

Table of contents

I GENERAL ANATOMY AND EMBRYOLOGY

1	General anatomy	3	2.3.2	Blastocysts and implantation	50
	Friedrich Paulsen, Faramarz Dehghani		2.4	Gastrulation	51
1.1	Subdivisions	5	2.4.1	Two-leaved germinal disc	51
1.2	Architecture of the human body	5	2.4.2	Creation of the germinal layers	51
1.2.1	Organisation	5	2.5	Development of the ectoderm	53
1.2.2	Body proportions	7	2.5.1	Induction of the neuroectoderm	53
1.2.3	Positional descriptions	8	2.5.2	Neurulation	54
1.2.4	General anatomical descriptions	10	2.5.3	Neural crest	55
1.3	Skin and skin appendages	15	2.6	Development of the mesoderm	56
1.3.1	Skin types and skin layers	16	2.6.1	Axial mesoderm	56
1.3.2	Skin appendages	16	2.6.2	Paraxial mesoderm	56
1.4	Musculoskeletal system	18	2.6.3	Intermediate mesoderm	59
1.4.1	Cartilage	18	2.6.4	Lateral mesoderm	60
1.4.2	Bones	18	2.7	Development of the endoderm	61
1.4.3	Joints	23	2.8	Folding movements of the embryo	61
1.4.4	General considerations on muscles	29	2.8.1	Craniocaudal curvature	62
1.5	Circulation systems	33	2.8.2	Lateral folding up	62
1.5.1	Body and pulmonary circulation	33	2.9	Extra-embryonic tissue	63
1.5.2	Portal vein circulation	37	2.9.1	Trophoblast	63
1.5.3	Prenatal circulation	38	2.9.2	Chorionic cavity and yolk sac	63
1.5.4	Lymphatic circulation	38	2.9.3	Amnion	64
1.6	Mucous membranes, glands, serous cavities	41	2.9.4	Allantois	64
1.6.1	Mucous membranes	41	2.10	Early development of the extremities ..	65
1.6.2	Glands	41	2.10.1	Formation of the extremity buds	65
1.6.3	Serous cavities	41	2.10.2	Pattern formation in the extremities positions	65
1.7	Nervous system	42	2.10.3	Origin of the skeleton and the muscles of the extremities	66
2	General embryology	45	2.11	Early development of the head and throat area	66
	Martin Scaal		2.11.1	Pharyngeal arches	66
2.1	Introduction	47	2.11.2	Pharyngeal grooves and pharyngeal pouches	70
2.2	Fertilisation	47	2.11.3	Development of the tongue and thyroid gland	70
2.2.1	Translocation and capacitation	47	2.11.4	Facial development	71
2.2.2	Acrosome reaction and fusion of the germ cells	48	2.11.5	Development of the oral and nasal cavities	72
2.2.3	Fusion of genetic material	48			
2.3	Preimplantation development	50			
2.3.1	Cleavage and compaction	50			

II MUSCULOSKELETAL SYSTEM

3	Torso	75	3.1.1	General structure	76
3.1	Ventral torso wall	76	3.1.2	Thoracic wall	77
	Martin Gericke, Martin Krüger (with contribution from Ingo Bechmann)		3.1.3	Diaphragm	87
			3.1.4	Abdominal wall	90

