mouse spinal cord anatomy

Mouse Spinal Cord Anatomy: A Detailed Exploration

mouse spinal cord anatomy is a fascinating subject that provides valuable insights not only into the biology of rodents but also into broader neurological functions applicable across mammalian species. Understanding the mouse spinal cord is crucial for researchers, especially in fields like neuroscience, developmental biology, and medical research where mice serve as important model organisms. This article aims to guide you through the intricate aspects of the mouse spinal cord anatomy, highlighting its structure, function, and relevance in scientific studies.

Overview of the Mouse Spinal Cord

The spinal cord in mice, much like in other mammals, acts as a vital communication highway between the brain and the rest of the body. It’s housed within the vertebral column, shielded by bones and meninges, and comprises both gray and white matter. The spinal cord facilitates motor commands, sensory information processing, and reflex actions that are essential for survival.

In mice, the spinal cord extends from the brainstem down through the vertebral canal, ending near the lumbar region. Despite its small size, the mouse spinal cord exhibits complex organization, allowing researchers to study neural circuits and disease mechanisms effectively.

Gross Anatomy and Segmentation

The mouse spinal cord is segmented into cervical, thoracic, lumbar, sacral, and coccygeal regions, each corresponding to specific vertebral levels. These segments give rise to spinal nerves that innervate different parts of the mouse’s body.

- **Cervical segments** control forelimb movements and receive sensory inputs from the neck and shoulders.
- **Thoracic segments** are involved in trunk stability and autonomic functions.
- **Lumbar and sacral segments** govern hindlimb movements and pelvic organ functions.

This segmentation is crucial in studies that manipulate or examine specific neural pathways, as targeted lesions or genetic modifications in certain segments can reveal functional roles of particular spinal cord regions.

Microscopic Anatomy: Gray and White Matter

Diving deeper, the mouse spinal cord’s anatomy becomes even more intriguing when

considering its microscopic structure. The gray matter and white matter serve distinct yet complementary roles.

Gray Matter

At the core of the spinal cord lies the gray matter, which contains neuron cell bodies, dendrites, and synapses. In mice, the gray matter is typically shaped like a butterfly or the letter “H” and is divided into dorsal (posterior), ventral (anterior), and lateral horns.

- The **dorsal horn** processes sensory information from peripheral nerves.
- The **ventral horn** houses motor neurons responsible for muscle contraction.
- The **lateral horn**, more prominent in thoracic segments, contains neurons involved in autonomic functions.

Within the gray matter, distinct laminae (layers) are recognized, each associated with specific types of neurons and functions. For example, lamina II is heavily involved in processing pain and temperature signals.

White Matter

Surrounding the gray matter is the white matter, composed mainly of myelinated axons that form ascending and descending tracts. These tracts transmit sensory information to the brain and motor commands from the brain to peripheral muscles.

Key tracts in the mouse spinal cord include:

- **Dorsal columns**, which carry fine touch and proprioception signals.
- **Spinothalamic tracts**, responsible for pain and temperature sensation.
- **Corticospinal tracts**, which mediate voluntary motor control.

The organization of these tracts is critical in experimental models studying spinal cord injury or neurodegenerative diseases, as damage to specific tracts leads to predictable functional deficits.

Functional Aspects of Mouse Spinal Cord Anatomy

Understanding the anatomy is only part of the story; the spinal cord’s functionality is central to its biological importance.

Neural Circuitry and Reflexes

The mouse spinal cord contains intricate neural circuits that generate reflexes—automatic responses to stimuli without brain involvement. For instance, the withdrawal reflex when a mouse encounters a painful stimulus is mediated at the spinal level. This reflex arc involves sensory neurons detecting the stimulus, interneurons processing the signal, and motor neurons triggering muscle contraction.

Studying these circuits in mice helps elucidate basic principles of neurophysiology and provides models for human neurological disorders.

Role in Sensory and Motor Integration

The spinal cord serves as a hub where sensory inputs from skin, muscles, and joints converge and are integrated with motor outputs. This integration ensures coordinated movement and posture control. In mice, precise anatomical mapping of these connections has allowed scientists to understand how certain genetic mutations affect motor function, aiding research into diseases like spinal muscular atrophy or amyotrophic lateral sclerosis (ALS).

Techniques for Studying Mouse Spinal Cord Anatomy

Modern neuroscience thrives on advanced imaging and molecular techniques to study the mouse spinal cord in detail.

