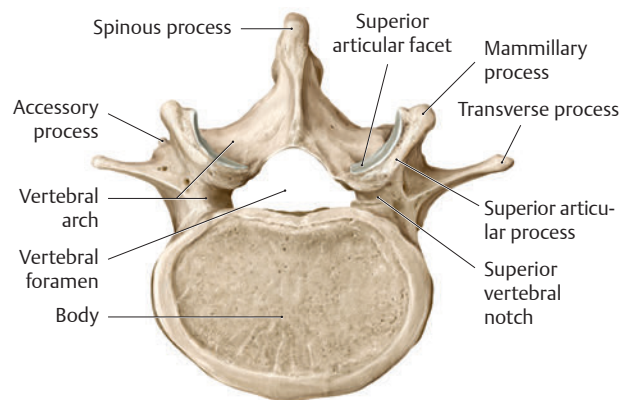
C Superior view.

Fig. 2.12 Lumbar spine

Left lateral view.

**Clinical box 2.3****Osteoporosis**

The spine is the structure most affected by degenerative diseases of the skeleton, such as arthrosis and osteoporosis. In osteoporosis, more bone material gets reabsorbed than built up, resulting in a loss of bone mass. Symptoms include compression fractures and resulting back pain.

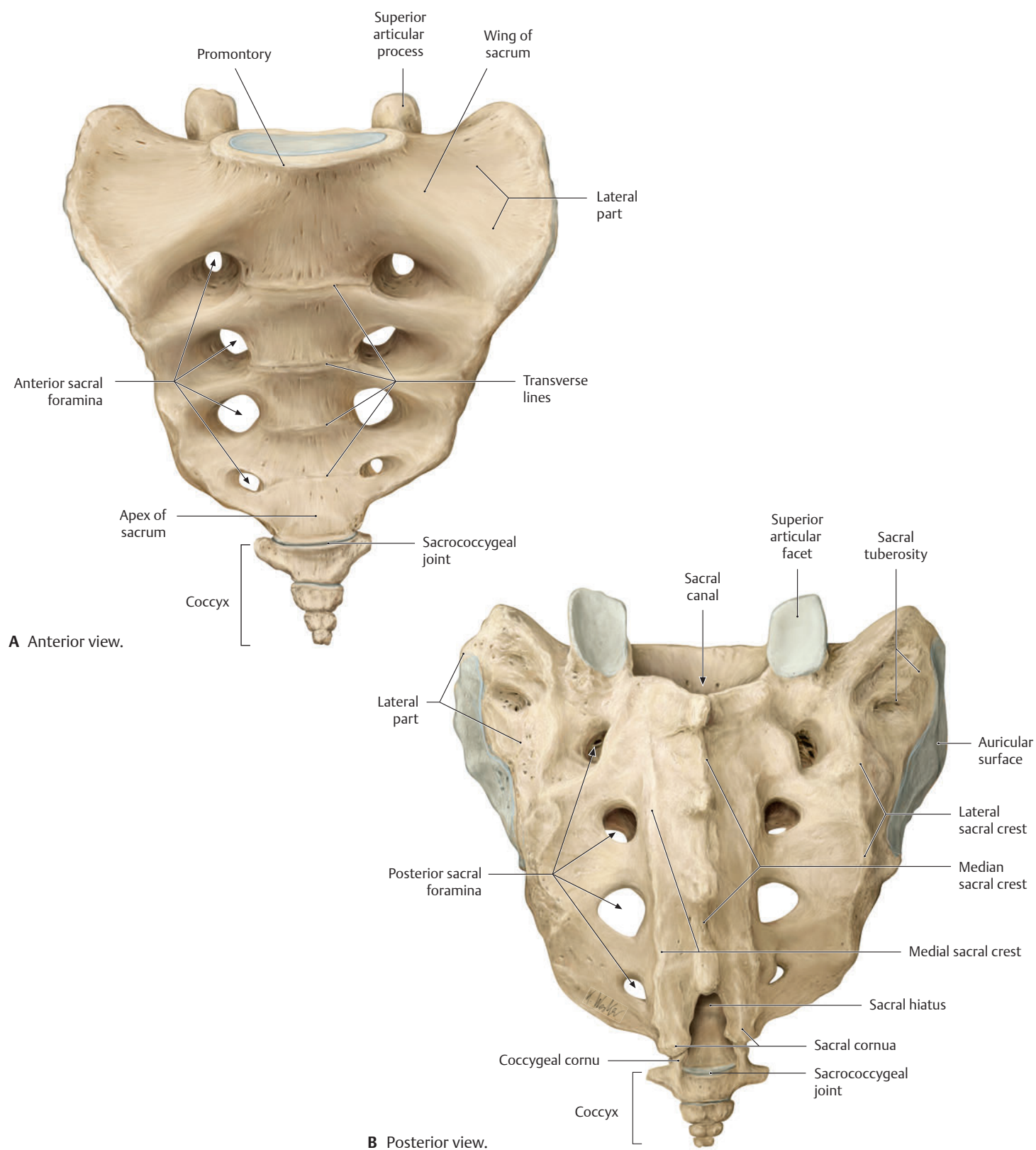
**A** Radiograph of a normal lumbar spine, left lateral view.**B** Radiograph of an osteoporotic lumbar spine with a compression fracture at L1 (arrow). Note that the vertebral bodies are decreased in density, and the internal trabecular structure is coarse.**Fig. 2.13 Typical lumbar vertebra (L4)****A** Left lateral view.**B** Anterior view.**C** Superior view.

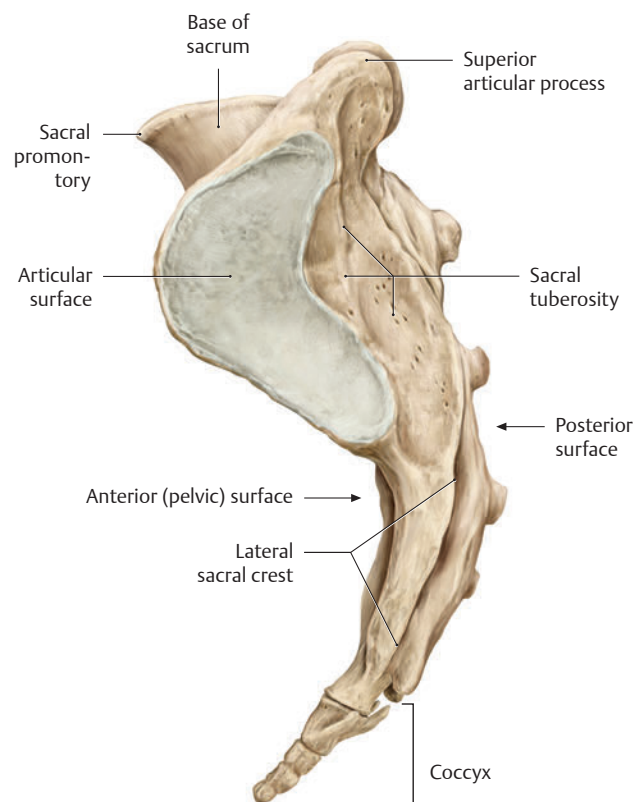
Sacrum & Coccyx

The sacrum is formed from five postnatally fused sacral vertebrae. The base of the sacrum articulates with the 5th lumbar

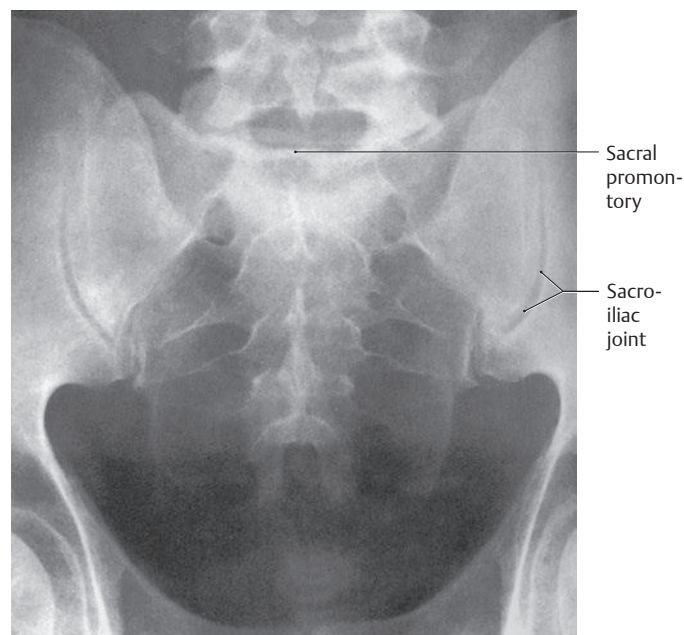
vertebra, and the apex articulates with the coccyx, a series of three or four rudimentary vertebrae. See **Fig. 19.1, p. 228.**

Fig. 2.14 Sacrum and coccyx





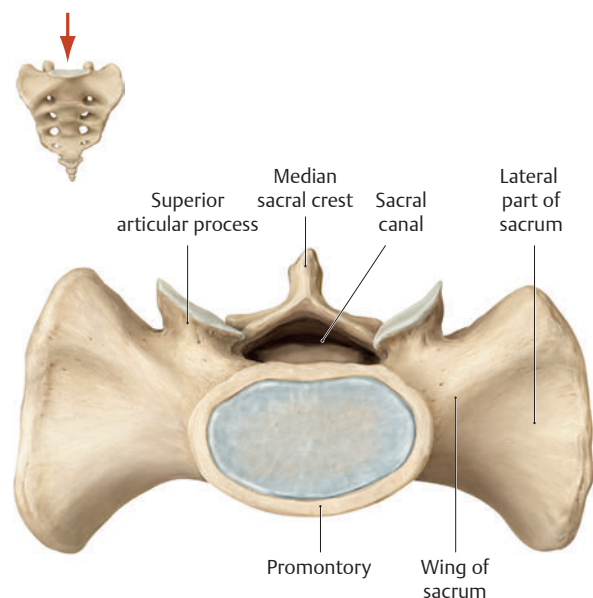
C Left lateral view.



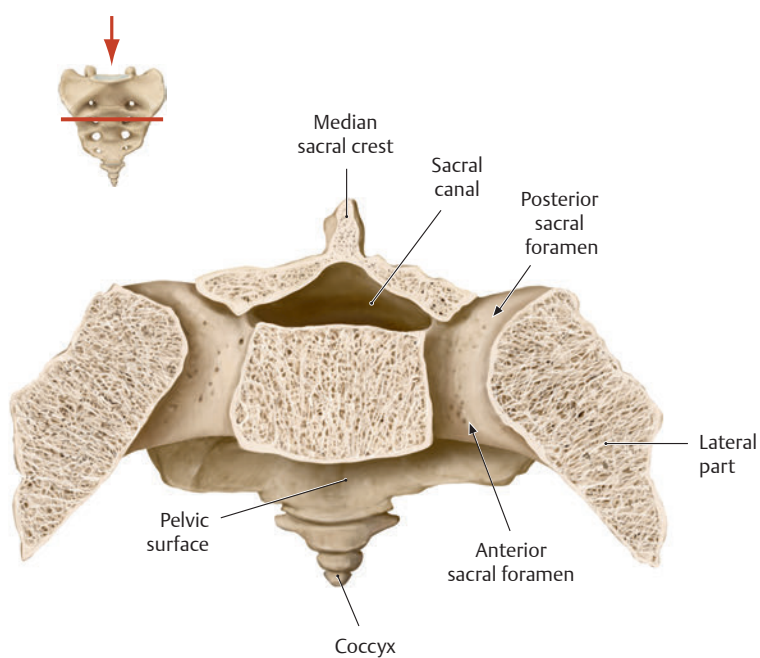
D Radiograph of sacrum, anteroposterior view.

Fig. 2.15 Sacrum

Superior view.



A Base of sacrum, superior view.



B Transverse section through second sacral vertebra demonstrating anterior and posterior sacral foramina, superior view.

Intervertebral Disks

Back

Fig. 2.16 Intervertebral disk in the vertebral column

Midsagittal section of T11–T12, left lateral view. The intervertebral disks occupy the spaces between vertebrae (intervertebral joints, see p. 16).

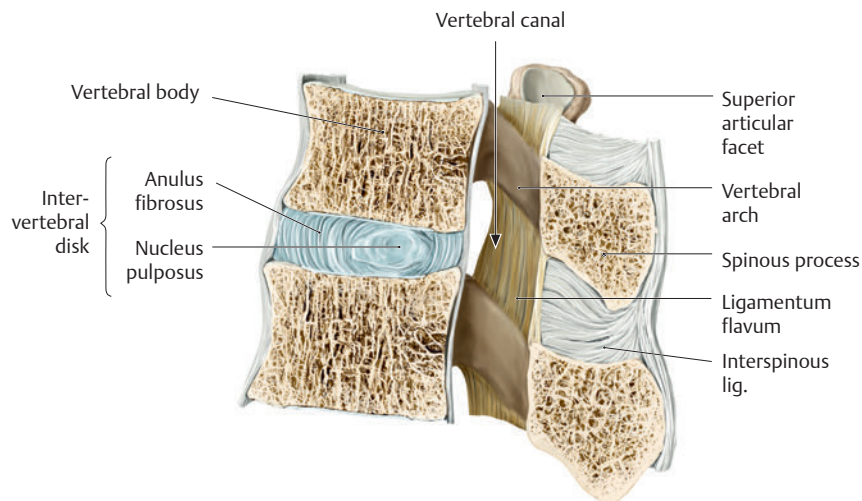


Fig. 2.17 Structure of intervertebral disk

Anterosuperior view with the anterior half of the disk and the right half of the end plate removed. The intervertebral disk consists of an external fibrous ring (annulus fibrosus) and a gelatinous core (nucleus pulposus).

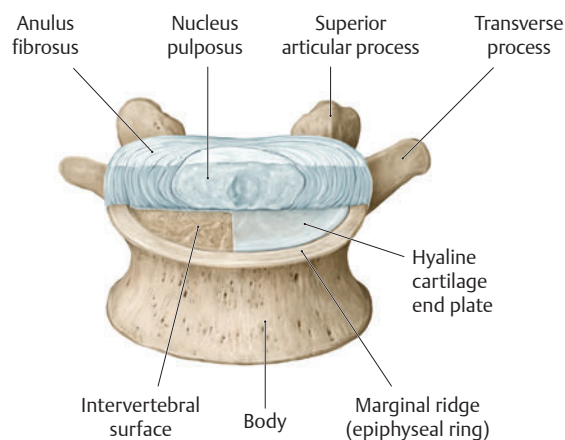


Fig. 2.18 Relation of intervertebral disk to vertebral canal

Fourth lumbar vertebra, superior view.

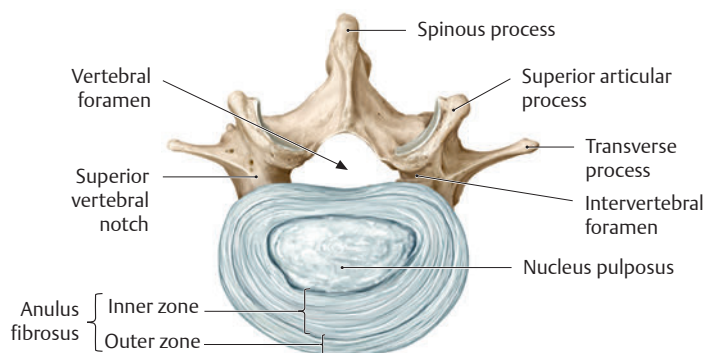
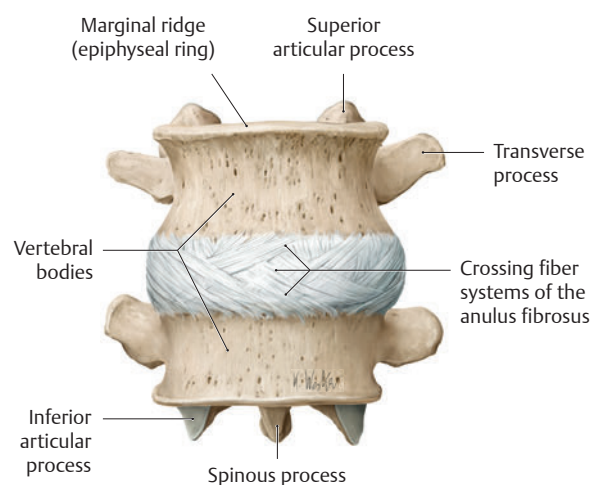


Fig. 2.19 Outer zone of the annulus fibrosus

Anterior view of L3–L4 with intervertebral disk.