3.2	Dorsal torso wall	104	4.6.7	N. ulnaris	183
	Friedrich Paulsen, Jens Waschke		4.6.8	N. cutanei brachii and antebrachii medialis	184
3.2.1	General structure	104	4.7	Arteries of the upper extremity	184
3.2.2	Back muscles	105	4.7.1	A. subclavia	185
3.2.3	Vascular, lymphatic and nervous systems of the dorsal torso wall	112	4.7.2	A. axillaris	186
3.3	Spine, spinal cord and thorax	104	4.7.3	A. brachialis	187
	Bernhard Hirt, Friedrich Paulsen		4.7.4	A. radialis	188
3.3.1	Embryology	115	4.7.5	A. ulnaris	189
3.3.2	Spine	115	4.8	Veins of the upper extremity	190
3.3.3	Spinal cord site	129	4.8.1	Superficial veins	190
3.3.4	Thorax	132	4.8.2	Deep veins	191
4	Upper extremity	139	4.9	Lymphatic vessels of the upper extremity	191
	Volker Spindler, Jens Waschke		4.9.1	Epifascial and subfascial lymph vessels	191
4.1	Overview	141	4.9.2	Lymph nodes of the axilla	191
4.2	Development of upper and lower extremities	142	4.10	Topographically important aspects of the arm	192
4.2.1	Course	142	4.10.1	Trigonum clavipectorale	192
4.2.2	Bones	143	4.10.2	Axillary cavity	192
4.2.3	Muscular system	143	4.10.3	Axillary spaces and triceps groove	193
4.2.4	Nerves	145	4.10.4	Elbow	193
4.2.5	Blood vessels	145	4.10.5	Carpal tunnel and GUYON's canal	194
4.3	Shoulder girdle	145	5	Lower extremity	195
4.3.1	Bones of the shoulder girdle	145		Volker Spindler, Jens Waschke	
4.3.2	Joints and ligament connections of the shoulder girdle	146	5.1	Overview	197
4.3.3	Shoulder girdle mechanics	147	5.2	Pelvis	198
4.3.4	Shoulder girdle muscles	148	5.2.1	Structure and form	198
4.4	Upper arm	150	5.2.2	Bones of the pelvis	199
4.4.1	Humerus	150	5.2.3	Pelvic joints and ligament attachments	201
4.4.2	Shoulder joint	150	5.2.4	Mechanics of the pelvic joints	201
4.4.3	Shoulder joint mechanics	151	5.3	Thigh	202
4.4.4	Shoulder muscles	152	5.3.1	Thigh bone	202
4.5	Forearm and hand	155	5.3.2	Hip joint	203
4.5.1	Bones of the forearm	156	5.3.3	Mechanics of the hip joint	205
4.5.2	Elbow joint	156	5.3.4	Muscles of the hip joint	205
4.5.3	Joint connections between the forearm bones	157	5.3.5	Fascia lata and Tractus iliotibialis	209
4.5.4	Elbow joint and distal radioulnar joint mechanics	157	5.4	Lower leg	209
4.5.5	Muscles	157	5.4.1	Bones of the leg	209
4.5.6	Structure and bones of the hand	159	5.4.2	Attachments between the Tibia and Fibula	211
4.5.7	Joints of the hand	160	5.4.3	Knee joint	211
4.5.8	Hand-joint mechanics	163	5.4.4	Mechanics of the knee joint	214
4.5.9	Muscles of the forearm and hand	164	5.4.5	Muscles of the knee joint	216
4.5.10	Auxiliary structures of the musculature in the area of the hand	169	5.5	Foot	218
4.6	Nerves of the upper extremity	174	5.5.1	Bones of the foot	219
4.6.1	Sensory innervation	174	5.5.2	Joints of the foot	220
4.6.2	Structure of the Plexus brachialis	175	5.5.3	Mechanics of the ankle joints	221
4.6.3	N. axillaris	178	5.5.4	The arch of the foot	223
4.6.4	N. radialis	178	5.5.5	Muscles of the lower leg and foot	225
4.6.5	N. musculocutaneus	180	5.5.6	Support facilities of the musculature in the region of the lower leg and foot	229
4.6.6	N. medianus	181			