Histology and Immunohistochemistry

Traditional histological staining methods, such as Nissl staining, reveal the distribution of neurons and glial cells within the spinal cord. Immunohistochemistry further allows researchers to label specific proteins, neurotransmitters, or receptors, providing insights into cellular composition and function.

Imaging Modalities

High-resolution microscopy techniques, including confocal and two-photon microscopy, enable visualization of neuronal networks and synapses within the mouse spinal cord. Additionally, MRI and diffusion tensor imaging (DTI) have been adapted for small animals to study white matter tracts non-invasively.

Genetic and Molecular Tools

Genetic manipulation in mice, such as the use of transgenic lines expressing fluorescent

markers in specific neuronal populations, has revolutionized spinal cord research. Optogenetics and chemogenetics allow precise control over neuronal activity, linking anatomy with function in living animals.

Relevance of Mouse Spinal Cord Anatomy in Research

The detailed understanding of mouse spinal cord anatomy has far-reaching implications in biomedical research.

Modeling Human Neurological Diseases

Mouse models replicate many human spinal cord conditions, including traumatic injury, neurodegeneration, and demyelinating diseases. Knowledge of spinal cord anatomy ensures accurate targeting and interpretation of experimental interventions.

Developmental Biology and Regeneration

Studying how the mouse spinal cord develops and regenerates after injury sheds light on potential therapies for spinal cord repair. Researchers examine the role of stem cells, growth factors, and molecular pathways in promoting neuronal survival and axonal regrowth.

Pharmacological Testing

The mouse spinal cord is often the site for testing drugs aimed at alleviating pain, spasticity, or motor dysfunction. Understanding the anatomical distribution of receptors and neuronal circuits enhances drug design and delivery strategies.

Tips for Studying Mouse Spinal Cord Anatomy Effectively

For students and researchers embarking on the study of mouse spinal cord anatomy, a few practical tips can enhance learning and experimentation:

- **Familiarize Yourself with Vertebral Landmarks:** Knowing vertebral levels helps in accurate dissection and segment identification.
- **Use Multiple Staining Techniques:** Combining Nissl, myelin, and immunostaining

provides a comprehensive view of spinal cord structure.

- **Leverage 3D Imaging:** Employ software tools that reconstruct spinal cord anatomy for better spatial understanding.
- **Integrate Functional Studies:** Pair anatomical analysis with electrophysiology or behavioral assays to link structure with function.

Exploring the mouse spinal cord with these approaches deepens insights and fosters more robust scientific outcomes.

Understanding mouse spinal cord anatomy opens doors to unraveling complex neural mechanisms, advancing medical research, and developing treatments for spinal cord-related conditions. This small but intricate structure continues to be a cornerstone of neuroscience and biomedical investigations.

Frequently Asked Questions

What are the main regions of the mouse spinal cord?

The mouse spinal cord is divided into cervical, thoracic, lumbar, sacral, and coccygeal regions, each corresponding to different segments that innervate specific parts of the body.

How is the gray matter organized in the mouse spinal cord?

The gray matter in the mouse spinal cord is organized into dorsal, ventral, and intermediate horns, containing different types of neurons responsible for sensory processing, motor control, and interneuronal communication.

What types of neurons are found in the mouse spinal cord?

The mouse spinal cord contains motor neurons in the ventral horn, sensory relay neurons in the dorsal horn, and interneurons in the intermediate zone, all playing critical roles in transmitting and processing neural signals.

How does the white matter of the mouse spinal cord differ from the gray matter?

White matter in the mouse spinal cord consists mainly of myelinated axons that form ascending and descending tracts for signal transmission, while gray matter contains neuronal cell bodies and synapses.

What is the significance of the dorsal root ganglia in mouse spinal cord anatomy?

Dorsal root ganglia contain the cell bodies of sensory neurons that transmit sensory information from the periphery to the spinal cord, playing a crucial role in sensory processing.

How does the mouse spinal cord support locomotion and reflexes?

The mouse spinal cord integrates sensory input and motor output through neural circuits in the gray matter, enabling locomotion and reflexes such as the withdrawal reflex, essential for coordinated movement and protection.

Additional Resources

Mouse Spinal Cord Anatomy: A Detailed Examination of Structure and Function

mouse spinal cord anatomy represents a critical area of study in neuroscience and comparative anatomy, offering valuable insights into vertebrate nervous system organization. As a widely used model organism in biomedical research, the mouse provides a fundamental framework for understanding spinal cord structure, neural circuitry, and injury mechanisms applicable to higher mammals, including humans. This article delves into the intricate anatomy of the mouse spinal cord, highlighting its key features, cellular composition, and functional relevance.