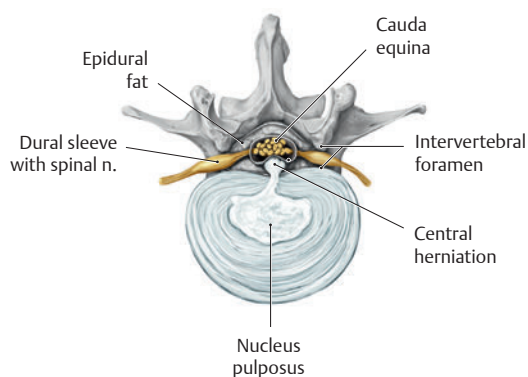


Clinical box 2.4

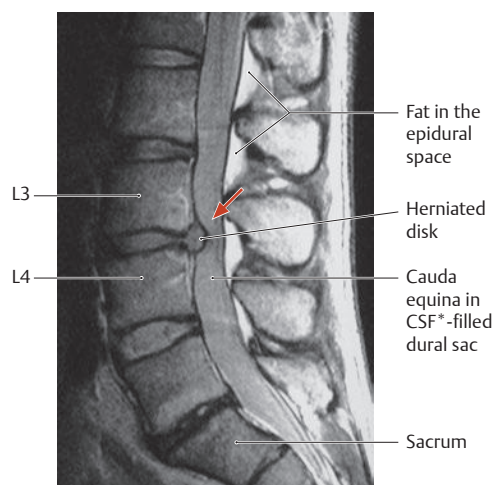
Disk herniation in the lumbar spine

As the stress resistance of the anulus fibrosus declines with age, the tissue of the nucleus pulposus may protrude through weak spots under loading. If the fibrous ring of the anulus ruptures completely, the herniated material may compress the contents of the intervertebral foramen (nerve roots and blood vessels—see posterolateral herniation below). These patients often suffer from severe local back pain. Pain is also felt in the associated dermatome

(see p. 42). When the motor part of the spinal nerve is affected, the muscles served by that spinal nerve will show weakening. It is an important diagnostic step to test the muscles innervated by a nerve from a certain spinal segment, as well as the sensitivity in the specific dermatome. Example: The first sacral nerve root innervates the gastrocnemius and soleus muscles; thus, standing or walking on toes can be affected (see p. 440).



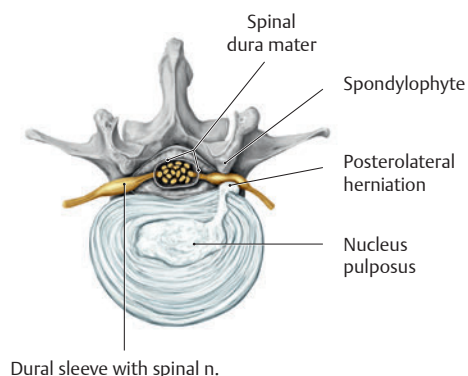
A Superior view.



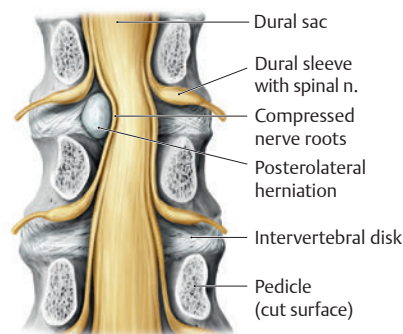
B Midsagittal T2-weighted MRI (magnetic resonance image).

Posterior herniation (A, B) In the MRI, a conspicuously herniated disk at the level of L3–L4 protrudes posteriorly (transligamentous herniation). The dural

sac is deeply indented at that level. *CSF (cerebrospinal fluid).



C Superior view.



D Posterior view, vertebral arches removed.

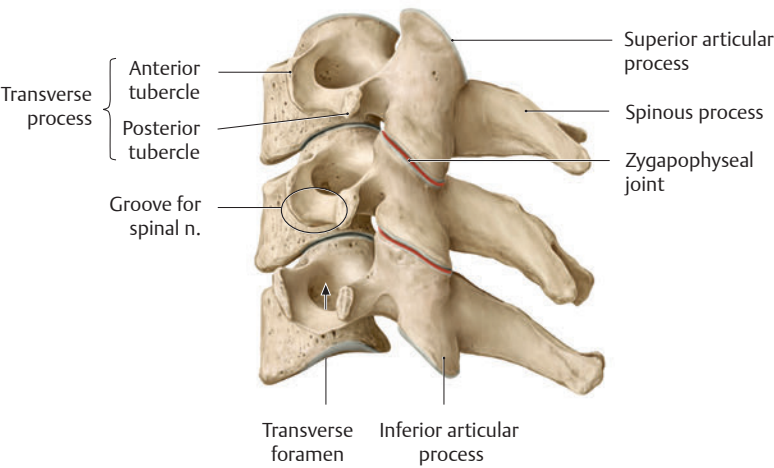
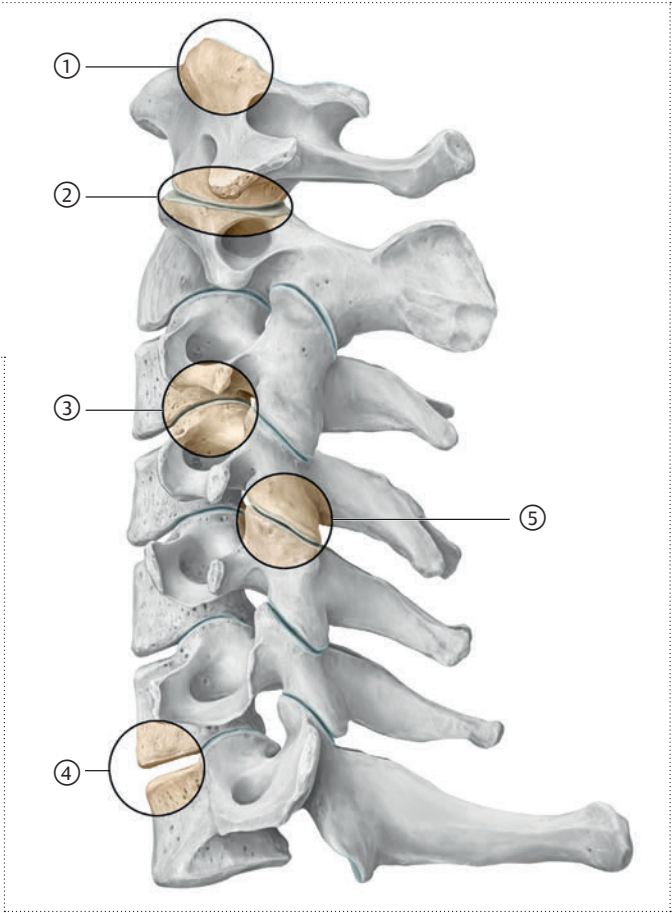
Posterolateral herniation (C, D) A posterolateral herniation may compress the spinal nerve as it passes through the intervertebral foramen. If more

medially positioned, the herniation may spare the nerve at that level but impact nerves at inferior levels.

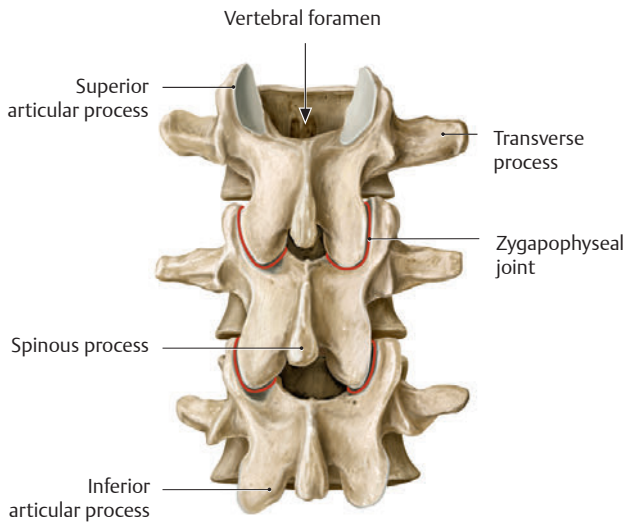
Joints of the Vertebral Column: Overview

Table 2.2 Joints of the vertebral column		
Craniovertebral joints		
①	Atlanto-occipital joints	Occiput–C1
②	Atlantoaxial joints	C1–C2
Joints of the vertebral bodies		
③	Uncovertebral joints	C3–C7
④	Intervertebral joints	C2–S1
Joints of the vertebral arch		
⑤	Zygapophyseal joints	C2–S1

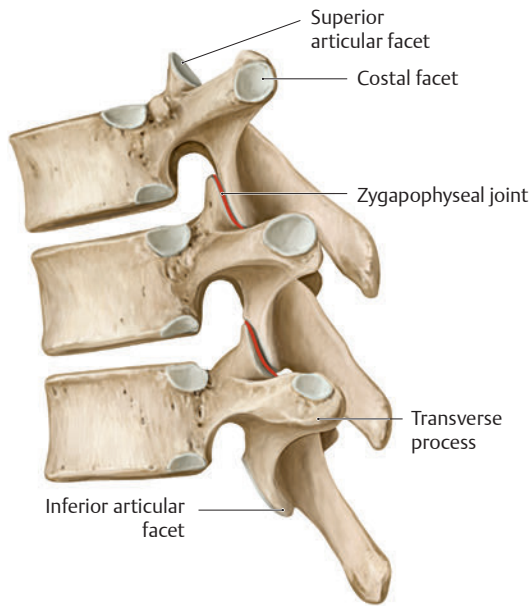
Fig. 2.20 Zygapophyseal (intervertebral facet) joints
The orientation of the zygapophyseal joints differs between the spinal regions, influencing the degree and direction of movement.



A Cervical region, left lateral view. The zygapophyseal joints lie 45 degrees from the horizontal.



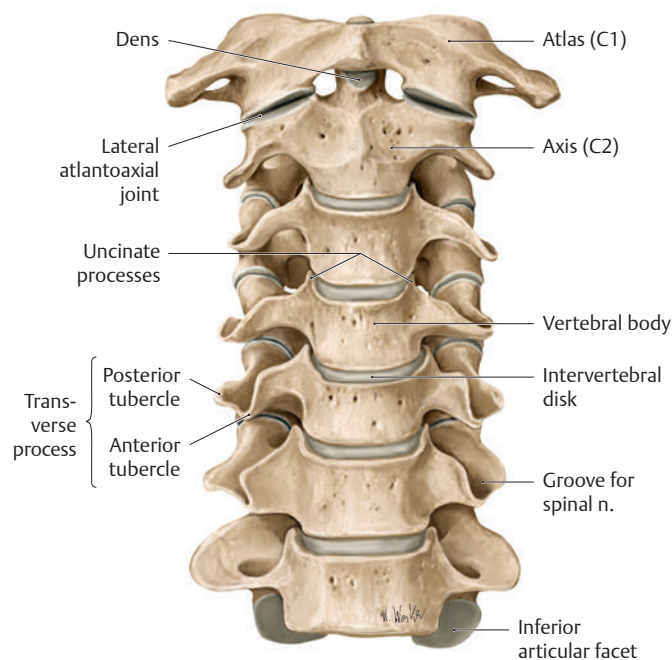
C Lumbar region, posterior view. The joints lie in the sagittal plane.



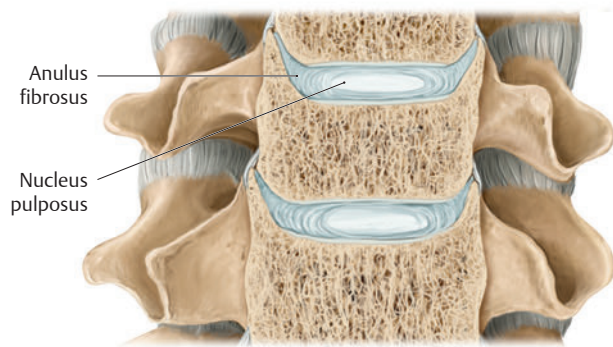
B Thoracic region, left lateral view. The joints lie in the coronal plane.

Fig. 2.21 Uncovertebral joints

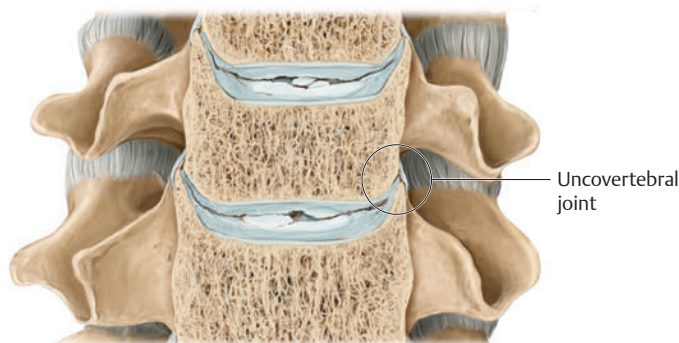
Anterior view. Uncovertebral joints form during childhood between the uncinate processes of C3–C7 and the vertebral bodies immediately superior. The joints may result from fissures in the cartilage of the disks that assume an articular character. If the fissures become complete tears, the risk of nucleus pulposus herniation is increased (see p. 15).



A Uncovertebral joints in the cervical spine of an 18-year-old man, anterior view.



B Uncovertebral joint (enlarged), anterior view of coronal section.

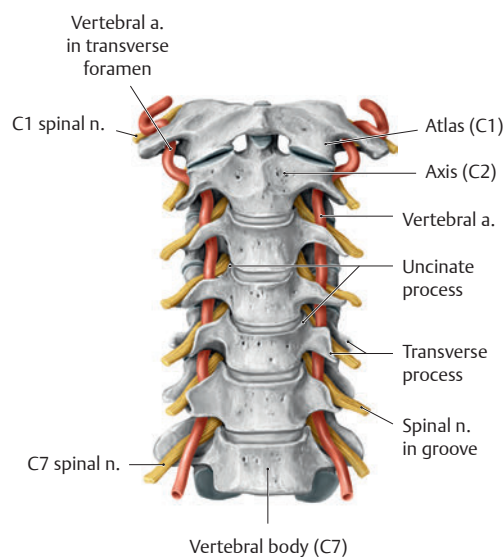


C Uncovertebral joints, split intervertebral disks, anterior view of coronal section.

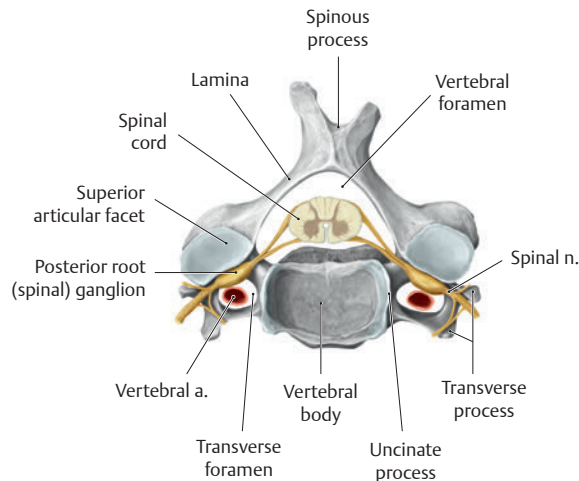
**Clinical box 2.5**

Proximity of the spinal nerve and vertebral artery to the uncinate process

The spinal nerve and vertebral artery pass through the intervertebral and transverse foramina, respectively. Bony outgrowths (osteophytes) on the uncinate process resulting from uncovertebral arthrosis (degeneration) may compress both the nerve and the artery and can lead to chronic pain in the cervical region.



A Cervical spine, anterior view.



B Fourth cervical vertebra, superior view.