5.6	Nerves of the lower extremity	231	5.9	Lymph vessels of the lower extremity ..	245
5.6.1	Plexus lumbosacralis	233	5.9.1	Lymph vessels	245
5.6.2	N. ischiadicus	236	5.9.2	Inguinal lymph nodes	245
5.7	Arteries of the lower extremity	238	5.9.3	Pelvic lymph nodes	245
5.7.1	A. iliaca externa	239	5.10	Topographically important aspects of the leg	246
5.7.2	A. femoralis	239	5.10.1	Lacuna musculorum and Lacuna vasorum	246
5.7.3	A. poplitea	241	5.10.2	Femoral triangle and adductor canal ...	247
5.7.4	A. tibialis anterior	241	5.10.3	Gluteal region	248
5.7.5	A. tibialis posterior	243	5.10.4	Hollow of the knee	249
5.8	Veins of the lower extremity	243			

III INTERNAL ORGANS

6	Chest viscera	253	6.5.2	Mediastinum	288
	Daniela Kugelmann, Jens Waschke		6.5.3	Pleural cavities	289
6.1	Heart	255	6.5.4	Breathing	290
6.1.1	Overview	255	6.5.5	Development of the visceral cavities ...	291
6.1.2	Function	255	6.6	Vessels and nerves of the thoracic cavity	294
6.1.3	Development of the heart and blood vessels	256	6.6.1	Overview	294
6.1.4	Prenatal and postnatal blood circulation	260	6.6.2	Arteries of the thoracic cavity	294
6.1.5	Location and projection	262	6.6.3	Veins of the thoracic cavity	295
6.1.6	Atria and ventricles	264	6.6.4	Lymph vessels of the thoracic cavity ...	296
6.1.7	Heart wall and pericardium	266	6.6.5	Nerves of the thoracic cavity	297
6.1.8	Cardiac skeleton and heart valves	267	7	Abdominal viscera	299
6.1.9	Conduction system and innervation of the heart	269	Jens Waschke		
6.1.10	Coronary blood vessel	271	7.1	Stomach	302
6.1.11	Veins and lymphatic vessels of the heart	273	7.1.1	Overview	302
6.2	Trachea and lungs	274	7.1.2	Functions of the stomach	302
6.2.1	Overview and function	274	7.1.3	Development of stomach, Bursa omentalis, Omentum minus and Omentum majus	303
6.2.2	Development of trachea and lungs	275	7.1.4	Projection of the stomach	305
6.2.3	Topography and structure of the trachea and main bronchi	276	7.1.5	Structure and sections of the stomach ..	305
6.2.4	Vessels and nerves of the trachea and main bronchi	277	7.1.6	Surface enlargement of the stomach lining	306
6.2.5	Projection of the lungs	277	7.1.7	Topography	306
6.2.6	Structure of the lungs	279	7.1.8	Arteries of the stomach	307
6.2.7	Vessels and nerves of the lungs	281	7.1.9	Veins of the stomach	307
6.3	Oesophagus	282	7.1.10	Lymph vessels of the stomach	308
6.3.1	Overview, function and development	282	7.1.11	Innervation of the stomach	309
6.3.2	Structure and projection	283	7.2	Intestines	309
6.3.3	Classification	283	7.2.1	Overview	310
6.3.4	Constrictions of the oesophagus	284	7.2.2	Functions of the intestine	310
6.3.5	Closing mechanisms	284	7.2.3	Development	310
6.3.6	Vessels and nerves of the oesophagus	285	7.2.4	Structure and projection of the small intestine	312
6.4	Thymus	287	7.2.5	Structure and projection of the large intestine	313
6.4.1	Overview, function and development	287	7.2.6	Structural features of the small and large intestines	315
6.4.2	Structure	288	7.2.7	Topography of small and large intestines	316
6.4.3	Vessels and nerves of the thymus	288	7.2.8	Intestinal arteries	318
6.5	Thoracic cavity	288	7.2.9	Veins of the intestine	320
6.5.1	Overview	288			