Overview of Mouse Spinal Cord Anatomy

The spinal cord of the mouse is a cylindrical structure extending from the medulla oblongata to the cauda equina, encased within the vertebral column. Despite its small size relative to humans, the mouse spinal cord maintains a conserved organization that facilitates sensory processing, motor coordination, and autonomic functions. Typically, the mouse spinal cord measures approximately 15-20 mm in length and is segmented into cervical, thoracic, lumbar, sacral, and coccygeal regions, each corresponding to specific vertebral levels.

One notable aspect of mouse spinal cord anatomy is the proportionally larger lumbar enlargement compared to other segments. This enlargement corresponds to the innervation of the hind limbs, reflecting the animal's locomotor demands. The cervical enlargement, similarly, supports forelimb control. These regional differences in size and neuronal density underscore the functional specialization within the spinal cord.

Structural Organization: Gray Matter and White Matter

The mouse spinal cord, like that of other mammals, exhibits a distinct division between gray matter and white matter. The gray matter is centrally located and shaped roughly like a butterfly or the letter “H” in cross-section. It consists primarily of neuronal cell bodies, dendrites, and unmyelinated axons, whereas the surrounding white matter contains myelinated axonal tracts responsible for communication between the brain and peripheral nervous system.

Within the gray matter, the dorsal (posterior) horns are predominantly involved in sensory input processing. In contrast, the ventral (anterior) horns contain motor neurons that project to skeletal muscles. Intermediate zones in the gray matter house interneurons and autonomic neurons, contributing to reflex arcs and involuntary control.

The white matter is organized into funiculi: dorsal, lateral, and ventral. Each funiculus contains ascending sensory tracts and descending motor tracts, facilitating bidirectional neural signaling. For example, the dorsal columns carry fine touch and proprioceptive information, while the lateral corticospinal tract transmits voluntary motor commands.

Cellular Composition and Types

A detailed understanding of mouse spinal cord anatomy requires consideration of its cellular heterogeneity. The gray matter comprises various neuronal populations, including alpha and gamma motor neurons, interneurons, and sensory relay neurons. Alpha motor neurons are particularly significant as they innervate extrafusal muscle fibers, enabling voluntary movement.

Glial cells such as astrocytes, oligodendrocytes, and microglia are also abundant. Astrocytes maintain homeostasis and support neuronal metabolism. Oligodendrocytes are responsible for the myelination of axons within the central nervous system, enhancing signal conduction velocity. Microglia function as immune cells, responding to injury and inflammation.

The dorsal root ganglia, located just outside the spinal cord, contain the cell bodies of sensory neurons that transmit peripheral signals into the dorsal horn. This arrangement underpins the integration of sensory modalities such as pain, temperature, and touch.

Functional Significance and Comparative Anatomy

The mouse spinal cord serves as a pivotal conduit for sensorimotor integration. Its anatomy reflects the balance between afferent sensory input and efferent motor output, facilitating reflexes and complex behaviors. The segmental organization allows for precise mapping of neural circuits, which is invaluable for experimental interventions.

Comparative studies indicate that while the overall structural plan of the spinal cord is conserved across mammals, mice exhibit certain distinctions in tract size and neuronal density due to their smaller body size and differing locomotive patterns. For instance, the

mouse corticospinal tract is less prominent than in primates but still critical for fine motor control.

Implications for Research and Disease Modeling

Given the mouse spinal cord’s detailed and accessible anatomy, it is extensively utilized in research on spinal cord injury, neurodegenerative diseases, and developmental neuroscience. Genetic tools available in mouse models allow for targeted manipulation of specific neuronal populations, advancing understanding of spinal cord function and repair mechanisms.

The small size and well-characterized segmental structure facilitate electrophysiological recordings, histological analyses, and in vivo imaging. Moreover, the anatomical parallels with human spinal cords make findings in mice translatable to clinical contexts, particularly in studies of motor neuron diseases such as amyotrophic lateral sclerosis (ALS) and multiple sclerosis (MS).