Joints of the Vertebral Column: Craniovertebral Region

Fig. 2.22 Craniovertebral joints

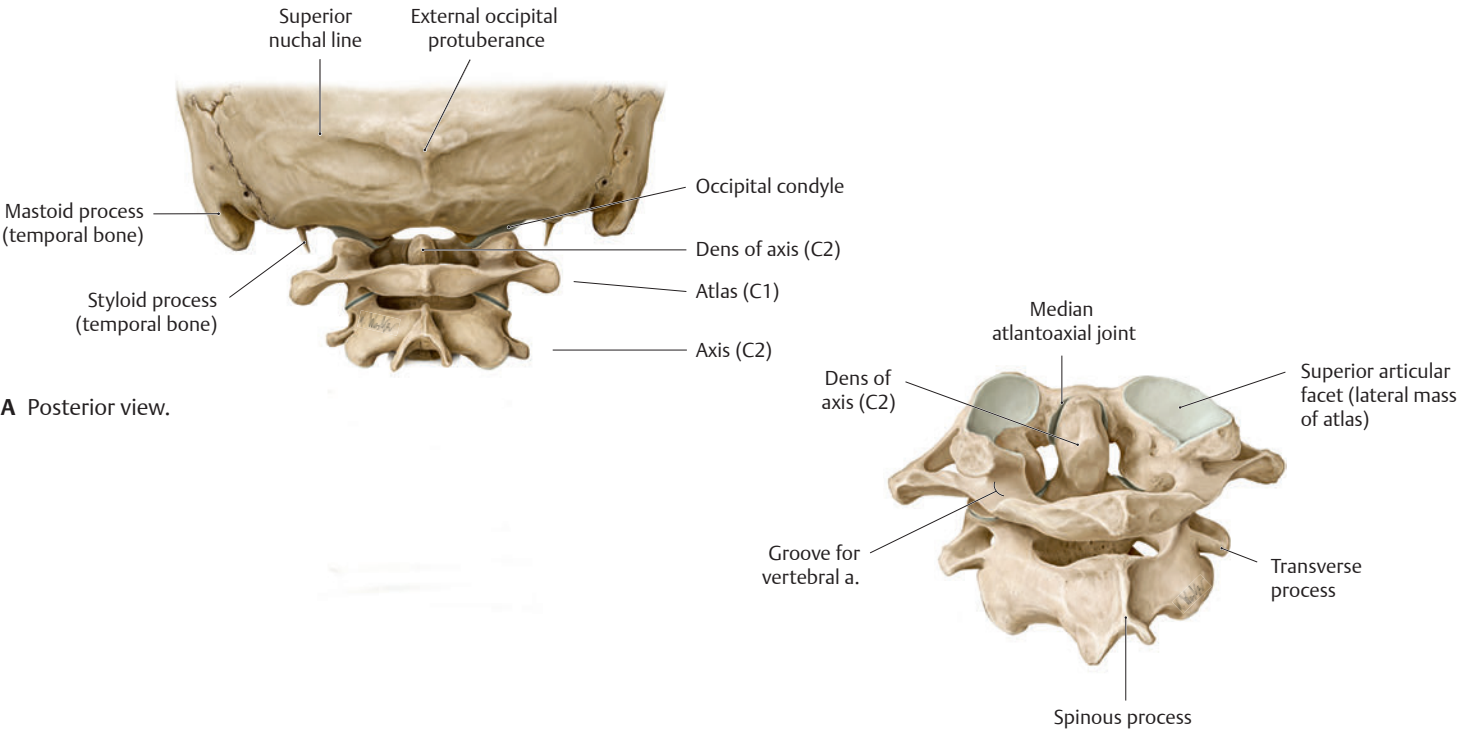
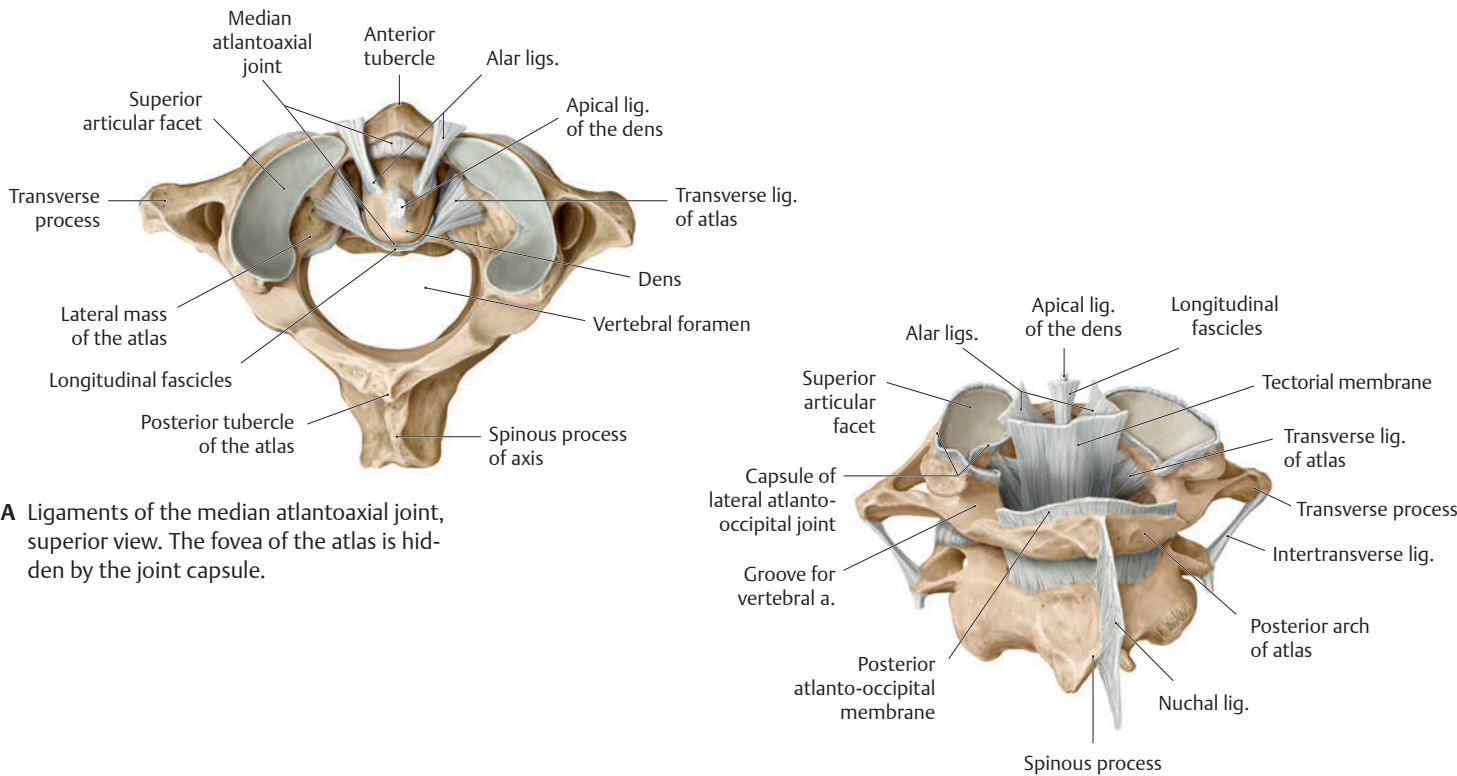


Fig. 2.23 Ligaments of the craniovertebral joints

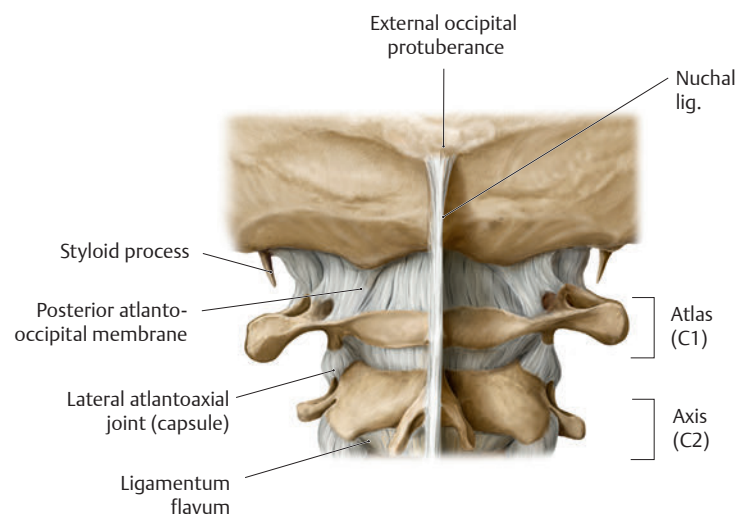




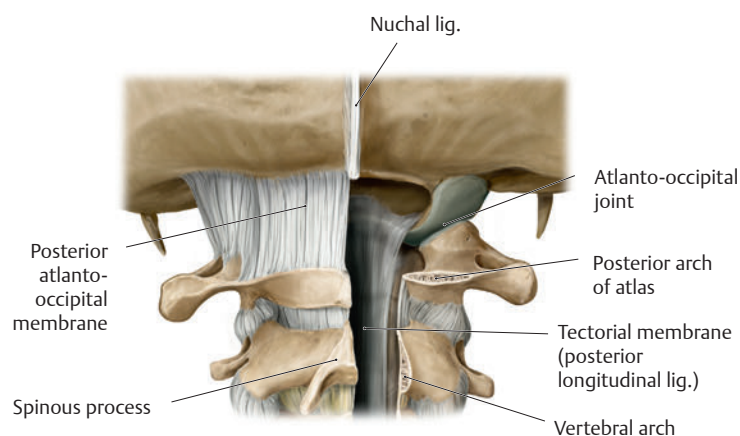
The atlanto-occipital joints are the two articulations between the convex occipital condyles of the occipital bone and the slightly concave superior articular facets of the atlas (C1). The atlanto-

axial joints are the two lateral and one medial articulations between the atlas (C1) and axis (C2).

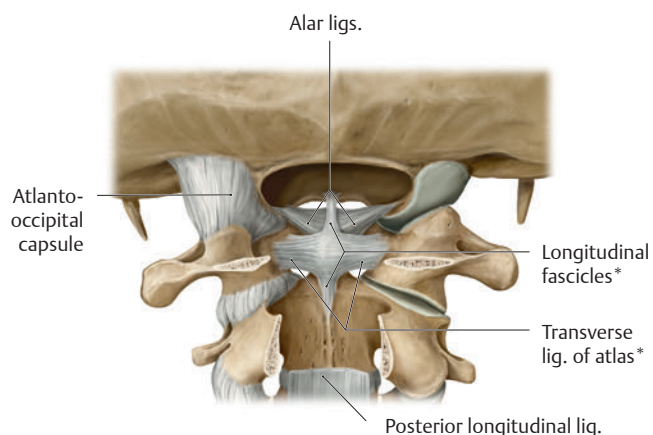
Fig. 2.24 Dissection of the craniovertebral joint ligaments



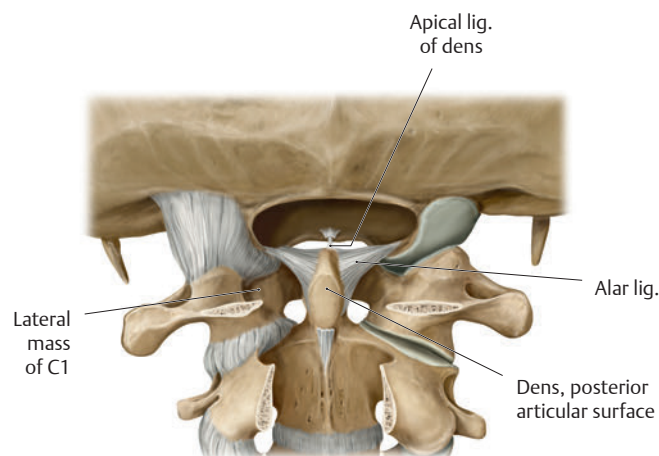
A Nuchal ligament and posterior atlanto-occipital membrane.



B Posterior longitudinal ligament. *Removed:* Spinal cord; vertebral canal windowed.



C Cruciform ligament of atlas (*). *Removed:* Tectorial membrane, posterior atlanto-occipital membrane, and vertebral arches.



D Alar and apical ligaments. *Removed:* Transverse ligament of atlas.

Vertebral Ligaments: Overview & Cervical Spine

The ligaments of the spinal column bind the vertebrae and enable the spine to withstand high mechanical loads and shearing

stresses and limit the range of motion. The ligaments are subdivided into vertebral body ligaments and vertebral arch ligaments.

Fig. 2.25 Vertebral ligaments
Viewed obliquely from the left posterior view.

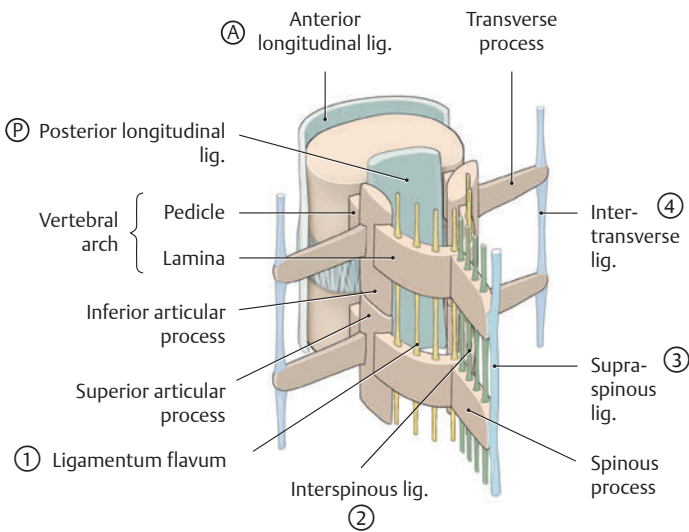


Table 2.3 Vertebral ligaments		
Ligament		Location
Vertebral body ligaments		
(A)	Anterior longitudinal lig.	Along anterior surface of vertebral body
(P)	Posterior longitudinal lig.	Along posterior surface of vertebral body
Vertebral arch ligaments		
(1)	Ligamentum flavum	Between laminae
(2)	Interspinous lig.	Between spinous process
(3)	Supraspinous lig.	Along posterior ridge of spinous processes
(4)	Intertransverse lig.	Between transverse processes
Nuchal lig.*		Between external occipital protuberance and spinous process of C7
*Corresponds to a supraspinous ligament that is broadened superiorly.		

Fig. 2.26 Anterior longitudinal ligament
Anterior view with base of skull removed.

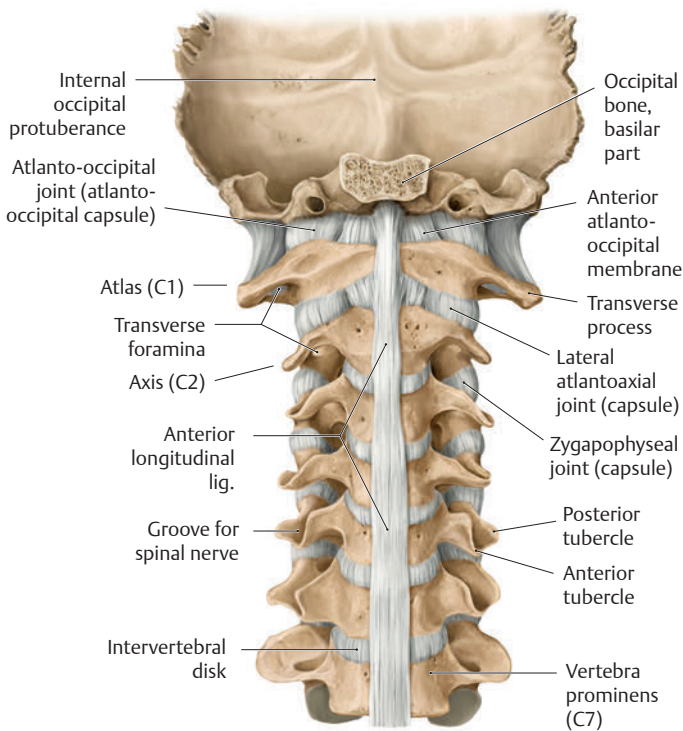


Fig. 2.27 Posterior longitudinal ligament
Posterior view with vertebral canal opened via laminectomy and spinal cord removed. The tectorial membrane is a broadened expansion of the posterior longitudinal ligament.

