

CONTENTS

Preface	ix	
Acknowledgements	xii	
Contributors to the forty-second edition	xii	
Historical introduction		
A brief history of <i>Gray's Anatomy</i>		
<i>Ruth Richardson</i>		
Anatomical nomenclature	xvi	
SECTION 1: CELLS, TISSUES AND SYSTEMS		
Section Editor: Caroline B Wigley		
1. Basic structure and function of cells	4	
<i>Abraham L Kierszenbaum</i>		
2. Integrating cells into tissues	29	
<i>Caroline B Wigley</i>		
3. Nervous system	43	
<i>Nobutaka Hirokawa, Shigeo Okabe, Yosuke Takei</i>		
4. Blood, lymphoid tissues and haemopoiesis	71	
<i>Andrew George, Uday Kishore</i>		
5. Functional anatomy of the musculoskeletal system	85	
<i>Michael A Adams</i>		
6. Smooth muscle and the cardiovascular and lymphatic systems	127	
<i>Jeremy PT Ward</i>		
7. Skin and its appendages	145	
<i>John A McGrath, Joey Edward Lai-Cheong</i>		
Commentaries		
1.1. Fluorescence microscopy today: a perspective		
<i>Dylan M Owen, M Makarova</i>		
1.2. Electron microscopy in the twenty-first century		
<i>Roland A Fleck</i>		
1.3. Metaplasia		
<i>Jonathan MW Slack</i>		
1.4. Merkel cells		
<i>Ellen A Lumpkin</i>		
1.5. The reaction of peripheral nerves to injury		
<i>Rolfe Birch, Praveen Anand</i>		
1.6. A critical evaluation of the current status of myofascial chains		
<i>Jan Wilke, Winfried Banzer</i>		
Videos		
Video 1.1 – Mitosis in a cell with fluorescently labelled chromosomes and microtubules		
<i>Jonathon Pines, Daisuke Izawa</i>		
Video 1.2.1 – Diagnostic histopathology by electron microscopy		
<i>Roland A Fleck</i>		
SECTION 2: EMBRYOGENESIS AND DEVELOPMENT		
Section Editor: Patricia Collins		
8. Preimplantation development	170	
<i>Alison Campbell</i>		
9. Implantation and placentation	178	
<i>Eric Jauniaux, Graham J Burton</i>		
10. Cell populations at gastrulation	188	
<i>Patricia Collins</i>		
11. Overarching concepts in development	196	
<i>Patricia Collins</i>		
12. Cell populations at the start of organogenesis	201	
<i>Patricia Collins</i>		
13. Development of the heart and circulation	208	
<i>Patricia Collins, Antoon FM Moorman, Jaeike Welmoed Faber, Bjarke Jensen, Michael A Hall</i>		
14. Development of the nervous system	233	
<i>Zoltán Molnár, Patricia Collins</i>		
15. Development of the eye	264	
<i>Jane C Sowden</i>		
16. Development of the ear	269	
<i>Abigail Saffron Tucker</i>		
17. Development of the head and neck	273	
<i>Gillian Morriss-Kay</i>		
18. Development of the back	292	
<i>Martin Scaal</i>		
19. Development of the limbs	303	
<i>Cheryll Tickle</i>		
20. Development of the lungs, thorax and respiratory diaphragm	314	
<i>Andrew Bush, Patricia Collins</i>		
21. Development of the peritoneal cavity, gastrointestinal tract and its adnexae	323	
<i>Patricia Collins</i>		
22. Development of the urogenital system	341	
<i>Patricia Collins</i>		
23. Pre- and postnatal growth and the neonate	365	
<i>Patricia Collins, Michael A Hall, Kelly Brown</i>		
Commentaries		
2.1. Head-trunk interface in the vertebrate embryo		
<i>Shigeru Kuratani</i>		