7.2.10	Lymph vessels of the intestine	320	8.1	Kidneys	352
7.2.11	Innervation of the intestine	320	8.1.1	Overview	352
7.3	Liver	322	8.1.2	Functions of the kidneys	352
7.3.1	Overview	322	8.1.3	Development of the kidneys	352
7.3.2	Functions of the liver	322	8.1.4	Projection and structure of the kidney ..	354
7.3.3	Development of the liver and gall bladder	323	8.1.5	Fascial system of the kidney	355
7.3.4	Projection of the liver	323	8.1.6	Topography	356
7.3.5	Structure	324	8.1.7	Vessels and nerves of the kidney	357
7.3.6	Parts and segments of the liver	325	8.2	Adrenal gland	358
7.3.7	Fine structure of the liver	326	8.2.1	Overview	358
7.3.8	Topography	327	8.2.2	Functions of the adrenal gland and development	358
7.3.9	Arteries of the liver	327	8.2.3	Structure, projection and topography of the adrenal glands	359
7.3.10	Veins of the liver	328	8.2.4	Vessels and nerves of the adrenal glands	359
7.3.11	Portocaval anastomoses	328	8.3	Efferent urinary tracts	359
7.3.12	Lymph vessels of the liver	329	8.3.1	Overview and function	359
7.3.13	Innervation of the liver	330	8.3.2	Development of the efferent urinary tracts	359
7.4	Gall bladder and bile ducts	331	8.3.3	Renal pelvis and ureter	361
7.4.1	Overview and function	331	8.3.4	Urinary bladder	362
7.4.2	Projection and topography of the gall bladder	331	8.3.5	Urethra	362
7.4.3	Construction of gall bladder and extrahepatic bile ducts	331	8.3.6	Closure mechanisms of the urinary bladder and the urethra ..	363
7.4.4	Pathways of the gall bladder and bile ducts	332	8.3.7	Vessels and nerves of the efferent urinary tracts	363
7.4.5	CALOT's triangle	333	8.4	Rectum and anal canal	364
7.5	Pancreas	333	Jens Waschke, Friedrich Paulsen		
7.5.1	Overview	333	8.4.1	Overview and function	364
7.5.2	Functions of the pancreas	334	8.4.2	Classification, projection and structure of rectum and anal canal	364
7.5.3	Development	334	8.4.3	Mesorectum	365
7.5.4	Projection and structure of the pancreas	334	8.4.4	Continence organ	366
7.5.5	Excretory duct system of the pancreas ..	335	8.4.5	Arteries of the rectum and anal canal ..	369
7.5.6	Topography	335	8.4.6	Veins of the rectum and anal canal	369
7.5.7	Vessels and nerves of the pancreas ..	337	8.4.7	Lymphatic vessels of the rectum and anal canal	370
7.6	Spleen	338	8.4.8	Innervation of the rectum and anal canal	370
7.6.1	Overview	338	8.5	Male genitalia	371
7.6.2	Functions of the spleen	338	8.5.1	Overview	372
7.6.3	Development	338	8.5.2	Function of the male genitalia	372
7.6.4	Projection, construction and topography of the spleen	339	8.5.3	Development of the male genitalia	372
7.6.5	Vessels and nerves of the spleen	339	8.5.4	Penis and scrotum	375
7.7	Peritoneal cavity	340	8.5.5	Testis and epididymis	376
7.7.1	Overview	340	8.5.6	Vas deferens and spermatic cord	377
7.7.2	Omentum majus and Omentum minus	341	8.5.7	Accessory sex glands	378
7.7.3	Recessus of the peritoneal cavity	342	8.5.8	Vessels and nerves of the external and internal male genitalia	379
7.8	Vessels and nerves of the peritoneal cavity	343	8.6	Female genitalia	383
7.8.1	Overview	343	8.6.1	Overview	384
7.8.2	Arteries of the peritoneal cavity	343	8.6.2	Function of the female genitalia	385
7.8.3	Veins of the peritoneal cavity	345	8.6.3	Development of the external and internal female genitalia	385
7.8.4	Lymph vessels of the peritoneal cavity ..	345	8.6.4	Vulva	386
7.8.5	Nerves of the peritoneal cavity	346	8.6.5	Ovary and fallopian tubes	387
8	Pelvic viscera	349			
	Jens Waschke				