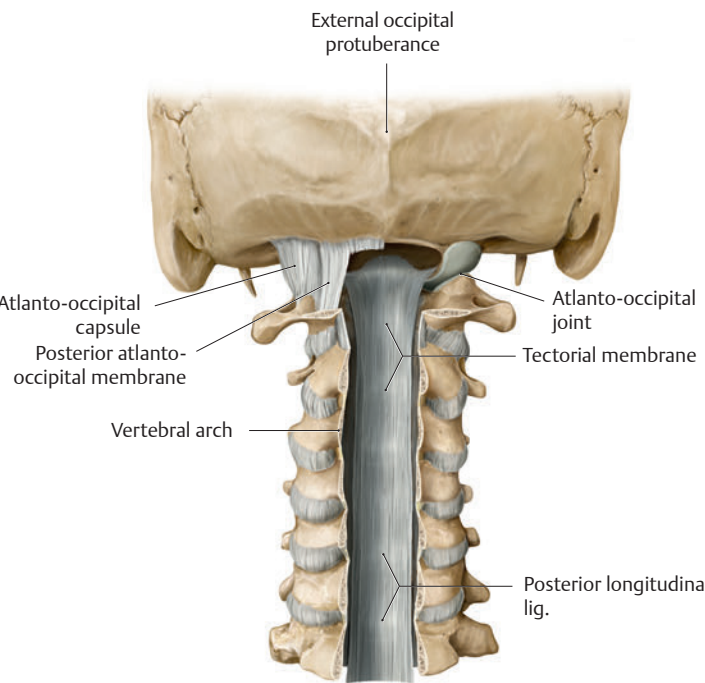
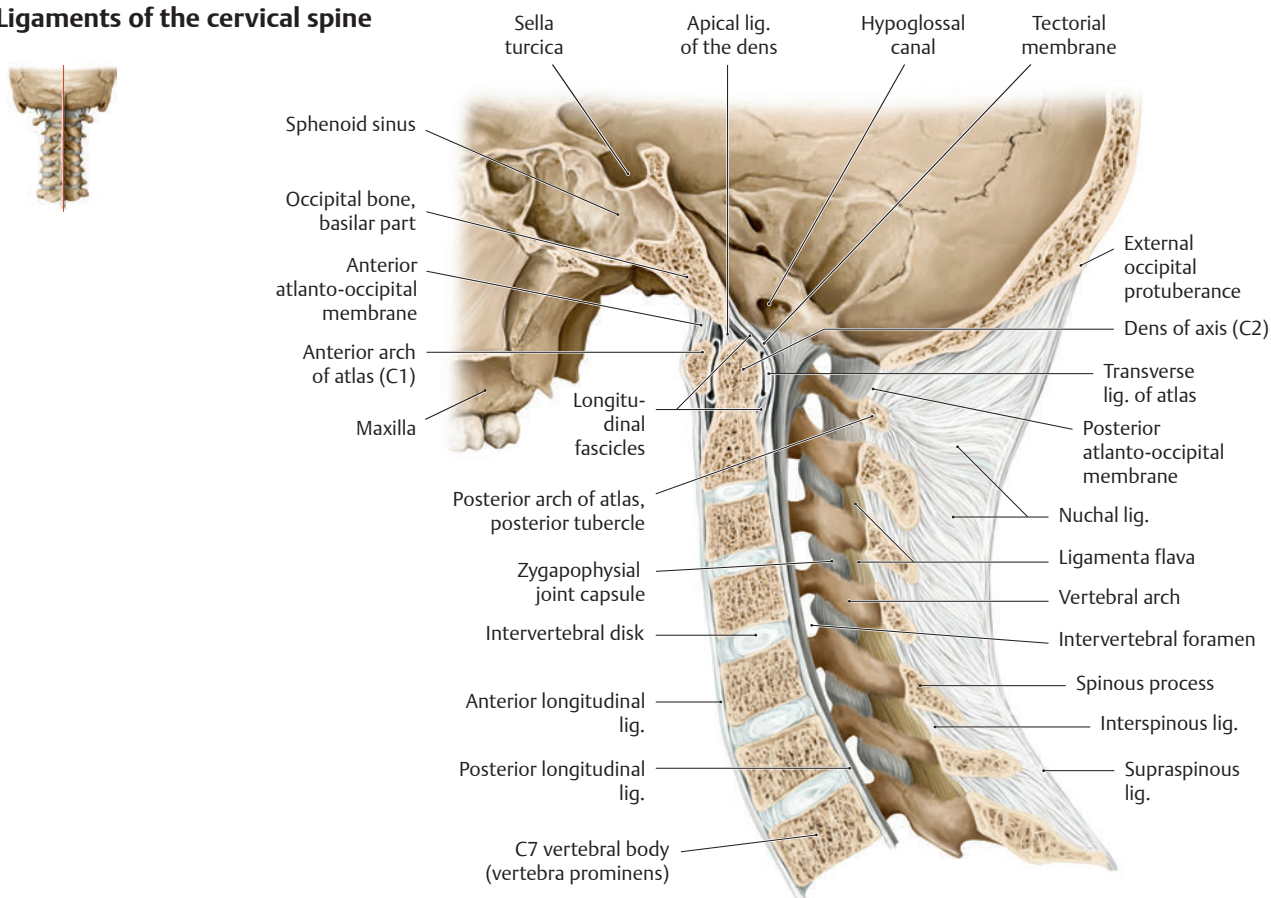
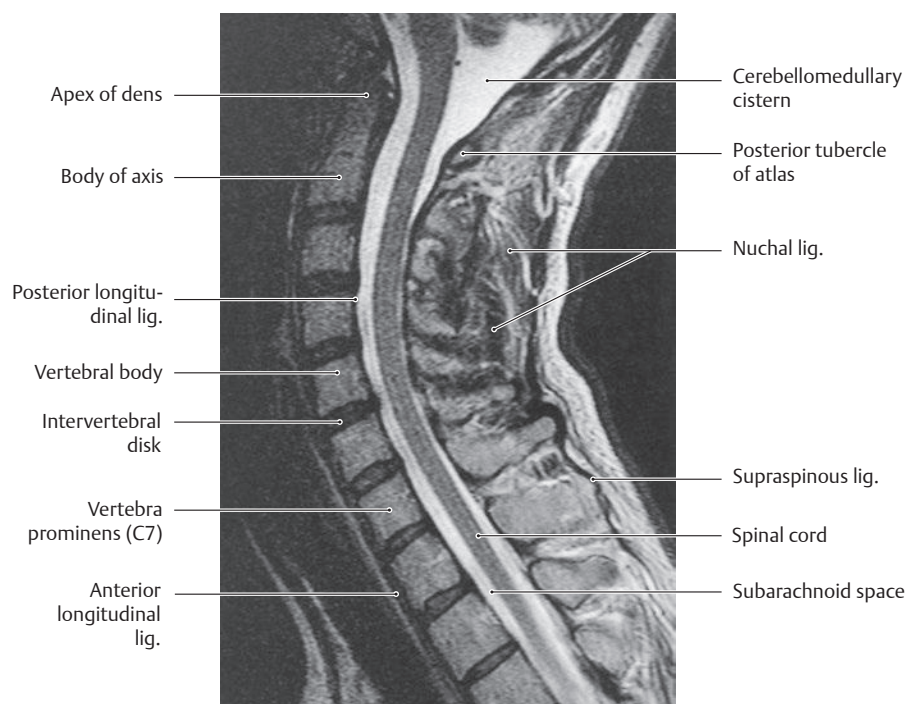


Fig. 2.28 Ligaments of the cervical spine

A Midsagittal section, left lateral view. The nuchal ligament is the broadened, sagittally oriented part of the supraspinous ligament that extends from the vertebra prominens (C7) to the external occipital protuberance.



B Midsagittal T2-weighted MRI, left lateral view.

Vertebral Ligaments: Thoracolumbar Spine

Back

Fig. 2.29 Ligaments of the vertebral column: Thoracolumbar junction

Left lateral view of T11–L3, with T11–T12 sectioned in the midsagittal plane.

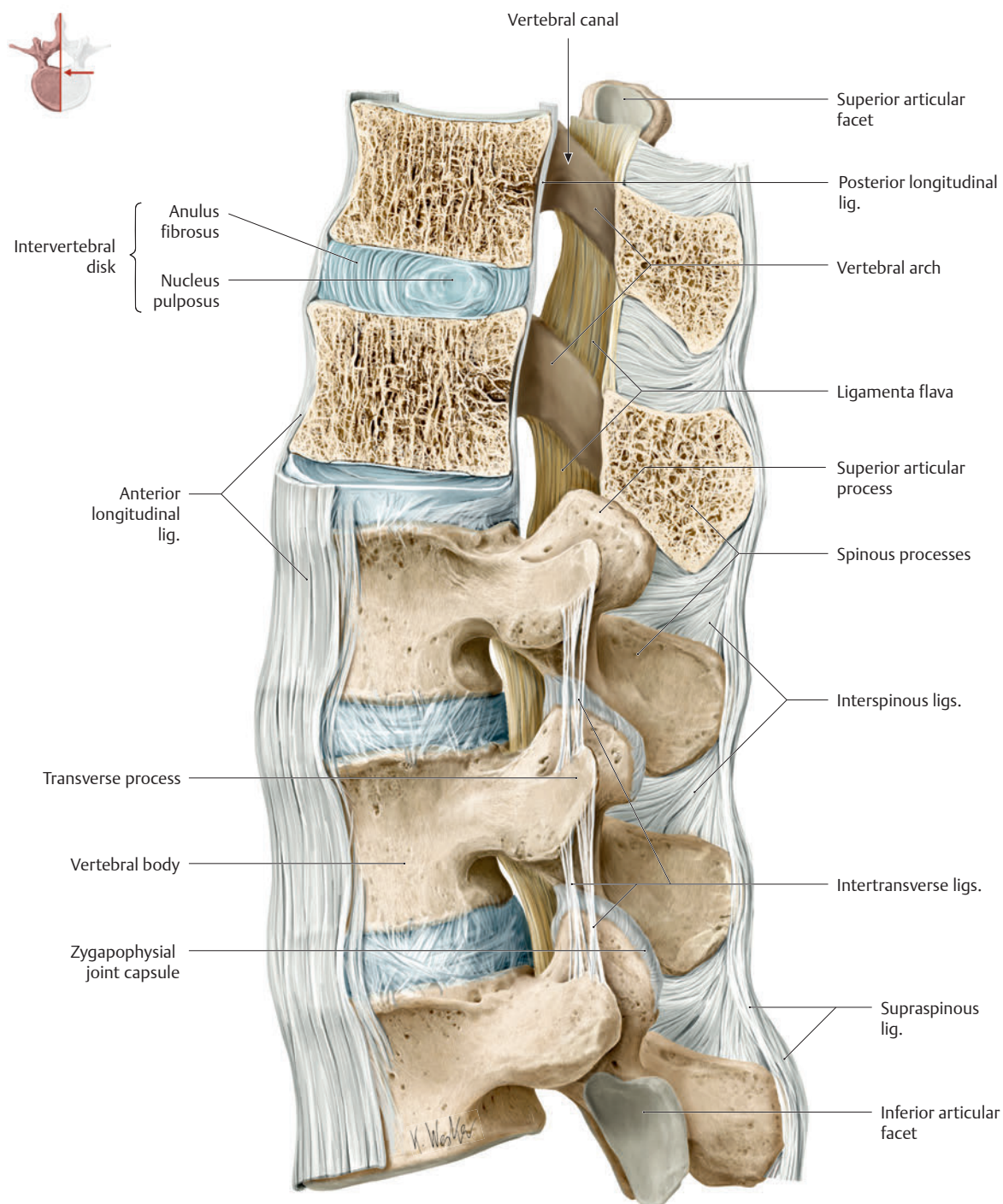


Fig. 2.30 Anterior longitudinal ligament

Anterior view of L3–L5.

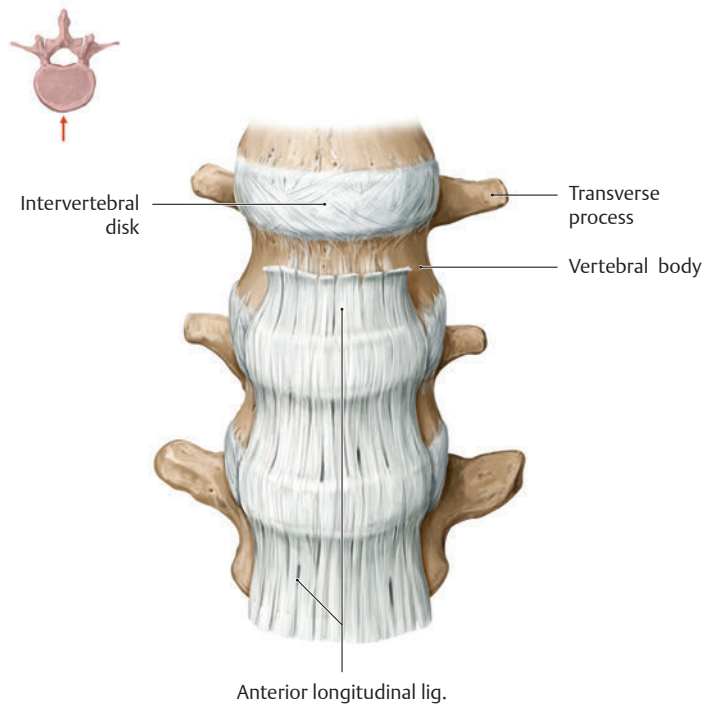


Fig. 2.32 Posterior longitudinal ligament

Posterior view of opened vertebral canal at level of L2–L5.

Removed: L2–L4 vertebral arches at pedicular level.

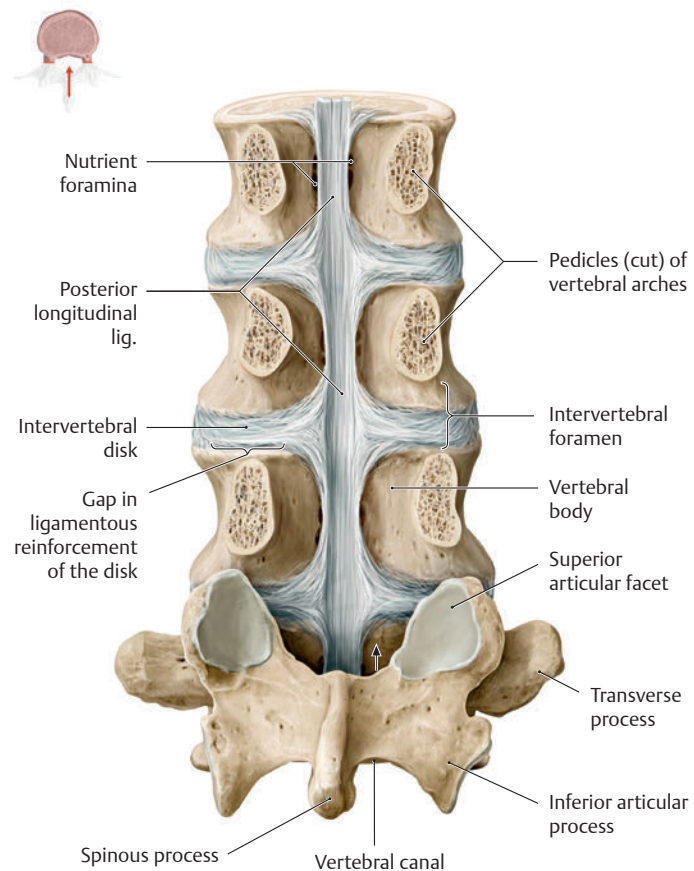
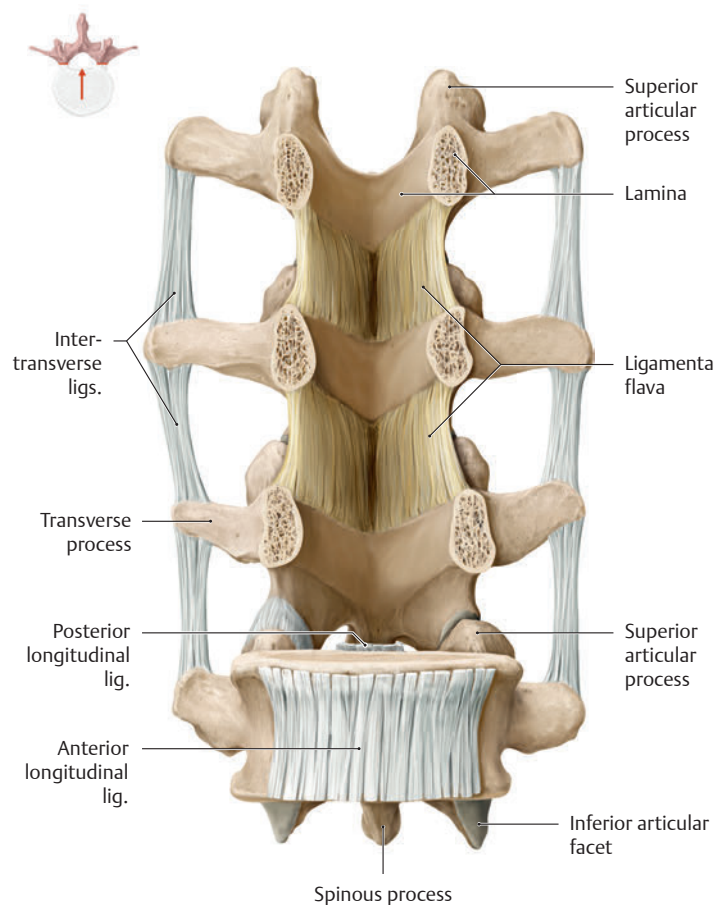


Fig. 2.31 Ligamenta flava and intertransverse ligaments

Anterior view of opened vertebral canal at level of L2–L5.