Key Anatomical Features in Detail

Segmental Organization and Vertebral Correlation

The mouse spinal cord is divided into approximately 30 segments, each giving rise to a pair of spinal nerves. These nerves emerge through intervertebral foramina and split into dorsal and ventral roots. The dorsal roots carry sensory afferents to the dorsal horn, while ventral roots contain motor efferents from the ventral horn.

Understanding the correlation between spinal cord segments and vertebrae is essential for precise experimental targeting. The cervical enlargement spans roughly from the C3 to T1 segments, while the lumbar enlargement extends from L1 to S1, corresponding to limb innervation.

Vascularization and Meningeal Coverings

The spinal cord is supplied by a network of arteries and veins. In mice, the anterior spinal artery runs along the ventral midline, supplying the ventral two-thirds of the spinal cord, while paired posterior spinal arteries nourish the dorsal regions. This vascular arrangement is critical for maintaining metabolic demands and is a consideration in ischemic injury studies.

Surrounding the spinal cord are the meninges—dura mater, arachnoid mater, and pia mater—that provide protection and support. The pia mater closely adheres to the spinal cord surface, containing blood vessels, while the cerebrospinal fluid-filled subarachnoid space cushions the cord, contributing to homeostatic regulation.

Neurochemical and Molecular Markers

Advances in molecular biology have enabled the identification of neurochemical markers specific to mouse spinal cord neurons. For instance, choline acetyltransferase (ChAT) labels cholinergic motor neurons in the ventral horn, while markers such as NeuN and MAP2 highlight neuronal populations. Glial fibrillary acidic protein (GFAP) marks astrocytes, and ionized calcium-binding adapter molecule 1 (Iba1) identifies microglia.

These markers facilitate mapping of spinal cord circuits and assessment of pathological changes in disease models. They also aid in characterizing developmental stages and responses to injury.

Challenges and Future Directions in Mouse Spinal Cord Research

Despite the extensive knowledge of mouse spinal cord anatomy, certain challenges persist. The small size of the mouse spinal cord complicates surgical manipulations and in vivo imaging. Additionally, interspecies differences require cautious interpretation when extrapolating findings to humans.

Emerging technologies such as high-resolution microscopy, optogenetics, and single-cell RNA sequencing are expanding the understanding of spinal cord microarchitecture and function. These approaches promise to unravel the complexities of neuronal networks and glial interactions in health and disease.

Furthermore, the development of novel injury models and regenerative therapies continues to rely on detailed anatomical knowledge. The ability to precisely target specific spinal cord regions will enhance therapeutic outcomes and drive translational research.

Mouse spinal cord anatomy remains a foundational subject in neuroscience, bridging basic biological understanding with clinical relevance. Its detailed structural features and functional capacities provide a rich platform for exploring nervous system organization, injury responses, and potential regenerative strategies.

Mouse Spinal Cord Anatomy

mouse spinal cord anatomy: The Spinal Cord Charles Watson, George Paxinos, Gulgun Kayalioglu, 2009-11-27 Many hundreds of thousands suffer spinal cord injuries leading to loss of

sensation and motor function in the body below the point of injury. Spinal cord research has made some significant strides towards new treatment methods, and is a focus of many laboratories worldwide. In addition, research on the involvement of the spinal cord in pain and the abilities of nervous tissue in the spine to regenerate has increasingly been on the forefront of biomedical research in the past years. The Spinal Cord, a collaboration with the Christopher and Dana Reeve Foundation, is the first comprehensive book on the anatomy of the mammalian spinal cord. Tens of thousands of articles and dozens of books are published on this subject each year, and a great deal of experimental work has been carried out on the rat spinal cord. Despite this, there is no comprehensive and authoritative atlas of the mammalian spinal cord. Almost all of the fine details of spinal cord anatomy must be searched for in journal articles on particular subjects. This book addresses this need by providing both a comprehensive reference on the mammalian spinal cord and a comparative atlas of both rat and mouse spinal cords in one convenient source. The book provides a descriptive survey of the details of mammalian spinal cord anatomy, focusing on the rat with many illustrations from the leading experts in the field and atlases of the rat and the mouse spinal cord. The rat and mouse spinal cord atlas chapters include photographs of Nissl stained transverse sections from each of the spinal cord segments (obtained from a single unfixed spinal cord), detailed diagrams of each of the spinal cord segments pictured, delineating the laminae of Rexed and all other significant neuronal groupings at each level and photographs of additional sections displaying markers such as acetylcholinesterase (AChE), calbindin, calretinin, choline acetlytransferase, neurofilament protein (SMI 32), enkephalin, calcitonin gene-related peptide (CGRP), and neuronal nuclear protein (NeuN). - The text provides a detailed account of the anatomy of the mammalian spinal cord and surrounding musculoskeletal elements - The major topics addressed are: development of the spinal cord; the gross anatomy of the spinal cord and its meninges; spinal nerves, nerve roots, and dorsal root ganglia; the vertebral column, vertebral joints, and vertebral muscles; blood supply of the spinal cord; cytoarchitecture and chemoarchitecture of the spinal gray matter; musculotopic anatomy of motoneuron groups; tracts connecting the brain and spinal cord; spinospinal pathways; sympathetic and parasympathetic elements in the spinal cord; neuronal groups and pathways that control micturition; the anatomy of spinal cord injury in experimental animals - The atlas of the rat and mouse spinal cord has the following features: Photographs of Nissl stained transverse sections from each of 34 spinal segments for the rat and mouse; Detailed diagrams of each of the 34 spinal segments for rat and mouse, delineating the laminae of Rexed and all other significant neuronal groupings at each level. ; Alongside each of the 34 Nissl stained segments, there are additional sections displaying markers such as acetylcholinesterase, calbindin, calretinin, choline acetlytransferase, neurofilament protein (SMI 32), and neuronal nuclear protein (NeuN) - All the major motoneuron clusters are identified in relation to the individual muscles or muscle groups they supply