CONTENTS

Videos

- Video 8.1 – Human *in vitro* fertilization and early development**
Alison Campbell
Video 9.1 – Ultrasound features of the maternal placental blood flow
Eric Jauniaux
Video 13.1 – Animation of the pattern of contraction of the early heart tube
Antoon FM Moorman
Video 13.2 – Ultrasound features of a four-chambered fetal heart
Warren Foster
Video 23.1 – Ultrasound features of a fetus at 26 weeks
Patricia Collins, Jonathan D Spratt

SECTION 3: NEUROANATOMY

Section Editors: Alan R Crossman, Marco Catani

- 24. Overview of the nervous system** 386
Alan R Crossman, Marco Catani
25. Meninges and ventricular system 398
Ranjeet Singh Bhangoo, Francesco Vergani, Juan C Fernandez-Miranda
26. Vascular supply and drainage of the brain 415
Gerardo Conesa Bertran, Ignacio Delgado-Martínez
27. Spinal cord 425
Roger Lemon
28. Brainstem 442
Thomas P Naidich
29. Cerebellum 465
Jeremy D Schmahmann
30. Diencephalon 489
Carmen Cavada
31. Basal ganglia 503
Tipu Zahed Aziz, Erlick AC Pereira
32. Cerebral hemispheres 512
Marco Catani, Karl Zilles[†]

Commentaries

- 3.1. Comparative anatomy of the corticospinal system**
Roger Lemon

Videos

- Video 26.1 – From angiography to anatomy: the internal carotid artery and its major branches**
Gerardo Conesa Bertran
Video 26.2 – From angiography to anatomy: veins of the cerebral system
Gerardo Conesa Bertran
Video 32.1 – Tractography reconstruction of the corpus callosum and corticofugal pathways using spherical deconvolution tractography
Ahmad Beyh, Flavio Dell'Acqua

SECTION 4: HEAD AND NECK

Section Editor: Michael Gleeson

- 33. Head and neck: overview and surface anatomy** 546
Michael Gleeson, Richard Tunstall

Head and neck

- 34. The skull** 558
Craig Andrew Cunningham, Juan C Fernandez-Miranda

35. Neck

John C Watkinson, Michael Gleeson

36. Face and scalp

Simon Holmes

Upper aerodigestive tract

- 37. Mouth** 636
Barrie KB Berkovitz

- 38. Infratemporal and pterygopalatine fossae and temporomandibular joint** 664
Andrew J Sidebottom, Michael Gleeson

- 39. Nose, nasal cavity and paranasal sinuses** 686
Claire Hopkins

- 40. Pharynx** 702
Eitan Prisman, Emmanuel D'Heygere

- 41. Larynx** 717
Declan Costello

Special senses

- 42. External and middle ear** 735
Michael Gleeson

- 43. Inner ear** 752
David Nicholas Furness

- 44. Orbit and accessory visual apparatus** 769
John Gerard Lawrenson, Ronald H Douglas

- 45. Eye** 790
John Gerard Lawrenson, Ronald H Douglas

Videos

Video 38.1 – Temporomandibular joint arthroscopy demonstrating intracapsular anatomy
Gary Warburton

Video 38.2 – Endoscopic anatomy of the infratemporal and pterygopalatine fossae
Carl H Snyderman, Juan C Fernandez-Miranda

Video 41.1 – Stroboscopic examination of the vocal folds
Declan Costello

SECTION 5: BACK

Section Editor: Neel Anand

- 46. Back** 814
Eli Baron, Richard Tunstall

- 47. Spinal cord and spinal nerves: gross anatomy** 856
Eli Baron, Guirish Solanki

SECTION 6: PECTORAL GIRDLE AND UPPER LIMB

Section Editor: Alistair Ross

- 48. Pectoral girdle and upper limb: overview and surface anatomy** 871
Alistair Ross, Richard Tunstall