Removed: L2–L4 vertebral bodies.



Muscles of the Back: Overview



The muscles of the back are divided into two groups, the extrinsic and the intrinsic muscles, which are separated by the posterior layer of the thoracolumbar fascia. The superficial

extrinsic muscles are considered muscles of the upper limb that have migrated to the back; these muscles are discussed in the Upper Limb, pp. 312–317.

Fig. 3.1 Superficial extrinsic muscles of the back
 Posterior view. *Removed:* Trapezius and latissimus dorsi (right). *Revealed:* Thoracolumbar fascia. *Note:* The posterior layer of the thoracolumbar fascia is reinforced by the aponeurotic origin of the latissimus dorsi.

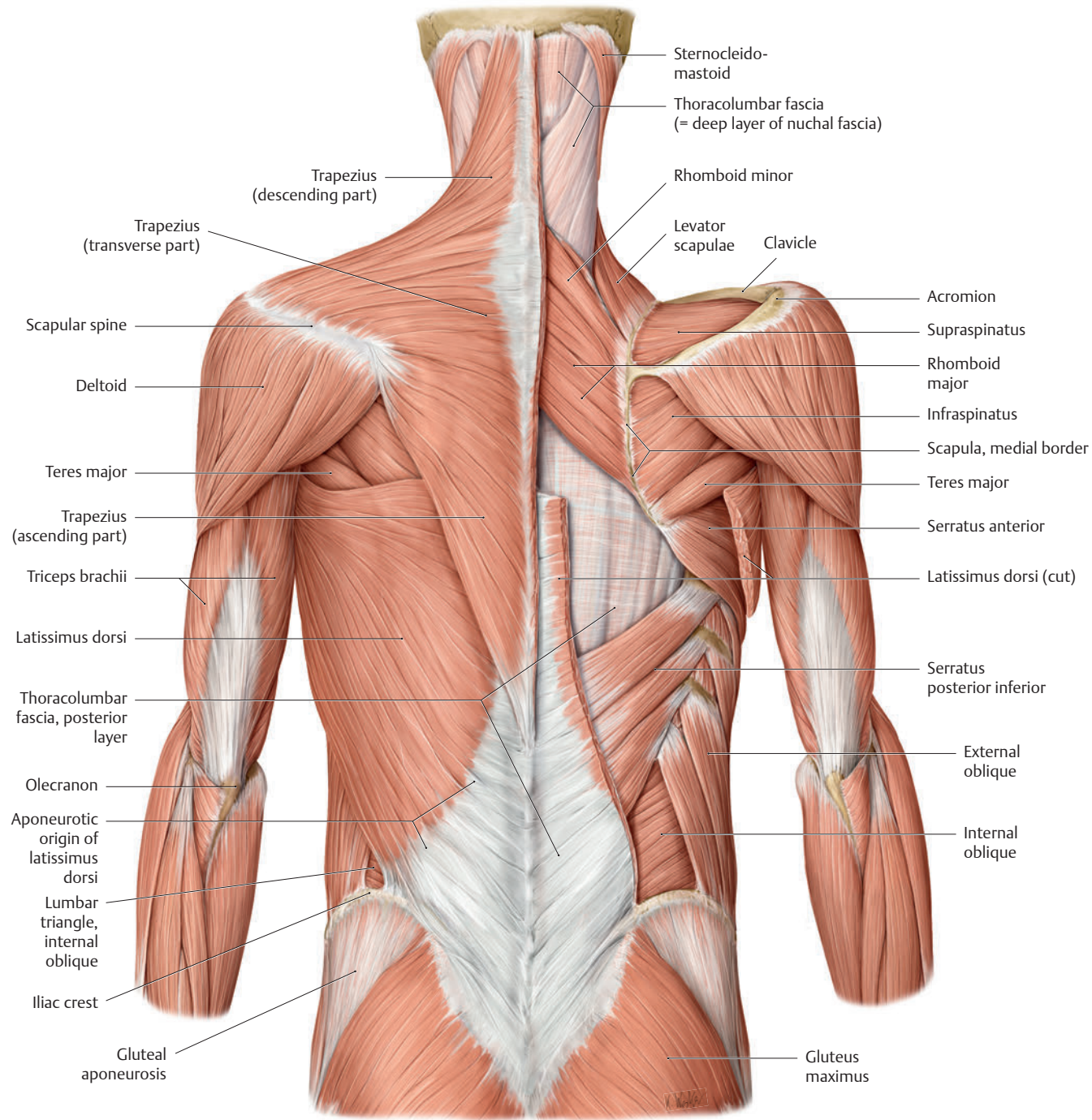
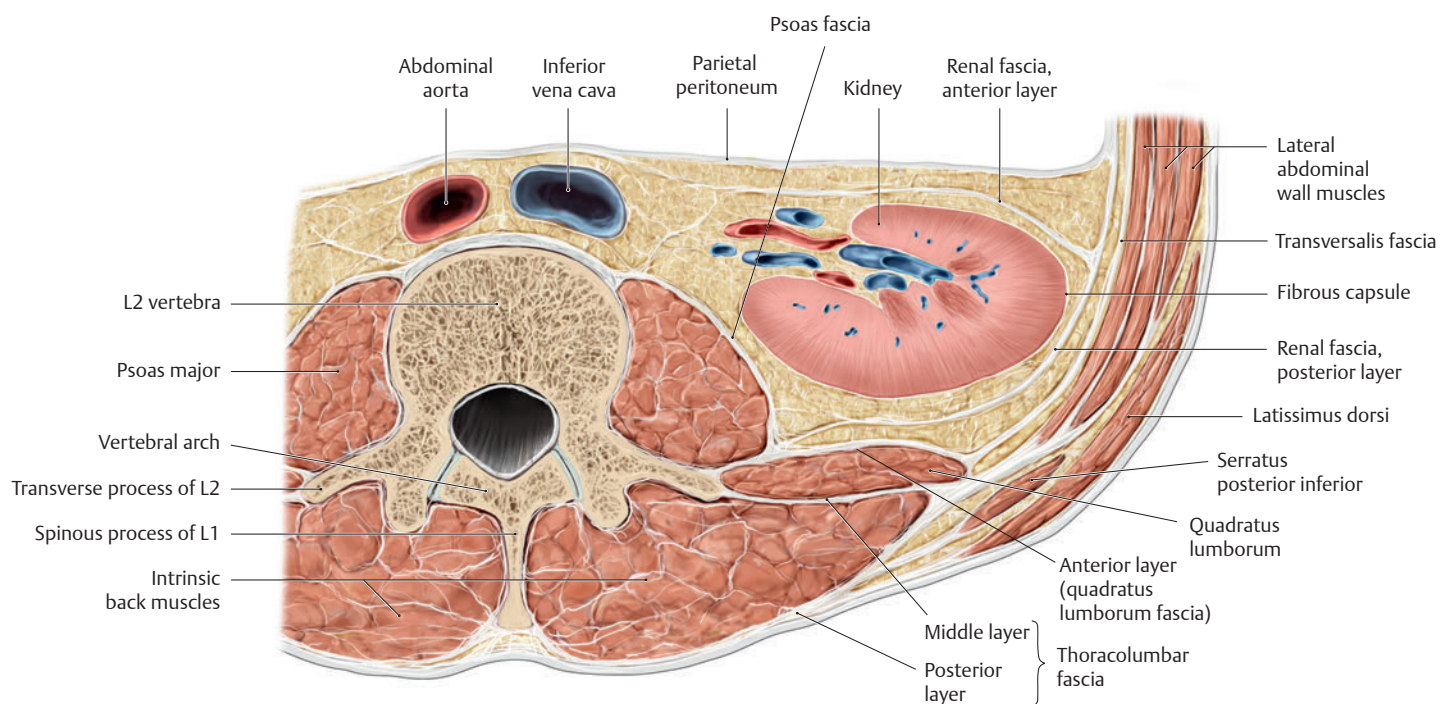
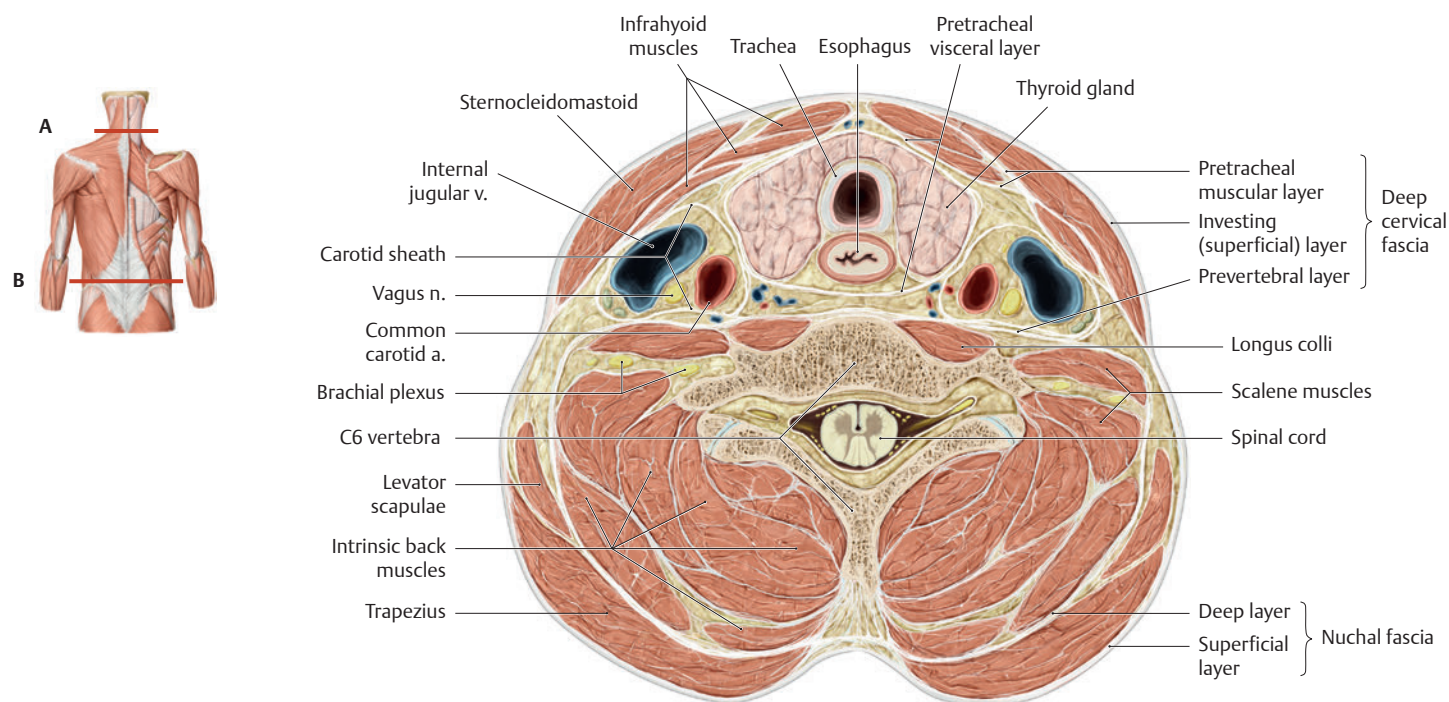


Fig. 3.2 Thoracolumbar fascia

Transverse section, superior view. The intrinsic back muscles are sequestered in an osseofibrous canal, formed by the thoracolumbar fascia, the vertebral arches, and the spinous and transverse processes of associated vertebrae. The thoracolumbar fascia consists of a posterior

and middle layer that unite at the lateral margin of the intrinsic back muscles. In the neck, the posterior layer blends with the nuchal fascia (deep layer), becoming continuous with the deep cervical fascia (pre-vertebral layer).



Intrinsic Muscles of the Cervical Spine

Back

Fig. 3.3 Muscles in the nuchal region

Posterior view. *Removed:* Trapezius, sternocleidomastoid, splenius, and semispinalis muscles (right). *Revealed:* Nuchal muscles (right).