mouse spinal cord anatomy: Neuroanatomy of the Mouse Hannsjörg Schröder, Natasha Moser, Stefan Huggenberger, 2020-02-28 This textbook describes the basic neuroanatomy of the laboratory mouse. The reader will be guided through the anatomy of the mouse nervous system with the help of abundant microphotographs and schemata. Learning objectives and summaries of key facts at the beginning of each chapter provide the reader with an overview on the most important information. As transgenic mice are one of the most widely used paradigms when it comes to modeling human diseases, a basic understanding of the neuroanatomy of the mouse is of considerable value for all students and researchers in the neurosciences and pharmacy, but also in human and veterinary medicine. Accordingly, the authors have included, whenever possible, comparisons of the murine and the human nervous system. The book is intended as a guide for all those who are about to embark on the structural, histochemical and functional phenotyping of the mouse's central nervous system. It can serve as a practical handbook for students and early researchers, and as a reference book for neuroscience lectures and laboratories.

mouse spinal cord anatomy: *The Mouse Nervous System* Charles Watson, George Paxinos, Luis Puelles, 2011-11-28 The Mouse Nervous System provides a comprehensive account of the

central nervous system of the mouse. The book is aimed at molecular biologists who need a book that introduces them to the anatomy of the mouse brain and spinal cord, but also takes them into the relevant details of development and organization of the area they have chosen to study. The Mouse Nervous System offers a wealth of new information for experienced anatomists who work on mice. The book serves as a valuable resource for researchers and graduate students in neuroscience. Systematic consideration of the anatomy and connections of all regions of the brain and spinal cord by the authors of the most cited rodent brain atlases A major section (12 chapters) on functional systems related to motor control, sensation, and behavioral and emotional states A detailed analysis of gene expression during development of the forebrain by Luis Puelles, the leading researcher in this area Full coverage of the role of gene expression during development and the new field of genetic neuroanatomy using site-specific recombinases Examples of the use of mouse models in the study of neurological illness

mouse spinal cord anatomy: Clinical Vascular Anatomy and Variations P. Lasjaunias, Alejandro Berenstein, Karel Ter Brugge, 2001-06-06 The first volume of this second edition of Surgical Neuroangiography contains the previous volumes 1 and 3 in one book. The edited and updated text provides a practical understanding of the challenges that face the modern management of vascular diseases. Additional 3-D angiographic photographs as well as new illustrations complete this classic book of vascular disease management in adults and children. The authors, Pierre Lasjaunias, Alex Berenstein, and Karel ter Brugge are highly committed to both research and teaching . This second edition is a prerequisite for anybody wishing to fully understand clinical challenges and vascular intervention.