8.6.6	Uterus	388	8.8.2	Arteries of the retroperitoneum and pelvic cavity	394
8.6.7	Vagina	389	8.8.3	Veins of the retroperitoneum and pelvic cavity	397
8.6.8	Vessels and nerves of the external and internal female genitalia	390	8.8.4	Lymphatic vessels of the retroperitoneum and pelvic cavity	398
8.7	Retroperitoneal space and pelvic cavity	392	8.8.5	Nerves of the retroperitoneum and pelvic cavity	400
8.7.1	Overview	392	8.9	Pelvic floor and perineal region	401
8.7.2	Retroperitoneal space	392	8.9.1	Overview	401
8.7.3	Subperitoneal space	392	8.9.2	Pelvic floor	401
8.8	Vessels and nerves of the extraperitoneal space and pelvic cavity	394	8.9.3	Perineal region	402
8.8.1	Overview	394			

IV HEAD AND THROAT

9	Head	409	9.5	Ear	477
9.1	Skull	411	Friedrich Paulsen		
	Lars Bräuer		9.5.1	Embryology	478
9.1.1	Neurocranium and viscerocranium	411	9.5.2	External ear	478
9.1.2	Skull development – Embryology	411	9.5.3	Middle ear	481
9.1.3	Calvaria	413	9.5.4	Internal ear	488
9.1.4	Base of the skull	414	9.6	Nose	491
9.1.5	Individual bones of the viscerocranium	418	Friedrich Paulsen		
9.1.6	Individual bones of the neurocranium	422	9.6.1	Overview	492
9.2	Soft tissue covering	424	9.6.2	Development	492
	Lars Bräuer, Friedrich Paulsen		9.6.3	External nose	493
9.2.1	Overview	424	9.6.4	Nasal cavities	495
9.2.2	Scalp	425	9.6.5	Paranasal sinuses	499
9.2.3	Face and facial soft tissue	428	9.6.6	Vascular, lymphatic and nervous systems	500
9.2.4	Superficial lateral facial region	436	9.7	Oral cavity, masticatory apparatus, tongue, palate, floor of the mouth, salivary glands	502
9.2.5	Deep lateral facial region	439	Wolfgang H. Arnold		
9.3	Cranial nerves	443	9.7.1	Oral cavity	503
	Lars Bräuer		9.7.2	Masticatory apparatus – teeth	506
9.3.1	N. olfactarius [I]	444	9.7.3	Masticatory apparatus –	
9.3.2	N. opticus [II]	445	9.7.4	Masticatory muscles	512
9.3.3	N. oculomotorius [III]	445	9.7.5	Masticatory apparatus – temporomandibular joint	514
9.3.4	N. trochlearis [IV]	446	9.7.6	Tongue	516
9.3.5	N. trigeminus [V]	447	9.7.7	Palate	520
9.3.6	N. abducens [VI]	449	9.7.8	Floor of the mouth	524
9.3.7	N. facialis [VII]	449	9.7.9	Lymphatic pathways of the oral cavity	526
9.3.8	N. vestibulocochlearis [VIII]	453	10	Neck	531
9.3.9	N. glossopharyngeus [IX]	454	10.1	Overview	533
9.3.10	N. vagus [X]	455	Michael Scholz		
9.3.11	N. accessorius [XI]	457	10.1.1	Surface anatomy of the neck	533
9.3.12	N. hypoglossus [XII]	457	10.1.2	Regions of the neck and neck triangles	534
9.4	Eye	459	10.2	Musculoskeletal system of the neck	534
	Michael Scholz		Michael Scholz		
9.4.1	Embryology	460	10.2.1	Passive sections	534
9.4.2	Protective and auxiliary structures of the eye	461	10.2.2	Active sections – neck muscles	535
9.4.3	Orbita	465			
9.4.4	Bulbus oculi	472			