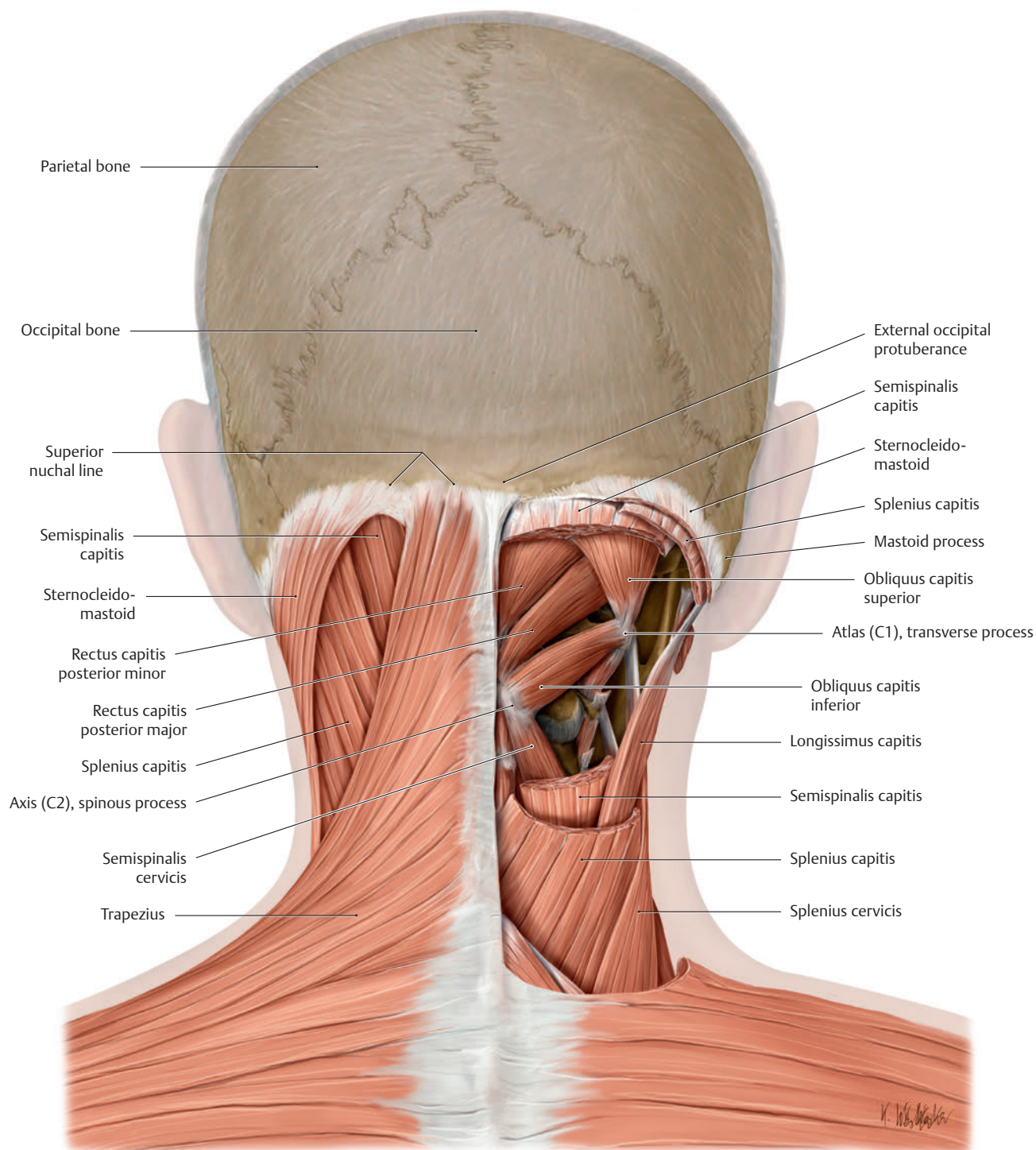
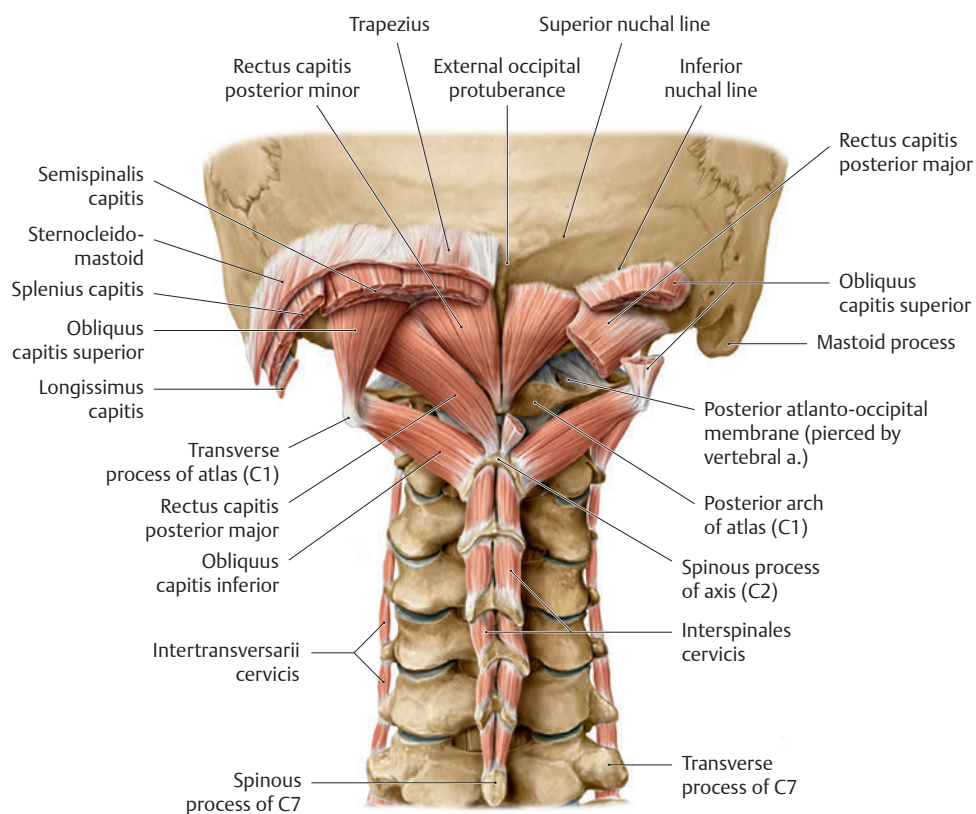


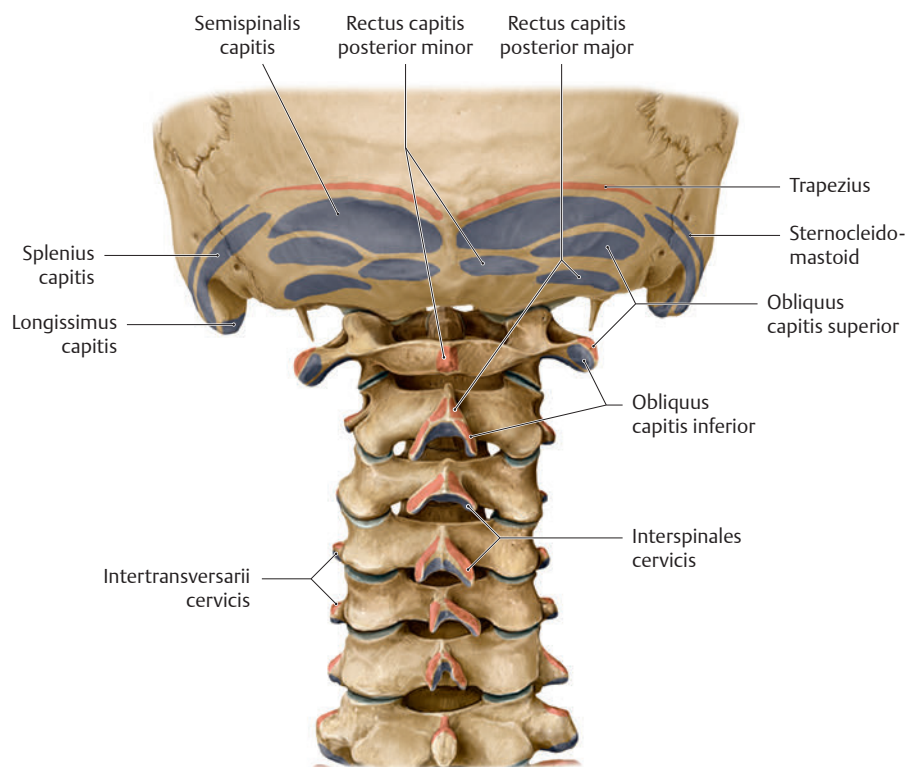
Fig. 3.4 Short nuchal muscles

Posterior view. See Fig. 3.6.

Three of the short nuchal muscles (obliquus capitis inferior, obliquus capitis superior and the rectus capitis posterior major) form the boundaries of the suboccipital triangle (region).



A Course of the short nuchal muscles.



B Suboccipital region. Muscle origins are shown in red, insertions in blue.

Intrinsic Muscles of the Back

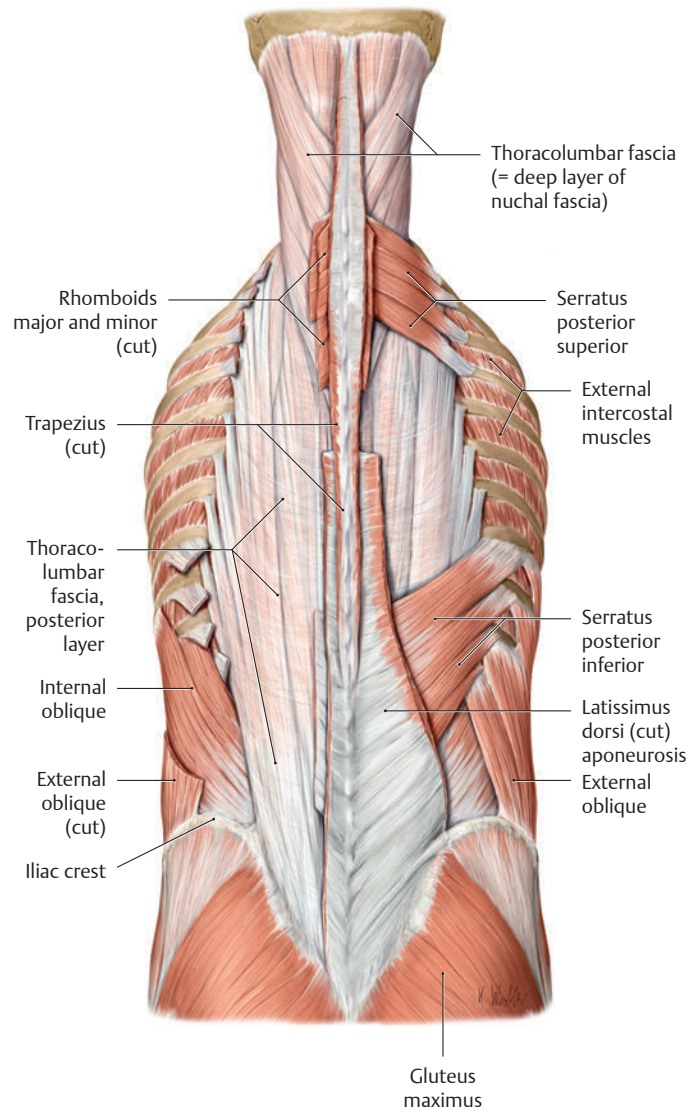


The extrinsic muscles of the back (trapezius, latissimus dorsi, levator scapulae, and rhomboids) are discussed in the Upper Limb, pp. 316–317.

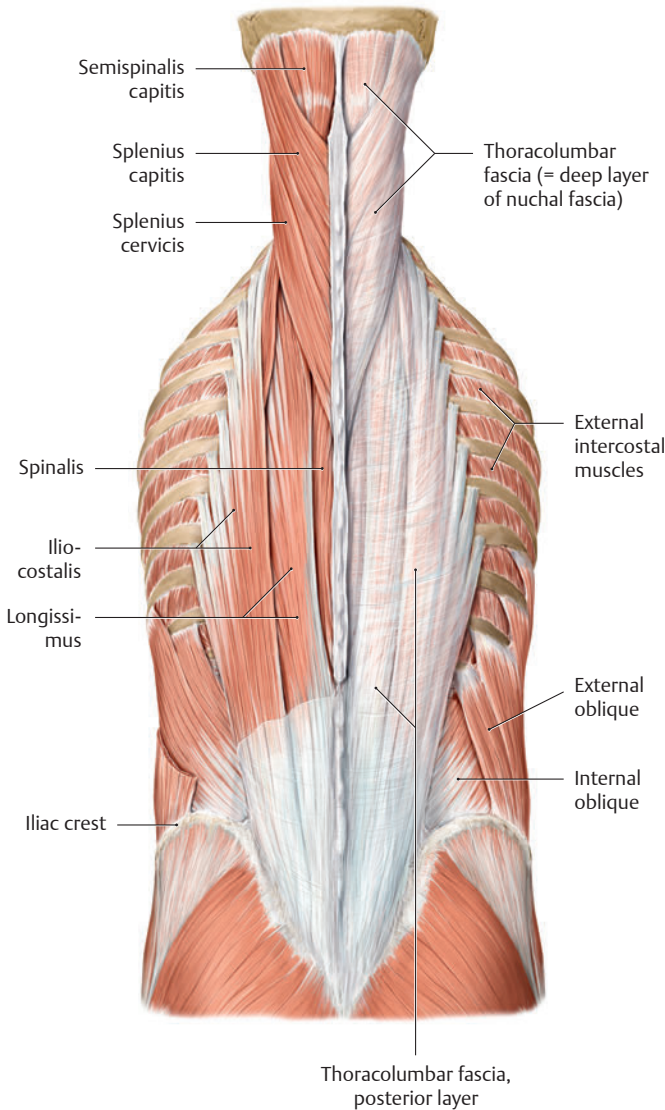
The serratus posterior, considered an intermediate extrinsic back muscle, has been included with the superficial intrinsic muscles in this unit.

Fig. 3.5 Intrinsic muscles of the back

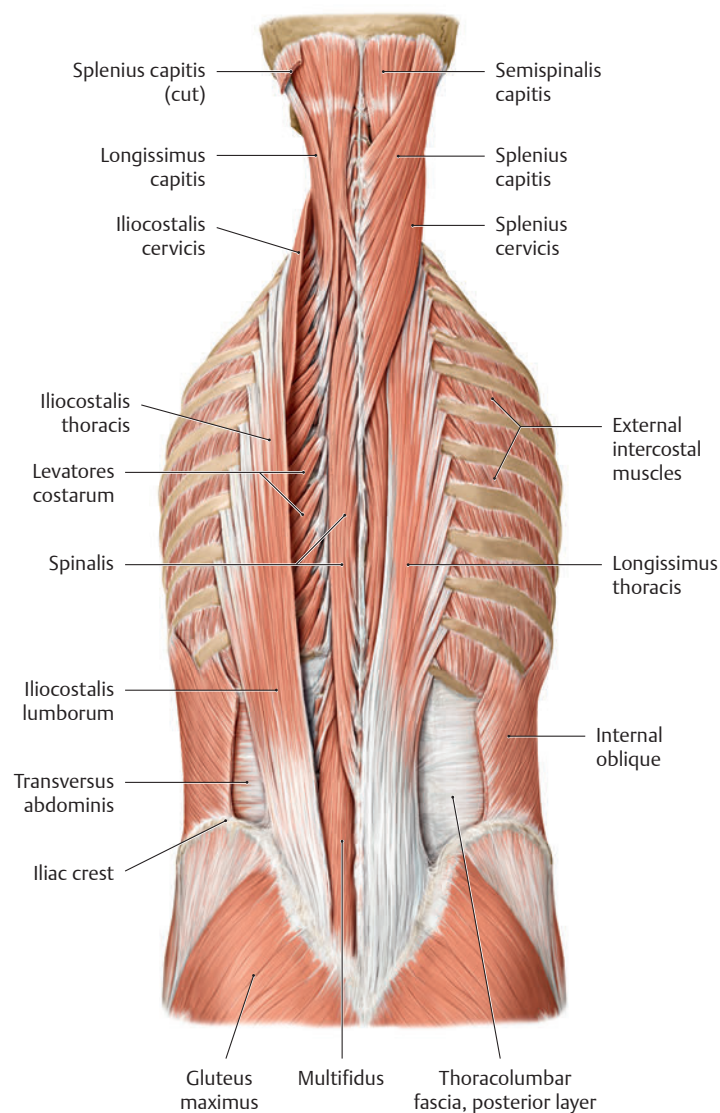
Posterior view. Sequential dissection of the thoracolumbar fascia, superficial intrinsic muscles, intermediate intrinsic muscles, and deep intrinsic muscles of the back.



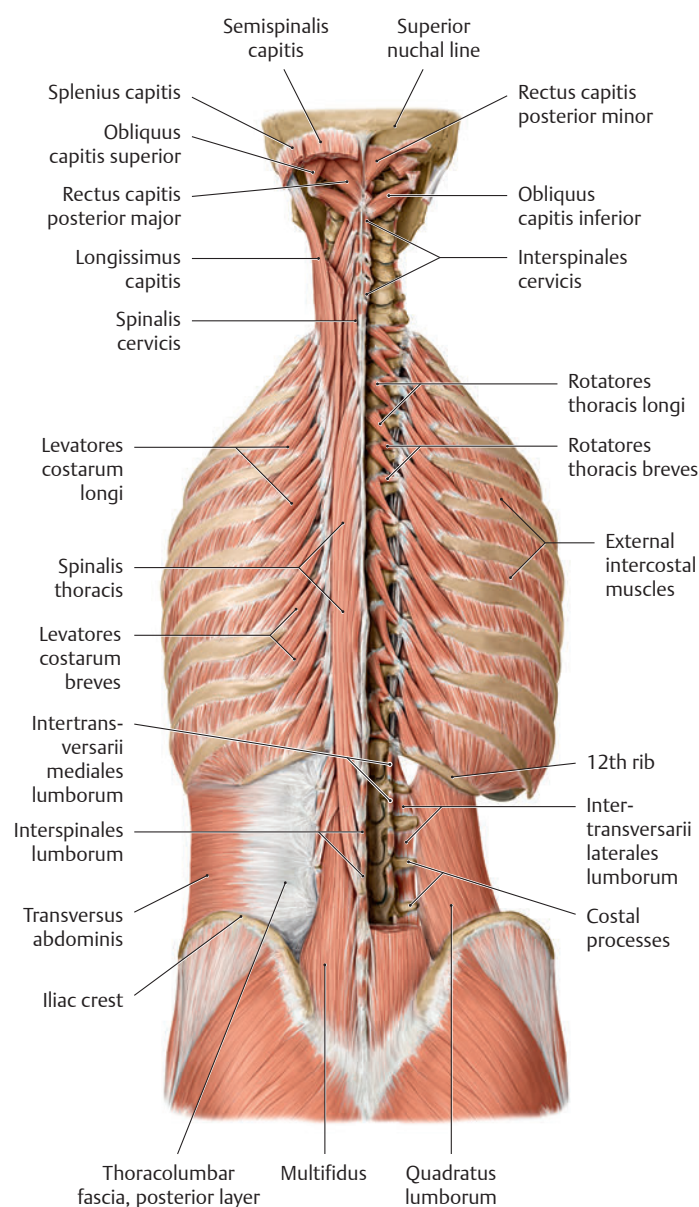
A Thoracolumbar fascia. *Removed:* Shoulder girdles and extrinsic back muscles (except serratus posterior and aponeurotic origin of latissimus dorsi). *Revealed:* Posterior layer of thoracolumbar fascia.



