

# Contents

## 1 The body

### What is anatomy? 4

*How can gross anatomy be studied?* 4

*Important anatomical terms* 4

### Imaging 7

*Diagnostic imaging techniques* 7

*Nuclear medicine imaging* 10

### Image interpretation 11

*Plain radiography* 12

*Computed tomography* 12

*Magnetic resonance imaging* 13

*Nuclear medicine imaging* 13

### Safety in imaging 13

## Body systems 14

*Skeletal system* 14

Cartilage 14

Bone 15

Joints 20

*Skin and fascias* 26

Skin 26

Fascia 26

*Muscular system* 27

*Cardiovascular system* 29

*Lymphatic system* 31

Lymphatic vessels 31

Lymph nodes 32

Lymphatic trunks and ducts 32

*Nervous system* 34

Central nervous system 34

Functional subdivisions of the CNS 34

Somatic part of the nervous system 35

Visceral part of the nervous system 41

*Other systems* 52

## Clinical cases 53

## 2 Back

### Conceptual overview 56

*General description* 56

*Functions* 57

Support 57

Movement 57

Protection of the nervous system 58

*Component parts* 58

Bones 58

Muscles 60

Vertebral canal 62

Spinal nerves 63

*Relationship to other regions* 64

Head 64

Thorax, abdomen, and pelvis 65

Limbs 65

*Key features* 65

Long vertebral column and short spinal cord 65

Intervertebral foramina and spinal nerves 66

Innervation of the back 66

### Regional anatomy 67

*Skeletal framework* 67

Vertebrae 67

Intervertebral foramina 75

Posterior spaces between vertebral arches 75

*Joints* 79

Joints between vertebrae in the back 79

*Ligaments* 82

Anterior and posterior longitudinal ligaments 82

Ligamenta flava 82

Supraspinous ligament and ligamentum  
nuchae 83

Interspinous ligaments 84

*Back musculature* 86

Superficial group of back muscles 86

Intermediate group of back muscles 92

Deep group of back muscles 93

Suboccipital muscles 99

### Spinal cord 101

Vasculature 102

Meninges 104

Arrangement of structures in the vertebral  
canal 106

Spinal nerves 107

## **Surface anatomy 112**

- Back surface anatomy 112
- Absence of lateral curvatures 112
- Primary and secondary curvatures in the sagittal plane 112
- Useful nonvertebral skeletal landmarks 112
- How to identify specific vertebral spinous processes 114
- Visualizing the inferior ends of the spinal cord and subarachnoid space 115
- Identifying major muscles 116

## **Clinical cases 118**

## **3 Thorax**

### **Conceptual overview 124**

#### *General description* 124

#### *Functions* 125

- Breathing 125
- Protection of vital organs 125
- Conduit 125

#### *Component parts* 125

- Thoracic wall 125
- Superior thoracic aperture 126
- Inferior thoracic aperture 126
- Diaphragm 127
- Mediastinum 128
- Pleural cavities 128

#### *Relationship to other regions* 129

- Neck 129
- Upper limb 130
- Abdomen 130
- Breast 130

#### *Key features* 130

- Vertebral level TIV/V 130
- Venous shunts from left to right 132
- Segmental neurovascular supply of thoracic wall 132
- Sympathetic system 134
- Flexible wall and inferior thoracic aperture 134
- Innervation of the diaphragm 134

## **Regional anatomy 137**

### *Pectoral region* 137

- Breast 137
- Muscles of the pectoral region 139

### *Thoracic wall* 141

- Skeletal framework 141
- Intercostal spaces 147

### *Diaphragm* 156

- Venous drainage 158
- Innervation 158

### *Movements of the thoracic wall and diaphragm during breathing* 158

### *Pleural cavities* 159

- Pleura 159
- Lungs 163

## **Mediastinum 176**

- Middle mediastinum 177
- Superior mediastinum 204
- Posterior mediastinum 215
- Anterior mediastinum 223