- 49. Shoulder girdle and arm** 890
Simon Lambert

- 50. Elbow and forearm** 930
Adam C Watts

- 51. Wrist and hand** 955
David Warwick, James Logan

Commentaries

- 6.1. Nerve biomechanics
Kimberly S Topp
- 6.2. The anatomy and variation of the coracoid attachment of the subclavius muscle and its relation to the clavi-coraco-axillary aponeurosis
Simon Lambert
- 6.3. Instability of the shoulder – a neurological disease
Simon Lambert

Videos

- Video 48.1** – Upper limb surface anatomy
Rolf Birch
- Video 51.1** – Arthroscopic anatomy of the radiocarpal joint
Greg Couzens
- Video 51.2** – Movements of the wrist
James Logan
- Video 51.3** – Carpal mechanics and pathomechanics
James Logan
- Video 51.4** – Sagittal band function
James Logan
- Video 51.5** – Function of the intrinsic muscles of the hand
James Logan
- Video 51.6** – Movements of the thumb
James Logan
- Video 51.7** – Functional grips of the hand
James Logan
- Video 51.8** – Surface anatomy of the hand and wrist
James Logan
- Video 51.9** – Wrist block: surface anatomy
Dominic Harmon
- Video 51.10** – Wrist block: cadaveric anatomy
Dominic Harmon

SECTION 7: THORAX

Section Editor: Richard Tunstall

- 52. Thorax: overview and surface anatomy
Richard Tunstall 990
- 53. Chest wall and breast
James J Going, Erin P Fillmore, Donna Geddes 997
- Lungs and respiratory diaphragm**
- 54. Pleura, lungs, trachea and bronchi
Quentin Fogg 1020
- 55. Respiratory diaphragm and phrenic nerves
Albert van Schoor 1038
- Heart and mediastinum**
- 56. Mediastinum
Peter J Ward 1047
- 57. Heart
Marios Loukas 1068
- 58. Great vessels
Marios Loukas 1097

Commentaries

- 7.1. Breast cancer
Donna Geddes, James J Going
- 7.2. Computed tomography coronary angiography (CTCA) of anomalous coronary vasculature
Julia Sun, Jonathan Weir-McCall

SECTION 8: ABDOMEN AND PELVIS

Section Editor: R Shane Tubbs

- 59. Abdomen and pelvis: overview and surface anatomy
R Shane Tubbs 1107
- 60. Anterior abdominal wall
Eric M Pauli 1122
- 61. Posterior abdominal wall and retroperitoneum
R Shane Tubbs 1137
- 62. Peritoneum, mesentery and peritoneal cavity
John Calvin Coffey, Peter Dockery 1150
- Gastrointestinal tract**
- 63. Abdominal oesophagus and stomach
James J Going, Stuart Ballantyne, Andrew MacDonald, Matthew J Forshaw 1160
- 64. Small intestine
Jeffrey L Ponsky, Andrew T Strong 1173
- 65. Large intestine
Jasneet Singh Bhullar 1185
- Abdominal viscera**
- 66. Liver
Charles B Rosen 1205
- 67. Gallbladder and biliary tree
Mark D Stringer 1217
- 68. Pancreas
Claudius Conrad 1223
- 69. Spleen
Koichi Watanabe 1232
- 70. Suprarenal gland
Mohamad E Alaf, Michael A Gorin 1239
- Urogenital system**
- 71. Lesser pelvis and perineum
Mickey Karram, Hoi Tik Hyde Yuen 1244
- 72. Kidney and ureter
Joe Iwanaga 1259
- 73. Bladder, prostate and urethra
Leonard G Gomella, Paul H Chung 1276
- 74. Male reproductive system
Justine Schober 1292
- 75. Female reproductive system
Patrick J Woodman 1307
- Commentaries**
- 8.1. The mesentery and the mesenteric model of abdominal compartmentalization
John Calvin Coffey, Kevin Gerard Byrnes, Peter Dockery, Dara Walsh