mouse spinal cord anatomy: *The Anatomical Basis of Mouse Development* Matthew H. Kaufman, Jonathan B.L. Bard, 1999-03-03 The Anatomical Basis of Mouse Development by Kaufman and Bard is an essential anatomical resource for developmental biologists needing to know about any aspect of mouse developmental anatomy, as well as for geneticists using the mouse embryo as a model. This book is a companion to Kaufman's The Atlas of Mouse Development and details the developmental anatomy of the early embryo, the transitional tissues, and all the major organ systems. It also includes extensive reference indexes detailing developmental stage criteria, when tissues first appear, and the constituent tissues of embryos at each of the 26 Theiler stages, as well as tissue and author indexes and a glossary. Key features: * Gives anatomical descriptions from oogenesis to birth at a level of detail that often goes beyond that found in the literature. * Provides detailed explanations for geneticists and molecular biologists with limited anatomical background to help them understand the emergence of all the major structures in the mouse embryo. * Contains comprehensive indexes detailing the appearance of over 1000 organs, tissues and their components at different stages of mouse embryogenesis, together with the Theiler developmental stages (1-26) at which each first appears. * Includes comparisons with normal and abnormal human development * Has over 100 clear line diagrams showing mouse developmental anatomy as well as lineage relationships for the major organ systems. This book will be a key reference work for anyone who needs to understand developmental anatomy in normal and mutant mice.

mouse spinal cord anatomy: *Pathology of Genetically Engineered and Other Mutant Mice* John P. Sundberg, Peter Vogel, Jerrold M. Ward, 2022-01-26 An updated and comprehensive reference to pathology in every organ system in genetically modified mice The newly revised and thoroughly updated Second Edition of Pathology of Genetically Engineered and Other Mutant Mice delivers a comprehensive resource for pathologists and biomedical scientists tasked with identifying and understanding pathologic changes in genetically modified mice. The book is organized by body system, includes descriptions and explanations of a wide range of findings, as well as hundreds of color photographs illustrating both common and rare lesions that may be found in genetically engineered and wild type mice. The book is written by experienced veterinary and medical pathologists working in veterinary medical colleges, medical colleges, and research institutes. Covering the latest discoveries in mouse pathology resulting from advancements in biotechnology research over the last 30 years, this singular and accessible resource is a must-read for veterinary

and medical pathologists and researchers working with genetically engineered and other mice. Readers will also benefit from: A thorough introduction to mouse pathology and mouse genetic nomenclature, as well as databases useful for analysis of mutant mice An exploration of concepts related to validating animal models, including the Cinderella Effect Practical discussions of basic necropsy methods and grading lesions for computational analyses Concise diagnostic approaches to the respiratory tract, the oral cavity and GI tract, the cardiovascular system, the liver and pancreas, the skeletal system, and other tissues As a one-stop and up to date reference on mouse pathology, Pathology of Genetically Engineered and Other Mutant Mice is an essential book for veterinary and medical pathologists, as well as for scientists, researchers, and toxicologists whose work brings them into contact with genetically modified mice.

mouse spinal cord anatomy: Development of the Human Spinal Cord Joseph Altman, Shirley Ann Bayer, 2001 There exists a wealth of information about the development of the spinal cord in journal articles and monographs, yet this beautifully illustrated work is the first book devoted to this important topic. Because the developing human spinal cord cannot be subjected to experimental manipulations, the knowledge gained from experimental work in animals is applied here to an interpretation of the time course and mechanisms of spinal cord development in man. The book begins with a review of our current understanding of the structure and functions of the spinal cord. Special reference is made to the phylogeny of the vertebrate spinal cord because the authors' interpretation of the development and organization of the human spinal cord is specifically an evolutionary one. Following a detailed experiment-based account of spinal cord development in the rat, the development of the human spinal cord is described, illustrated and interpreted in separate chapters during three epochs: the first trimester (the embryonic period), the second and third trimesters (the fetal period), and the first year of postnatal life. Special attention is paid to such topics as neurons, and the growth and myelination of the ascending and descending fiber tracts of the spinal cord. The book ends with a correlation of the development of motor behavior with different stages in the morphological development of the human spinal cord during the embryonic, fetal, and postnatal periods. The successive acquisition of voluntary control over different parts of the body during infancy is correlated with the progressive myelination of the corticospinal tract. * The book contains an extensive review of work on spinal cord organization and development throughout the 20th century. * The interpretations are based on experimental studies of spinal cord development in the rat carried out by the authors and their associates. * The histological material on human spinal cord development is the largest ever assembled and reproduced (combining the Carnegie, Minot, and Yakovlev Collections). * The collected material (which varies in quality and some of it has begun to fade) has been digitized and electronically reprocessed for improved reproduction. * Discrete components of the spinal cord and new developments are highlighted by color coding; typically on one side only, leaving the contralateral side untouched to allow the reader to use his own interpretation. * Summary graphs are presented, many in color, to convey important structural relationships, developmental events, or theories. * The authors revive a few forgotten theories and offer several new ones regarding the development and organization of the human spinal cord. Development of the Human Spinal Cord will be of interest to developmental biologists, neuroscientists, embryologists, molecular biologists (those working on stem cell research), pediatric neurologists, pathologists, child and developmental psychologists, and their students and trainees.