## **Surface anatomy 224**

#### *Thorax surface anatomy* 224

#### *How to count ribs* 224

#### *Surface anatomy of the breast in women* 225

#### *Visualizing structures at the TIV/V vertebral level* 226

#### *Visualizing structures in the superior mediastinum* 227

#### *Visualizing the margins of the heart* 227

#### *Where to listen for heart sounds* 228

#### *Visualizing the pleural cavities and lungs, pleural recesses, and lung lobes and fissures* 228

#### *Where to listen for lung sounds* 229

## **Clinical cases 233**

## **4 Abdomen**

### **Conceptual overview 246**

#### *General description* 246

#### *Functions* 247

#### Houses and protects major viscera 247

#### Breathing 249

#### Changes in intra-abdominal pressure 249

#### *Component parts* 250

#### Wall 250

#### Abdominal cavity 251

#### Inferior thoracic aperture 253

#### Diaphragm 253

#### Pelvic inlet 254

#### *Relationship to other regions* 254

#### Thorax 254

#### Pelvis 254

#### Lower limb 255

#### *Key features* 256

#### Arrangement of abdominal viscera in the adult 256

Skin and muscles of the anterior and lateral abdominal wall and thoracic intercostal nerves 259  
The groin is a weak area in the anterior abdominal wall 260  
Vertebral Level L1 262  
The gastrointestinal system and its derivatives are supplied by three major arteries 262  
Venous shunts from left to right 264  
All venous drainage from the gastrointestinal system passes through the liver 265  
Abdominal viscera are supplied by a large prevertebral plexus 266

## Regional anatomy 268

**Surface topography** 268  
Four-quadrant pattern 268  
Nine-region pattern 269  
**Abdominal wall** 270  
Superficial fascia 270  
Anterolateral muscles 272  
Extraperitoneal fascia 278  
Peritoneum 279  
Innervation 279  
Arterial supply and venous drainage 280  
Lymphatic drainage 282  
**Groin** 282  
Inguinal canal 284  
Inguinal hernias 288  
**Abdominal viscera** 292  
Peritoneum 292  
Peritoneal cavity 293  
Organs 297  
Arterial supply 327  
Venous drainage 337  
Lymphatics 341  
Innervation 341  
**Posterior abdominal region** 348  
Posterior abdominal wall 349  
Viscera 355  
Vasculation 366  
Lymphatic system 372  
Nervous system in the posterior abdominal region 374  
Sympathetic trunks and splanchnic nerves 374

## Surface anatomy 382

Abdomen surface anatomy 382  
Defining the surface projection of the abdomen 383  
How to find the superficial inguinal ring 384  
How to determine lumbar vertebral levels 385  
Visualizing structures at the L1 vertebral level 386

Visualizing the position of major blood vessels 387  
Using abdominal quadrants to locate major viscera 388  
Defining surface regions to which pain from the gut is referred 389  
Where to find the kidneys 390  
Where to find the spleen 390

## Clinical cases 391

# 5 Pelvis and perineum

## Conceptual overview 406

**General description** 406  
**Functions** 406  
Contain and support bladder, rectum, anal canal, and reproductive tracts 406  
Anchors the roots of the external genitalia 408

### Component parts 408

Pelvic inlet 408  
Pelvic walls 409  
Pelvic outlet 409  
Pelvic floor 411  
Pelvic cavity 411  
Perineum 412

### Relationship to other regions 414

Abdomen 414  
Lower limb 414

### Key features 415

The pelvic cavity projects posteriorly 415  
Important structures cross the ureters in the pelvic cavity 415  
The prostate is anterior to rectum 417  
The perineum is innervated by sacral spinal cord segments 417  
Nerves are related to bone 418  
Parasympathetic innervation from spinal cord levels S2 to S4 controls erection 418  
Muscles and fascia of the pelvic floor and perineum intersect at the perineal body 419  
Gender determines the course of the urethra 419

## Regional anatomy 421

**Pelvis** 421  
Bones 421  
Joints 426  
Orientation 428  
Gender differences 428  
True pelvis 429  
Viscera 438

Fascia	458
Peritoneum	460
Nerves	462
Blood vessels	471
Lymphatics	477
<b>Perineum</b>	<b>478</b>
Borders and ceiling	478
Ischio-anal fossae and their anterior recesses	480
Anal triangle	480
Urogenital triangle	483
Somatic nerves	490
Visceral nerves	492
Blood vessels	492
Veins	494
Lymphatics	496

## **Surface anatomy** 497

Surface anatomy of the pelvis and perineum	497
Orientation of the pelvis and perineum in the anatomical position	497
How to define the margins of the perineum	497
Identification of structures in the anal triangle	499
Identification of structures in the urogenital triangle of women	500
Identification of structures in the urogenital triangle of men	501