B Superficial and intermediate intrinsic back muscles. *Removed:* Thoracolumbar fascia, posterior layer (left). *Revealed:* Erector spinae and splenius muscles.



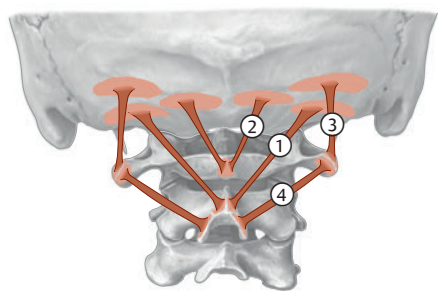
C Intermediate and deep intrinsic back muscles. *Removed:* Longissimus thoracis and cervicis, splenius muscles (left); iliocostalis (right). *Note:* The posterior layer of the thoracolumbar fascia gives origin to the internal oblique and transversus abdominis. *Revealed:* Deep muscles of the back.



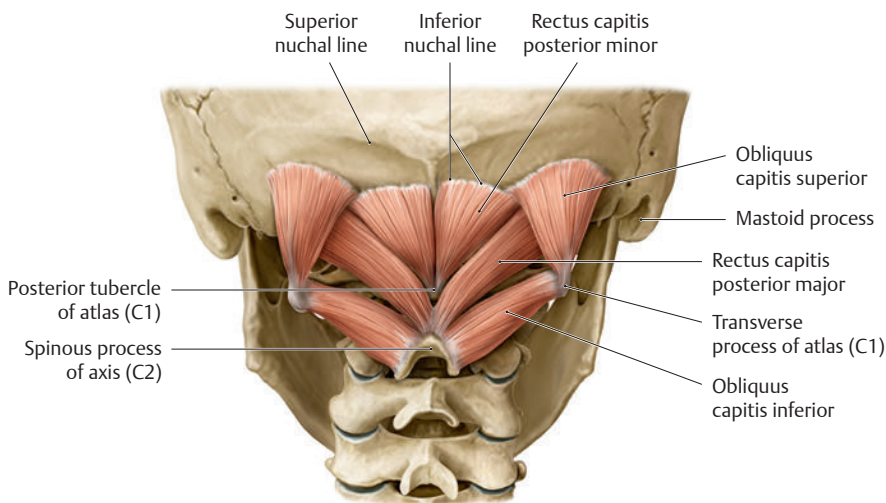
D Deep intrinsic back muscles. *Removed:* Superficial and intermediate intrinsic back muscles (all); deep fascial layer and multifidus (right). *Revealed:* Intertransversarii and quadratus lumborum (right).

Muscle Facts (I)

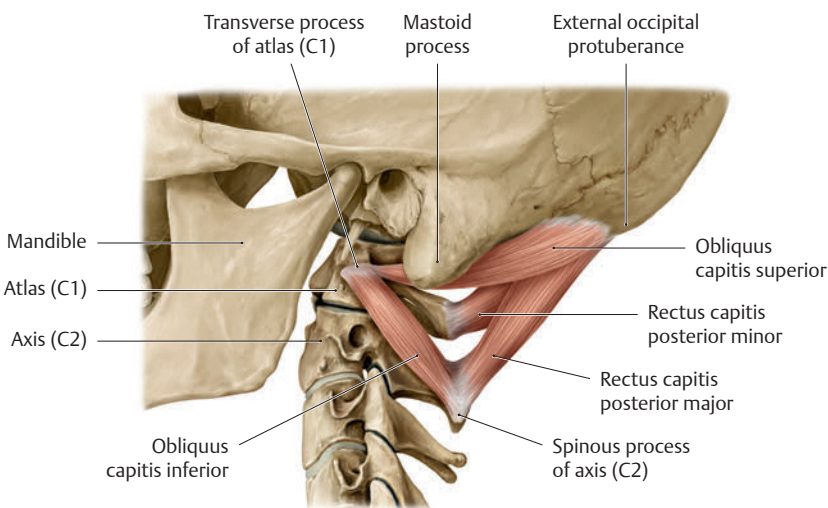
Fig. 3.6 Short nuchal and craniovertebral joint muscles



A Posterior view, schematic.

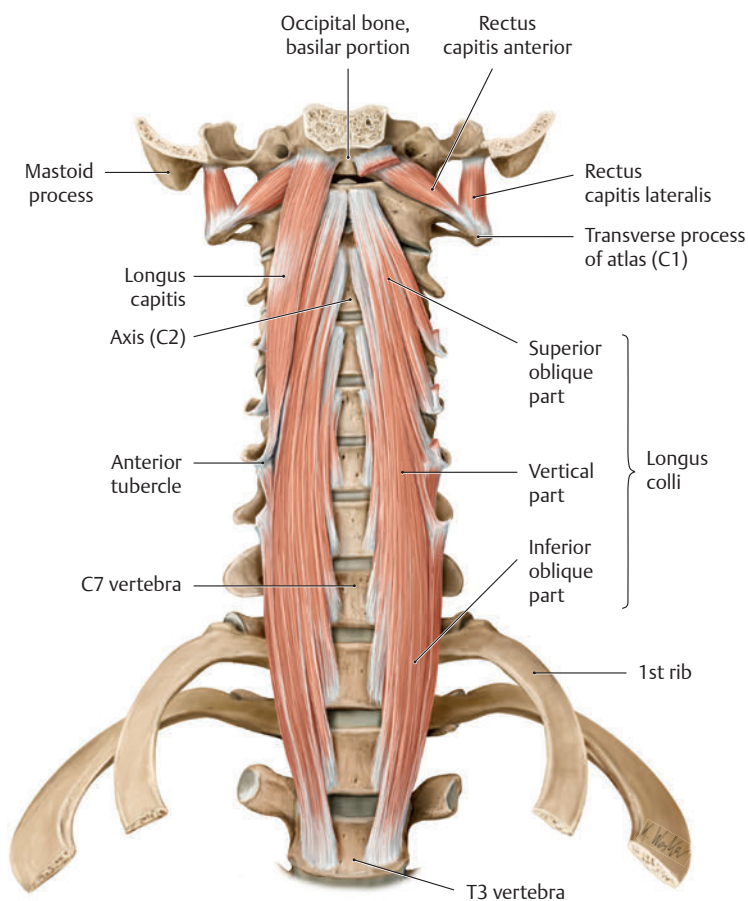
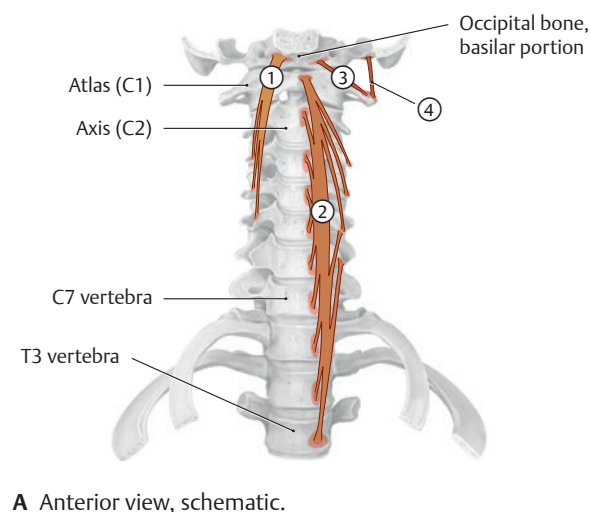


B Suboccipital muscles, posterior view.



C Suboccipital muscles, left lateral view.

Table 3.1 Short nuchal and craniovertebral joint muscles					
Muscle		Origin	Insertion	Innervation	Action
Rectus capitis posterior	① Rectus capitis posterior major	C2 (spinous process)	Occipital bone (inferior nuchal line, middle third)	C1 (posterior ramus = suboccipital n.)	<i>Bilateral:</i> Extends head <i>Unilateral:</i> Rotates head to same side
	② Rectus capitis posterior minor	C1 (posterior tubercle)	Occipital bone (inferior nuchal line, inner third)		
Obliquus capitis	③ Obliquus capitis superior	C1 (transverse process)	Occipital bone (inferior nuchal line, middle third; above rectus capitis posterior major)		<i>Bilateral:</i> Extends head <i>Unilateral:</i> Tilts head to same side; rotates to opposite side
	④ Obliquus capitis inferior	C2 (spinous process)	C1 (transverse process)		<i>Bilateral:</i> Extends head <i>Unilateral:</i> Rotates head to same side

Fig. 3.7 Prevertebral muscles**Table 3.2****Prevertebral muscles**

Muscle	Origin	Insertion	Innervation	Action
① Longus capitis	C3–C6 (transverse processes, anterior tubercles)	Occipital bone (basilar part)	Direct branches from cervical plexus (C1–C3)	<i>Bilateral:</i> Flexes head <i>Unilateral:</i> Tilts and slightly rotates head to same side
② Longus colli (cervicis)	Vertical (medial) part	C5–T3 (anterior sides of vertebral bodies)	Direct branches from cervical plexus (C2–C6)	<i>Bilateral:</i> Flexes cervical spine <i>Unilateral:</i> Tilts and rotates cervical spine to same side
	Superior oblique part	C3–C5 (transverse processes, anterior tubercles)		
	Inferior oblique part	T1–T3 (anterior sides of vertebral bodies)		
③ Rectus capitis anterior	C1 (lateral mass)	Occipital bone (basilar part)	C1 (anterior ramus)	<i>Bilateral:</i> Flexion at atlanto-occipital joint <i>Unilateral:</i> Lateral flexion at atlanto-occipital joint
④ Rectus capitis lateralis	C1 (transverse process)	Occipital bone (basilar part, lateral to occipital condyles)		

Muscle Facts (II)



The intrinsic back muscles are divided into superficial, intermediate, and deep layers. The serratus posterior muscles are extrinsic back muscles, innervated by the anterior rami of intercostal

nerves, not the posterior rami, which innervate the intrinsic back muscles. They are included here as they are encountered in dissection of the back musculature.

Table 3.3 Superficial intrinsic back muscles

Muscle		Origin	Insertion	Innervation	Action
Serratus posterior	① Serratus posterior superior	Nuchal lig.; C7–T3 (spinous processes)	2nd–4th ribs (superior borders)	Spinal nn. T2–T5 (anterior rami)	Elevates ribs
	② Serratus posterior inferior	T11–L2 (spinous processes)	8th–12th ribs (inferior borders, near angles)	Spinal nn. T9–T12 (anterior rami)	Depresses ribs
Splenius	③ Splenius capitis	Nuchal lig.; C7–T3 or T4 (spinous processes)	Lateral 1/3 nuchal line (occipital bone); mastoid process (temporal bone)	Spinal nn. C1–C6 (posterior rami, lateral branches)	<i>Bilateral:</i> Extends cervical spine and head
	④ Splenius cervicis	T3–T6 or T7 (spinous processes)	C1–C3/4 (transverse processes)		<i>Unilateral:</i> Flexes and rotates head to the same side

Fig. 3.8 Superficial intrinsic back muscles, schematic

Right side, posterior view.

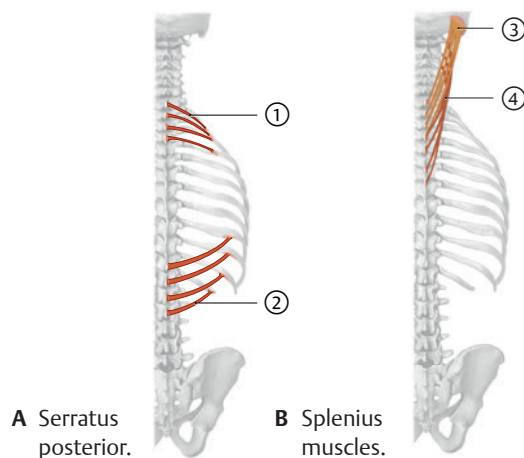


Fig. 3.9 Intermediate intrinsic back muscles, schematic

Right side, posterior view. These muscles are collectively known as the erector spinae.

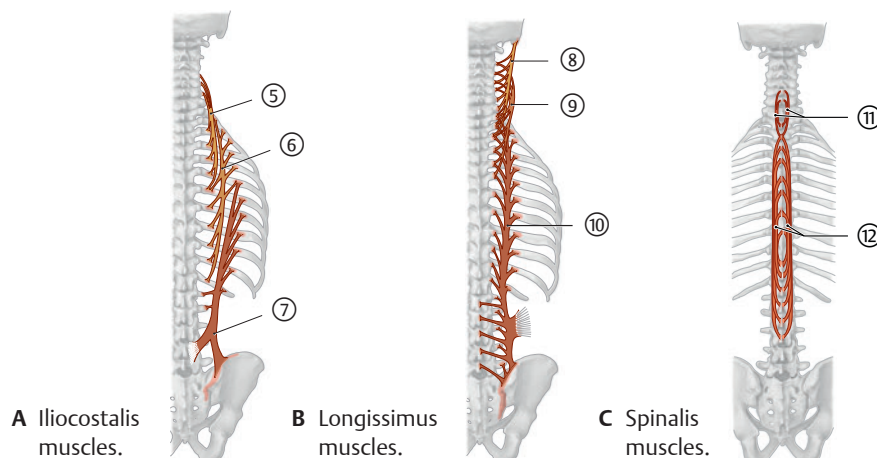
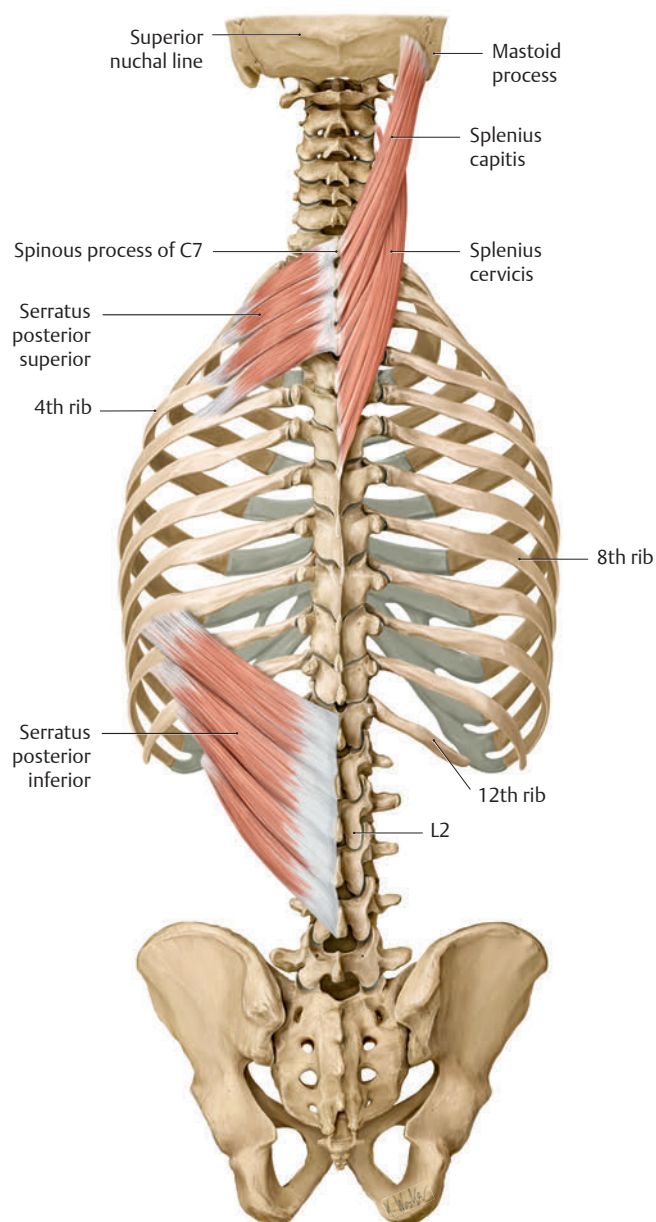


Table 3.4 Intermediate intrinsic back muscles (erector spinae)