Videos

- Video 59.1** – Dissection of the posterior abdominal wall
Shane Tubbs, Joe Iwanaga
- Video 59.2** – Dissection of the lumbosacral junction
Shane Tubbs, Joe Iwanaga
- Video 60.1** – Dissection of the anterior abdominal wall
Shane Tubbs, Joe Iwanaga

CONTENTS

- Video 62.1** – Dissection of the peritoneal cavity
Shane Tubbs, Joe Iwanaga
- Video 71.1** – Dissection of the sacral plexus
Shane Tubbs, Joe Iwanaga
- Video 73.1** – Laparoscopic view of bladder filling and emptying in relation to the rectovesical pouch
Serge Ginzburg, Anthony T Corcoran, Alexander Kutikov
- Video 73.2** – Laparoscopic view of the anterior abdominal wall and ligaments
Serge Ginzburg, Anthony T Corcoran, Alexander Kutikov
- Video 74.1** – Dissection of the male pelvis and perineum
Shane Tubbs, Joe Iwanaga
- Video 75.1** – Dissection of the female pelvis and perineum
Shane Tubbs, Joe Iwanaga

SECTION 9: PELVIC GIRDLE AND LOWER LIMB

Section Editor: Stephanie J Woodley

- 76.** Pelvic girdle and lower limb: overview and surface anatomy 1333
Nihal Apaydin, Stephanie J Woodley
- 77.** Pelvic girdle, hip, gluteal region and thigh 1352
Donald Anthony Neumann
- 78.** Knee and leg 1395
Robert J Spinner, Aaron J Krych, Christopher D Bernard
- 79.** Ankle and foot 1430
Anthony V D'Antoni, Garrett D Moore

Commentaries

- 9.1.** Functional anatomy and biomechanics of the pelvis
Andry Vleeming, Frank H Willard
- 9.2.** A proposed novel action of psoas minor
Donald Anthony Neumann
- 9.3.** Anterolateral ligament of the knee
Robert F LaPrade

Videos

- Video 76.1** – Walking gait cycle
Stephanie J Woodley, Stuart MacKenzie, Thomas Heaton
- Video 76.2** – Running gait cycle
Stephanie J Woodley, Stuart MacKenzie, Thomas Heaton
- Video 76.3** – Lower limb surface anatomy
Rolfe Birch
- Video 79.1** – Ankle block: surface anatomy
Dominic Harmon
- Video 9.2.1** – Psoas minor
Donald Anthony Neumann, LR Garceau

SYSTEMATIC ANATOMY

- 80.** The anatomy of the peripheral nervous system
Susan Standring
- 81.** The anatomy of the vascular and lymphatic systems
Susan Standring

IMAGING COLLECTION

Section 2

- 2.1.** Human oocyte undergoing fertilization, cell division, blastocyst development and hatching *in vitro*

Section 3

- 3.1.** MRI head: axial T2-weighted
- 3.2.** MRI head: coronal T2-weighted
- 3.3.** MRI head: sagittal T2-weighted

Section 4

- 4.1.** CT neck: axial post-IV contrast
- 4.2.** CT neck: coronal post-IV contrast

Section 7

- 7.1.** CT chest, abdomen and pelvis: axial post-IV contrast
- 7.2.** CT chest, abdomen and pelvis: coronal post-IV contrast
- 7.3.** CT chest, abdomen and pelvis: sagittal post-IV contrast

Section 8

- 8.1.** MRI male pelvis: axial T1-weighted

Section 9

- 9.1.** MRI male pelvis: coronal T1-weighted

Commentaries

- I.1.** A note on anatomy from an imaging perspective
Tom Turmezei
- I.2.** Technical aspects and applications of diagnostic radiology
Jonathan D Spratt
- I.3.** Imaging the ageing musculoskeletal system
Andoni P Toms
- I.4.** Cinematic rendering offers entirely new possibilities for studying human anatomy
Andrea Hofbauer, Klaus Engel

EPONYMS

Harold Ellis and Susan Standring

Index

1465