10.3	Cervical fascia and connective tissue spaces	541	10.6	Larynx	562
	Michael Scholz			Friedrich Paulsen	
10.3.1	Neck fasciae	542	10.6.1	Overview	563
10.3.2	Connective tissue spaces of the neck	543	10.6.2	Development	563
10.4	Vascular, lymphatic and nervous systems of the neck	545	10.6.3	Laryngeal skeleton	564
	Michael Scholz		10.6.4	Laryngeal levels	571
10.4.1	Arteries of the neck	545	10.6.5	Structure of the Plicae vocales und Plicae vestibulares	572
10.4.2	Veins of the neck	548	10.6.6	Vascular, lymphatic and nervous systems	573
10.4.3	Nerves of the neck	550	10.7	Pharynx	575
10.4.4	Lymph nodes of the neck	557		Wolfgang H. Arnold	
10.5	Thyroid and parathyroid glands	559	10.7.1	Development	575
	Michael Scholz		10.7.2	Levels of the pharynx	575
10.5.1	Location and function	559	10.7.3	Pharyngeal wall	576
10.5.2	Development	559	10.7.4	Pharyngeal musculature	576
10.5.3	Vascular, lymphatic and nervous systems	561	10.7.5	Vascular, lymphatic and nervous systems	577
			10.7.6	Swallowing	579
			10.7.7	Lymphatic pharyngeal ring	579

V NEUROANATOMY

11	General neuroanatomy	583	11.4.5	Cerebrospinal fluid	610
11.1	Embryology	584	11.4.6	Circumventricular organs	611
	Tobias M. Böckers		11.5	Cerebral vessels	612
11.1.1	Overview	584		Thomas Deller	
11.1.2	Further brain development	586	11.5.1	Overview	612
11.1.3	Development of the spinal cord	591	11.5.2	A. carotis interna and its branches	617
11.1.4	Development of the peripheral nervous system	593	11.5.3	Aa. vertebrales/A. basilaris and their branches	619
11.2	Structure of the nervous system	593	11.5.4	Central blood supply	622
	Anja Böckers		11.5.5	Vascular supply of the spinal cord	623
11.2.1	Overview	593	11.5.6	Topography and supply areas of the arteries	624
11.2.2	Structure of the CNS	593	11.5.7	Clinical description of the vascular sections	628
11.2.3	Morphology of the CNS	594	11.5.8	Venous sinuses of the brain	628
11.2.4	Distribution of grey matter in the CNS	599	11.5.9	Presentation of the vasculature	630
11.2.5	Distribution of white matter in the CNS	599	12	Special neuroanatomy	635
11.3	Meninges	603	12.1	Telencephalon	637
	Michael J. Schmeißer		12.1.1	Overview	637
11.3.1	Overview	603	12.1.2	Embryology	637
11.3.2	Embryology	604	12.1.3	Classification of the telencephalon	637
11.3.3	Pachymeninx – Dura mater	604	12.1.4	Fibre systems of the telencephalon	638
11.3.4	Leptomeninx	604	12.1.5	Neocortex	638
11.3.5	Neurovascular pathways of the meninges	606	12.1.6	Archicortex	643
11.4	Ventricular system and adjacent structures	607	12.1.7	Paleocortex	650
	Anja Böckers		12.1.8	Subcortical nuclei	652
11.4.1	Overview and structure	607	12.2	Diencephalon	656
11.4.2	Embryology	608		Tobias M. Böckers	
11.4.3	Inner cerebrospinal fluid space	609	12.2.1	Overview	656
11.4.4	External subarachnoid fluid spaces – Spatium subarachnoideum	610	12.2.2	Epithalamus	657
			12.2.3	Thalamus	658
			12.2.4	Hypothalamus	660
			12.2.5	Subthalamus	664