## **Clinical cases** 504

## **6 Lower limb**

### **Conceptual overview** 512

*General introduction* 512

#### **Function** 513

Support the body weight	513
Locomotion	515

#### **Component parts** 517

Bones and joints	517
Muscles	518

#### **Relationship to other regions** 520

Abdomen	520
Pelvis	521
Perineum	521

#### **Key points** 521

Innervation is by lumbar and sacral spinal nerves	521
Nerves related to bone	525
Superficial veins	525

#### **Regional anatomy** 526

Bony pelvis	526
Proximal femur	529

Hip joint	532
Gateways to the lower limb	535
Nerves	537
Arteries	540
Veins	542
Lymphatics	542
Deep fascia and the saphenous opening	544
Femoral triangle	545

#### **Gluteal region** 547

Muscles	548
Nerves	551
Arteries	554
Veins	554
Lymphatics	554

#### **Thigh** 555

Bones	555
Muscles	561
Arteries	569
Veins	573
Nerves	573
Knee joint	575
Tibiofibular joint	584
Popliteal fossa	584

#### **Leg** 585

Bones	586
Joints	588
Posterior compartment of leg	588
Lateral compartment of leg	595
Anterior compartment of leg	596

#### **Foot** 600

Bones	600
Joints	605
Tarsal tunnel, retinacula, and arrangement of major structures at the ankle	612
Arches of the foot	614
Plantar aponeurosis	615
Fibrous sheaths of toes	615
Extensor hoods	616
Intrinsic muscles	616
Arteries	622
Veins	624
Nerves	624

### **Surface anatomy** 628

Lower limb surface anatomy	628
Avoiding the sciatic nerve	628
Finding the femoral artery in the femoral triangle	630
Identifying structures around the knee	630
Visualizing the contents of the popliteal fossa	632
Finding the tarsal tunnel—the gateway to the foot	633
Identifying tendons around the ankle and in the foot	634

Finding the dorsalis pedis artery	635
Approximating the position of the plantar arterial arch	635
Major superficial veins	636
Pulse points	637

## Clinical cases 638

7

## Upper limb

### Conceptual overview 650

*General description* 650

#### Functions 651

- Positioning the hand 651
- The hand as a mechanical tool 651
- The hand as a sensory tool 654

#### Component parts 654

- Bones and joints 654
- Muscles 655

#### Relationship to other regions 657

- Neck 657
- Back and thoracic wall 658

#### Key points 659

- Innervation by cervical and upper thoracic nerves 659
- Nerves related to bone 663
- Superficial veins 663
- Orientation of the thumb 664

### Regional anatomy 665

#### Shoulder 665

- Bones 665
- Joints 668
- Muscles 675

#### Posterior scapular region 678

- Muscles 678
- Gateways to the posterior scapular region 680
- Nerves 682
- Arteries and veins 682

#### Axilla 684

- Axillary inlet 685
- Anterior wall 686
- Medial wall 688
- Lateral wall 690
- Posterior wall 691
- Gateways in the posterior wall 692
- Floor 693
- Contents of the axilla 693

#### Arm 710

- Bones 712
- Muscles 715
- Arteries and veins 717
- Nerves 720

#### Elbow joint 724

#### Cubital fossa 729

#### Forearm 731

- Bones 732
- Joints 734

#### Anterior compartment of the forearm 736

- Muscles 736
- Arteries and veins 742
- Nerves 743

#### Posterior compartment of the forearm 745

- Muscles 745
- Arteries and veins 750
- Nerves 751

#### Hand 751

- Bones 752
- Joints 754
- Carpal tunnel and structures at the wrist 756
- Palmar aponeurosis 758
- Palmaris brevis 759
- Anatomical snuffbox 759
- Fibrous digital sheaths 759
- Extensor hoods 760
- Muscles 762
- Arteries and veins 767
- Nerves 770

### Surface anatomy 775

- Upper limb surface anatomy 775
- Bony landmarks and muscles of the posterior scapular region 775
- Visualizing the axilla and locating contents and related structures 777
- Locating the brachial artery in the arm 779
- The triceps brachii tendon and position of the radial nerve 779
- Cubital fossa (anterior view) 779
- Identifying tendons and locating major vessels and nerves in the distal forearm 781
- Normal appearance of the hand 782
- Position of the flexor retinaculum and the recurrent branch of the median nerve 783
- Motor function of the median and ulnar nerves in the hand 783
- Visualizing the positions of the superficial and deep palmar arches 784
- Pulse points 784