mouse spinal cord anatomy: Human Neuroanatomy Reha Erzurumlu, Gulgun Sengul, Emel Ulupinar, 2024-06-17 Human Neuroanatomy is a unique resource that presents for readers the neuroanatomy of the central and peripheral nervous system together. This atlas-style reference features human brain sections with radiological correlations, and original illustrations accompanying macroscopic and microscopic photographs. Chapters include a large number of illustrations in the form of photographs, Illustrations, and MR imaging, including a human brain atlas. Boxes within each chapter contain clinical information, with tables of topic summaries. Presented along with clinical approaches and analyses, this is a reference for all neuroscientists, neurosurgeons, neurologists, medical students, and all students of neuroscience. - Presents the neuroanatomy of

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mouse spinal cord anatomy: Clinical Anatomy of the Spine, Spinal Cord, and ANS Gregory D. Cramer, Susan A. Darby, 2013-02-26 This one-of-a-kind text describes the specific anatomy and neuromusculoskeletal relationships of the human spine, with special emphasis on structures affected by manual spinal techniques. A comprehensive review of the literature explores current research of spinal anatomy and neuroanatomy, bringing practical applications to basic science. - A full chapter on surface anatomy includes tables for identifying vertebral levels of deeper anatomic structures, designed to assist with physical diagnosis and treatment of pathologies of the spine, as well as evaluation of MRI and CT scans. - High-quality, full-color illustrations show fine anatomic detail. - Red lines in the margins draw attention to items of clinical relevance, clearly relating anatomy to clinical care. - Spinal dissection photographs, as well as MRIs and CTs, reinforce important anatomy concepts in a clinical context. - Updated, evidence-based content ensures you have the information needed to provide safe, effective patient care. - New section on fascia provides the latest information on this emerging topic. - New illustrations, including line drawings, MRIs CTs, and x-rays, visually clarify key concepts.

mouse spinal cord anatomy: Neuromodulatory Control of Spinal Function in Health and Disease Brian R. Noga, Shawn Hochman, Hans Hultborn, 2020-02-20

mouse spinal cord anatomy: Cumulated Index Medicus , 1976

mouse spinal cord anatomy: Index Medicus , 2004 Vols. for 1963- include as pt. 2 of the Jan. issue: Medical subject headings.

mouse spinal cord anatomy: *Neuroanatomy of Human Brain Development* Hao Huang, Julia P. Owen, Pratik Mukherjee, 2017-03-07 The human brain is extraordinary complex and yet its origin is a simple tubular structure. Rapid and dramatic structural growth takes place during the fetal and perinatal period. By the time of birth, a repertoire of major cortical, subcortical and white matter structures resembling the adult pattern has emerged, however there are continued maturational changes of the gray matter and white matter throughout childhood and adolescence and into adulthood. The maturation of neuronal structures provides the neuroanatomical basis for the acquisition and refinement of cognitive functions during postnatal development. Histological imaging has been traditionally dominant in understanding neuroanatomy of early brain development and still plays an unparalleled role in this field. Modern magnetic resonance imaging (MRI) techniques including diffusion MRI, as noninvasive tools readily applied to in vivo brains, have become an important complementary approach in revealing the detailed brain anatomy, including the structural connectivity between brain regions. In this research topic, we presented the most recent investigations on understanding the neuroanatomy and connectivity of human brain development using both histology and MRI. Modern advances in mapping normal developmental brain anatomy and connectivity should elucidate many neurodevelopmental disorders, ranging from rare congenital malformations to common disorders such as autism and attention deficit hyperactivity disorder (ADHD), which is a prerequisite for better diagnosis and treatment of these currently poorly understood diseases.