12.3	Brainstem	664	13.1.3	Peripheral section	730
	Michael J. Schmeißer, Stephan Schwarzacher		13.1.4	Execution of voluntary movements	731
12.3.1	Mesencephalon	664	13.2	Somatosensory system	732
12.3.2	Pons and Medulla oblongata	668		Anja Böckers	
12.3.3	Functional systems of the brainstem	672	13.2.1	Overview	732
12.3.4	Blood supply to the brainstem	673	13.2.2	Peripheral section	732
12.4	Cerebellum	673	13.2.3	Central section	732
	Michael J. Schmeißer		13.3	Visual system	738
12.4.1	Overview	674		Michael J. Schmeißer	
12.4.2	Embryology	674	13.3.1	Optic tract	738
12.4.3	Position and external appearance	674	13.3.2	Visual reflexes	740
12.4.4	Internal structure	676	13.3.3	Management of ocular motor function	741
12.4.5	Neurovascular pathways	677	13.4	Auditory system	742
12.4.6	Blood supply	678		Anja Böckers	
12.5	Cranial nerves	679	13.4.1	Overview	743
	Anja Böckers, Michael J. Schmeißer		13.4.2	Peripheral section	743
12.5.1	Overview	679	13.4.3	Central section	744
12.5.2	Embryology	681	13.5	Vestibular system	746
12.5.3	Arterial blood supply	684		Anja Böckers	
12.5.4	N. olfactorius (1st cranial nerve, N. I)	684	13.5.1	Overview	746
12.5.5	N. opticus (2nd cranial nerve, N. II)	685	13.5.2	Peripheral section	746
12.5.6	N. oculomotorius (3rd cranial nerve, N. III)	685	13.5.3	Central section	746
12.5.7	N. trochlearis (4th cranial nerve, N. IV)	687	13.6	Olfactory system	748
12.5.8	N. trigeminus (5th cranial nerve, N. V)	688		Michael J. Schmeißer	
12.5.9	N. abducens (6th cranial nerve, N. VI)	695	13.6.1	Regio olfactoria	749
12.5.10	N. facialis (7th cranial nerve, N. VII)	696	13.6.2	Pathway of the olfactory tract	749
12.5.11	N. vestibulocochlearis (8th cranial nerve, N. VIII)	699	13.6.3	Olfactory cortex	750
12.5.12	N. glossopharyngeus (9th cranial nerve, N. IX)	701	13.7	Gustatory system	750
12.5.13	N. vagus (10th cranial nerve, N. X)	704		Anja Böckers	
12.5.14	N. accessorius (11th cranial nerve, N. XI)	708	13.7.1	Peripheral section	750
12.5.15	N. hypoglossus (12th cranial nerve, N. XII)	709	13.7.2	Central section	751
12.6	Spinal cord	711	13.8	Nociceptive system	752
	Anja Böckers			Anja Böckers	
12.6.1	Overview	711	13.8.1	Overview	752
12.6.2	Segmental structure of the Medulla spinalis	711	13.8.2	Pain conduction	752
12.6.3	Surface and cross-sectional anatomy	712	13.8.3	Pain processing	754
12.6.4	Structure of the Substantia nigra	715	13.9	Autonomic nervous system	755
12.6.5	Structure of the Substantia nigra	716		Thomas Deller	
12.6.6	Blood supply	719	13.9.1	Overview	755
12.6.7	Motor functions of the spinal cord	720	13.9.2	Visceromotor function	756
13	Functional systems	723	13.9.3	Viscerosensory function	762
13.1	Somatic nervous system	725	13.9.4	Autonomic reflex arcs and control circuits	763
	Tobias M. Böckers		13.9.5	Central regulation of the autonomic nervous system	764
13.1.1	Overview	725	13.9.6	Summary and outlook	768
13.1.2	Central section	725	13.10	Limbic system	768
				Thomas Deller	
13.10.1	Overview		13.10.1	Overview	768
13.10.2	Components of the limbic system		13.10.2	Components of the limbic system	769
13.10.3	Neuronal circuits of the limbic system		13.10.3	Neuronal circuits of the limbic system	769