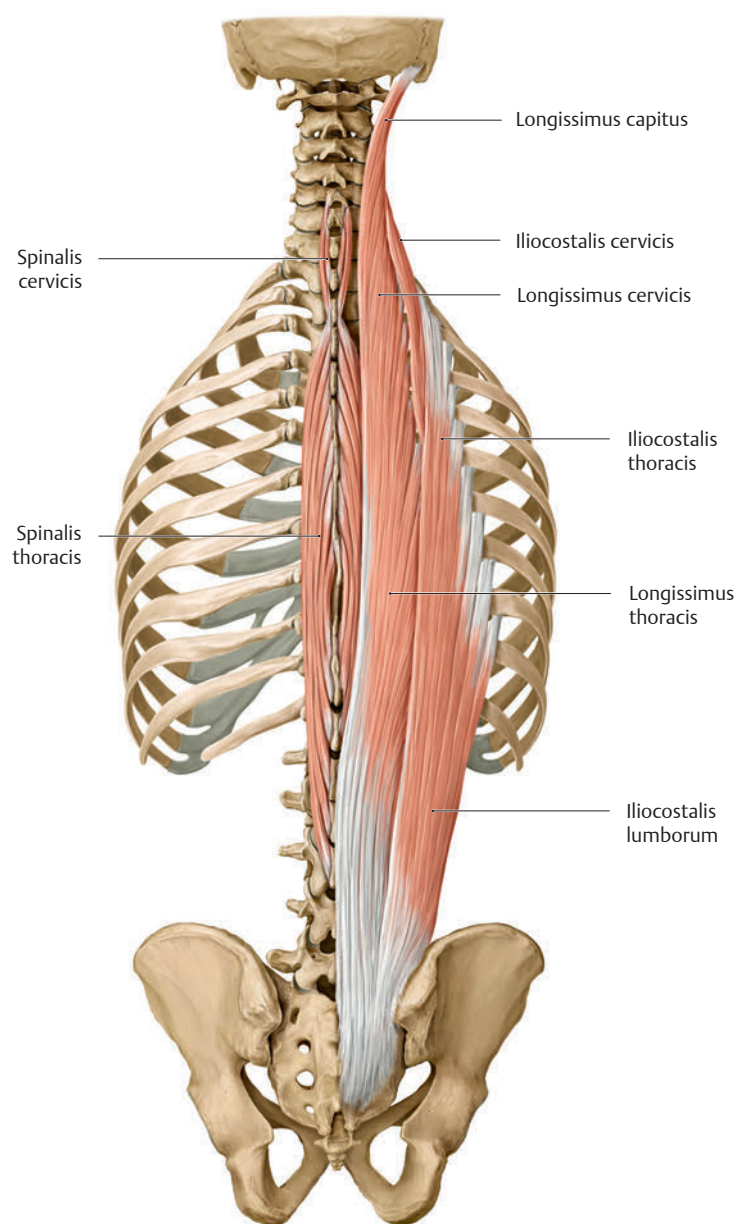
Muscle		Origin	Insertion	Innervation	Action
Iliocostalis	⑤ Iliocostalis cervicis	3rd–7th ribs	C4–C6 (transverse processes)	Spinal nn. C8–L1 (posterior rami, lateral branches)	<i>Bilateral:</i> Extends spine <i>Unilateral:</i> Bends spine laterally to same side
	⑥ Iliocostalis thoracis	7th–12th ribs	1st–6th ribs		
	⑦ Iliocostalis lumborum	Sacrum; iliac crest; thoracolumbar fascia (posterior layer)	6th–12th ribs; thoracolumbar fascia (posterior layer); upper lumbar vertebrae (transverse processes)		
Longissimus	⑧ Longissimus capitis	T1–T3 (transverse processes); C4–C7 (transverse and articular processes)	Temporal bone (mastoid process)	Spinal nn. C1–L5 (posterior rami, lateral branches)	<i>Bilateral:</i> Extends head <i>Unilateral:</i> Flexes and rotates head to same side
	⑨ Longissimus cervicis	T1–T6 (transverse processes)	C2–C5 (transverse processes)		<i>Bilateral:</i> Extends spine <i>Unilateral:</i> Bends spine laterally to same side
	⑩ Longissimus thoracis	Sacrum; iliac crest; lumbar vertebrae (spinous processes); lower thoracic vertebrae (transverse processes)	2nd–12th ribs; thoracic and lumbar vertebrae (transverse processes)		
Spinalis	⑪ Spinalis cervicis	C5–T2 (spinous processes)	C2–C5 (spinous processes)	Spinal nn. (posterior rami)	<i>Bilateral:</i> Extends cervical and thoracic spine <i>Unilateral:</i> Bends cervical and thoracic spine to same side
	⑫ Spinalis thoracis	T10–L3 (spinous processes, lateral surfaces)	T2–T8 (spinous processes, lateral surfaces)		

Fig. 3.10 Superficial and intermediate intrinsic back muscles

Posterior view.



A Superficial back muscles:
Splenius and serratus posterior muscles.



B Intermediate intrinsic back muscles (erector spinae): Iliocostalis, longissimus, and spinalis muscles.

Muscle Facts (III)



The deep intrinsic back muscles are divided into two groups: transversospinalis and deep segmental muscles. The transverso-

spinalis muscles pass between the transverse and spinous processes of the vertebrae.

Table 3.5		Transversospinalis muscles			
Muscle		Origin	Insertion	Innervation	Action
Rotatores	① Rotatores breves	T1–T12 (between transverse and spinous processes of adjacent vertebrae)		Spinal nn. (posterior rami)	<i>Bilateral:</i> Extends thoracic spine <i>Unilateral:</i> Rotates thoracic spine to opposite side
	② Rotatores longi	T1–T12 (between transverse and spinous processes, skipping one vertebra)			
Multifidus ③		Sacrum, ilium, mamillary processes of L1–L5, transverse and articular processes of T1–T4, C4–C7	Superomedially to spinous processes, skipping two to four vertebrae		<i>Bilateral:</i> Extends spine <i>Unilateral:</i> Flexes spine to same side, rotates it to opposite side
Semispinalis	④ Semispinalis capitis	C4–T7 (transverse and articular processes)	Occipital bone (between superior and inferior nuchal lines)		<i>Bilateral:</i> Extends thoracic and cervical spines and head (stabilizes craniovertebral joints)
	⑤ Semispinalis cervicis	T1–T6 (transverse processes)	C2–C5 (spinous processes)		<i>Unilateral:</i> Bends head, cervical and thoracic spines to same side, rotates to opposite side
	⑥ Semispinalis thoracis	T6–T12 (transverse processes)	C6–T4 (spinous processes)		

Fig. 3.11 Transversospinalis muscles
Posterior view, schematic.

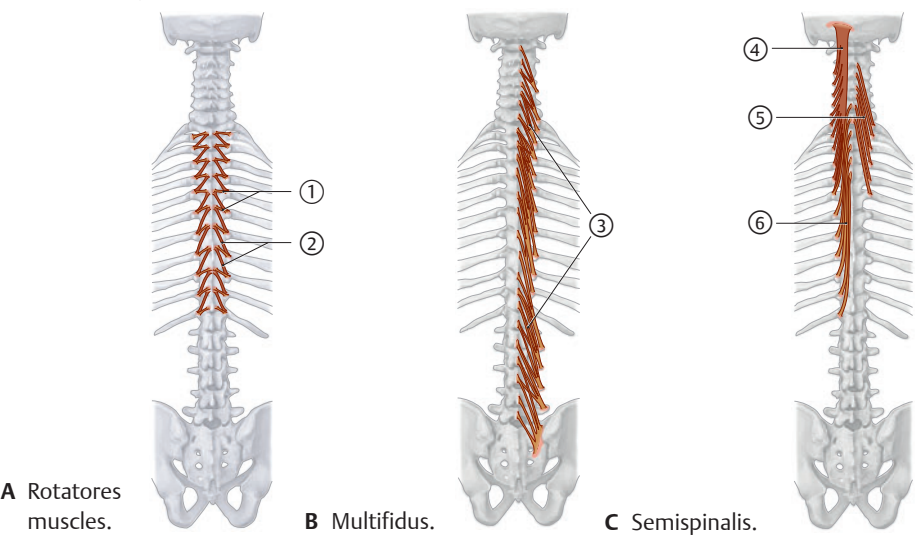


Fig. 3.12 Deep segmental muscles
Posterior view, schematic.

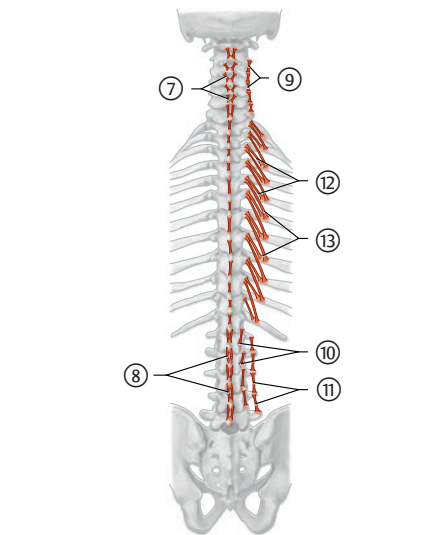
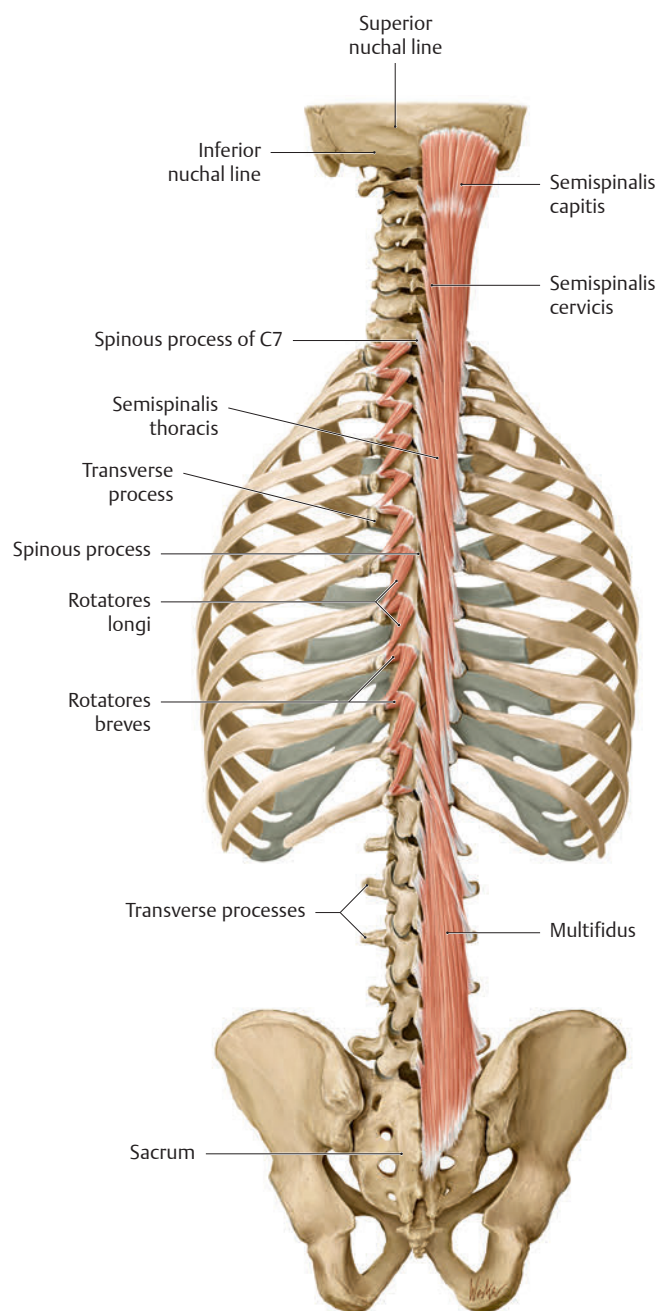


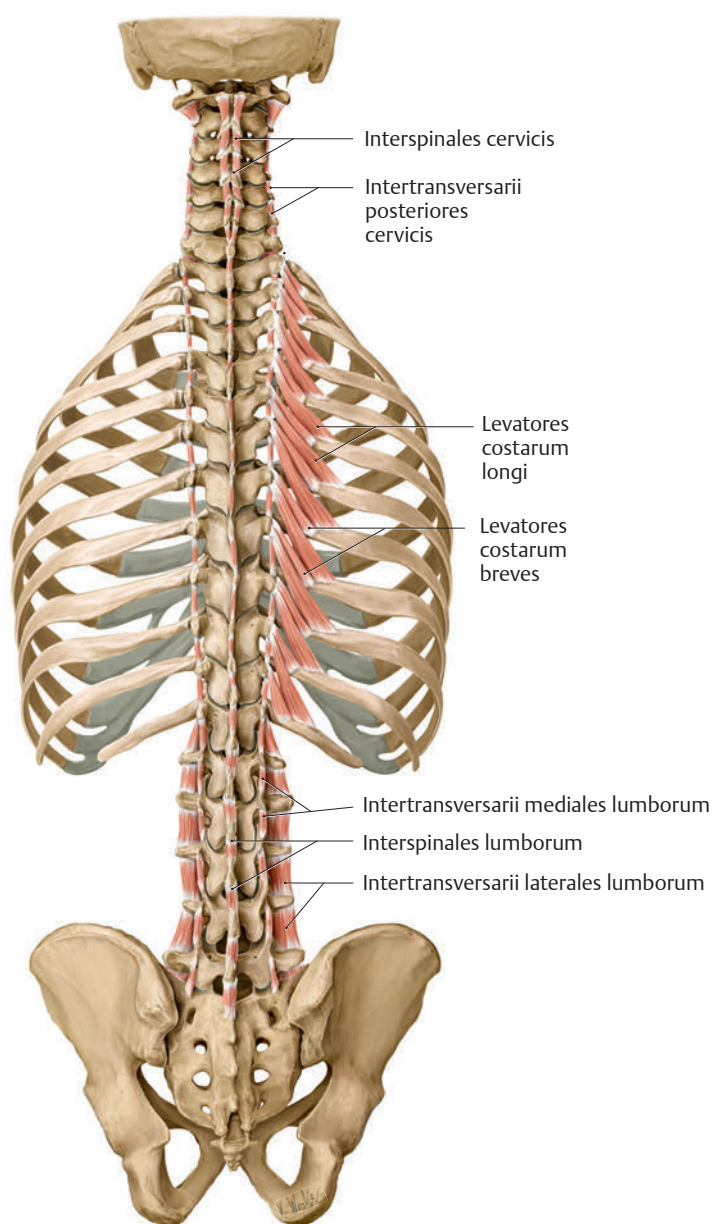
Table 3.6		Deep segmental back muscles			
Muscle		Origin	Insertion	Innervation	Action
Interspinales*	⑦ Interspinales cervicis	C1–C7 (between spinous processes of adjacent vertebrae)		Spinal nn. (posterior rami)	Extends cervical and lumbar spines
	⑧ Interspinales lumborum	L1–L5 (between spinous processes of adjacent vertebrae)			
Intertransversarii*	Intertransversarii anteriores cervicis	C2–C7 (between anterior tubercles of adjacent vertebrae)		Spinal nn. (anterior rami)	Bilateral: Stabilizes and extends the cervical and lumbar spines
	⑨ Intertransversarii posteriores cervicis	C2–C7 (between posterior tubercles of adjacent vertebrae)		Spinal nn. (posterior rami)	
	⑩ Intertransversarii mediales lumborum	L1–L5 (between mammillary processes of adjacent vertebrae)			Spinal nn. (anterior rami)
	⑪ Intertransversarii laterales lumborum	L1–L5 (between transverse processes of adjacent vertebrae)			
Levatores costarum	⑫ Levatores costarum breves		Costal angle of next lower rib	Spinal nn. (posterior rami)	Bilateral: Extends thoracic spine Unilateral: Bends thoracic spine to same side, rotates to opposite side
	⑬ Levatores costarum longi	C7–T11 (transverse processes)	Costal angle of rib two vertebrae below		

*Both the interspinales and intertransversarii muscles traverse the entire spine; only their clinically relevant components have been included.

Fig. 3.13 Deep intrinsic back muscles
Posterior view.



A Transversospinalis muscles: Rotatores, multifidus, and semispinalis.



B Deep segmental muscles: Interspinales, intertransversarii, and levatores costarum.