## Clinical cases 786

**Conceptual overview 796****General description 796**

Head 796

Neck 798

**Functions 799**

Protection 799

Contains upper parts of respiratory and digestive tracts 799

Communication 800

Positioning the head 800

Connects the upper and lower respiratory and digestive tracts 800

**Component parts 800**

Skull 800

Cervical vertebrae 802

Hyoid bone 803

Soft palate 804

Muscles 804

**Relationship to other regions 805**

Thorax 805

Upper limbs 805

**Key features 806**

Vertebral levels CIII/IV and CV/VI 806

Airway in the neck 806

Cranial nerves 807

Cervical nerves 808

Functional separation of the digestive and respiratory passages 808

Triangles of the neck 811

**Regional anatomy 812****Skull 812**

Anterior view 812

Lateral view 814

Posterior view 816

Superior view 818

Inferior view 819

**Cranial cavity 822**

Roof 822

Floor 823

**Meninges 830**

Cranial dura mater 830

Arachnoid mater 833

Pia mater 833

Arrangement of meninges and spaces 834

**Brain and its blood supply 835**

Brain 835

Blood supply 837

Venous drainage 842

**Cranial nerves 848**

Olfactory nerve [I] 849

Optic nerve [II] 850

Oculomotor nerve [III] 850

Trochlear nerve [IV] 850

Trigeminal nerve [V] 851

Ophthalmic nerve [V<sub>1</sub>] 852Maxillary nerve [V<sub>2</sub>] 852Mandibular nerve [V<sub>3</sub>] 852

Abducent nerve [VI] 852

Facial nerve [VII] 852

Vestibulocochlear nerve [VIII] 853

Glossopharyngeal nerve [IX] 853

Vagus nerve [X] 853

Accessory nerve [XI] 854

Hypoglossal nerve [XII] 854

**Face 856**

Muscles 857

Parotid gland 863

Innervation 865

Vessels 869

**Scalp 873**

Layers 873

Innervation 874

Vessels 876

Lymphatic drainage 877

**Orbit 878**

Bony orbit 878

Eyelids 879

Lacrimal apparatus 882

Sensory innervation 882

Fissures and foramina 885

Fascial specializations 886

Muscles 887

Vessels 892

Innervation 893

Eyeball 898

**Ear 902**

External ear 903

Middle ear 906

Internal ear 913

**Temporal and infratemporal fossae 920**

Bony framework 920

Temporomandibular joints 922

Masseter muscle 925

Temporal fossa 926

Infratemporal fossa 929

**Pterygopalatine fossa 940**

Skeletal framework 940

Gateways 941

Contents 942

**Neck 947**

- Fascia 948
- Superficial venous drainage 950
- Anterior triangle of the neck 954
- Posterior triangle of the neck 968
- Root of the neck 976

**Pharynx 985**

- Skeletal framework 986
- Pharyngeal wall 987
- Fascia 990
- Gaps in the pharyngeal wall and structures passing through them 990
- Nasopharynx 991
- Oropharynx 993
- Laryngopharynx 993
- Tonsils 993
- Vessels 994
- Nerves 996

**Larynx 997**

- Laryngeal cartilages 998
- Extrinsic ligaments 1000
- Intrinsic ligaments 1001
- Laryngeal joints 1002
- Cavity of the larynx 1003
- Intrinsic muscles 1005
- Function of the larynx 1008
- Vessels 1010
- Nerves 1012

**Nasal cavities 1013**

- Lateral wall 1014
- Regions 1015
- Innervation and blood supply 1016
- Skeletal framework 1016
- External nose 1018
- Paranasal sinuses 1018
- Walls, floor, and roof 1020

Nares 1024

Choanae 1024

Gateways 1024

Vessels 1026

Innervation 1028

**Oral cavity 1030**

- Multiple nerves innervate the oral cavity 1031
- Skeletal framework 1031
- Walls: the cheeks 1034
- Floor 1035
- Tongue 1037
- Salivary glands 1044
- Roof—palate 1047
- Oral fissure and lips 1055
- Oropharyngeal isthmus 1055
- Teeth and gingivae 1056

**Surface anatomy 1061**

- Head and neck surface anatomy 1061
- Anatomical position of the head and major landmarks 1062
- Visualizing structures at the CIII/CIV and CVI vertebral levels 1063
- How to outline the anterior and posterior triangles of the neck 1063
- How to locate the cricothyroid ligament 1064
- How to find the thyroid gland 1065
- Estimating the position of the middle meningeal artery 1066
- Major features of the face 1067
- The eye and lacrimal apparatus 1068
- External ear 1069
- Pulse points 1070

**Clinical cases 1071**