mouse spinal cord anatomy: *The Mammalian Spinal Cord* Charles Watson, Gulgun Sengul, George Paxinos, 2021-12-22 The Mammalian Spinal Cord provides a comprehensive account of the anatomy and histology of the spinal cord. The text covers the cytoarchitecture, chemoarchitecture, motor neuron distribution, long tracts, autonomic outflow, and gene expression in the spinal cord. A feature of the book is the inclusion of segment-by-segment atlases of the spinal cords of rat, mouse, newborn mouse, marmoset, rhesus monkey, and human. This book is an essential reference for researchers studying the spinal cord. - Includes full-color photographic images of Nissl-stained sections from every spinal cord segment in each of two rodent and three primate species, over 160 Nissl plates - Contains comprehensively labeled diagrams to accompany each Nissl-stained section, over 160 diagrams - Provides more than 500 photographic images of sections stained for AChE,

ChAT, parvalbumin, NADPH- diaphorase, calretinin, or other markers to supplement the Nissl-stained images

mouse spinal cord anatomy: Pediatric Neurosurgery Samer S. Hoz, Abdullah H. Al Ramadan, Ian Pople, Nada Mohammed, Waeel O. Hamouda, Ahmed El Damaty, Mustafa Ismail, 2024-02-22 This book is the first review book to use the multiple-choice question format in pediatric neurosurgery. More than 500 MCQs are provided in a convenient format that is suitable for self-study. The mission of the book is to help readers understand the content and maintain the knowledge, rather than merely finding answers for complicated questions. The strategy and the format of the questions provide a step-by-step, thorough explanation of each disease from the definition, associated anatomy, pathology, clinical features, radiology to surgical decision-making, and surgical tricks, providing a comprehensive and concise overview. Answers and definitions appear immediately below the questions to facilitate information retention. It is an important asset for residents across neurosurgical disciplines as it includes much of the pediatric neurosurgery knowledge that neurosurgical residents need to prepare for their certification tests. It is also useful for those seeking ways to solidify their knowledge or maintain their current certification. This book is an adjunct to the existing texts and does not intend to be the primary source of information; it rather aims to help readers identify their relevant strengths and weaknesses in the area.

mouse spinal cord anatomy: Anatomy and Development of the Mouse Spinal Cord Stem Cell Niche Marco Canizares, 2018

mouse spinal cord anatomy: Cerebrovascular Bibliography , 1968

mouse spinal cord anatomy: Advances in Central Nervous System Research and Treatment: 2011 Edition , 2012-01-09 Advances in Central Nervous System Research and Treatment: 2011 Edition is a ScholarlyEditions™ eBook that delivers timely, authoritative, and comprehensive information about Central Nervous System. The editors have built Advances in Central Nervous System Research and Treatment: 2011 Edition on the vast information databases of ScholarlyNews.™ You can expect the information about Central Nervous System in this eBook to be deeper than what you can access anywhere else, as well as consistently reliable, authoritative, informed, and relevant. The content of Advances in Central Nervous System Research and Treatment: 2011 Edition has been produced by the world's leading scientists, engineers, analysts, research institutions, and companies. All of the content is from peer-reviewed sources, and all of it is written, assembled, and edited by the editors at ScholarlyEditions™ and available exclusively from us. You now have a source you can cite with authority, confidence, and credibility. More information is available at http://www.ScholarlyEditions.com/.

mouse spinal cord anatomy: Cellular CNS repair strategies, technologies and therapeutic developments Jorg Dietrich, Tim-Henrik Bruun, Ulrich - Bogdahn, Anna Klingseisen, 2023-06-29

mouse spinal cord anatomy: Liu's Principles and Practice of Laboratory Mouse Operations Pengxuan Liu, Don Liu, 2023-07-16 This book fills the current void of academic writings on laboratory mouse operation, giving research scientists, graduate students, and laboratory technicians an authoritative textbook and definitive laboratory companion. It covers mouse anatomy, the handling of the mouse, anesthesia, drug administration, specimen collection, organ harvesting and daily laboratory skills as well as advanced micro-surgery techniques. Its detailed description of mouse anatomy corrects many inaccuracies and misconceptions in the literature. It provides a wealth of basic laboratory skills and numerous advanced surgical techniques. The step-by-step explanations, with extensive photographic images and videos, improve the current understanding and practice of laboratory mouse operations. This book lays the foundation of laboratory mouse operations by offering a clear understanding of the basic principles, updated anatomic studies, and providing invaluable practical tools. It serves a wide audience, including laboratory animal scientists, pharmaceutical science researchers, graduate students in these fields, micro surgeons, veterinarians, and laboratory technicians.

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