Neuroanatomy

- Organization and development of bilateral somatosensory feedback projections in mice
- 3D-Printed Patient-Specific Models of the Aortic Arch for Advanced Visualization of Complex Neurointerventional Cases
- Neurogenic thoracic outlet syndrome
- Neuroanatomy of blood feeding arthropods
- Expert Consensus on a Cognitive Rehabilitation Learning Package for Novice Occupational Therapists
- Julius Caesar Arantius (Aranzi) (1530-1589): insights into the fourth ventricle, hippocampus and eye muscles
- A three dimensional immunolabeling method with peroxidase-fused nanobodies and fluorochromized tyramide-glucose oxidase signal amplification
- Weight change patterns following surgery for cervical spondylosis in overweight and obese individuals: a nationwide longitudinal study

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Neuroanatomy Overview

1. Central Nervous System (CNS)

Components:

- **Brain**
  - **Cerebrum**: frontal, parietal, temporal, occipital lobes
  - **Diencephalon**: thalamus, hypothalamus
  - **Brainstem**: midbrain, pons, medulla oblongata
  - **Cerebellum**
- **Spinal Cord**
  - Segments: cervical, thoracic, lumbar, sacral, coccygeal
  - Contains ascending (sensory) and descending (motor) tracts

2. Peripheral Nervous System (PNS)

- **Cranial Nerves (I–XII)**
- **Spinal Nerves**: 31 pairs
- **Autonomic Nervous System**
  - Sympathetic (thoracolumbar)
  - Parasympathetic (craniosacral)
  - Enteric (gastrointestinal tract)

3. Functional Divisions

- **Motor vs Sensory**
- **Somatic vs Autonomic**
- **Cortical Areas**
  - Motor cortex (precentral gyrus)
  - Somatosensory cortex (postcentral gyrus)
  - Broca's area (speech production)
  - Wernicke's area (language comprehension)
  - Visual cortex (occipital lobe)
  - Auditory cortex (temporal lobe)

4. White and Gray Matter

- **Gray Matter**: neuronal cell bodies (cortex, nuclei)
- **White Matter**: myelinated axons (tracts, corpus callosum)

5. Ventricular System

- Pathway: lateral ventricles → 3rd ventricle → cerebral aqueduct → 4th ventricle
- CSF produced by **choroid plexus**, circulates through ventricles and subarachnoid space

6. Key Neural Pathways

- **Corticospinal Tract**: voluntary motor control
- **Spinothalamic Tract**: pain and temperature
- **Dorsal Columns**: fine touch, proprioception
- **Cerebellar Pathways**: coordination, balance

⚠ 7. Clinical Relevance

- **Internal capsule lesion** → dense hemiparesis
- **Broca's area lesion** → expressive aphasia
- **Spinal cord hemisection** → Brown-Séquard syndrome
- **Neuroimaging**: anatomy guides MRI and CT interpretation

Methods of assessment in anatomy vary across medical schools in the United Kingdom (UK) and beyond; common methods include written, spotter, and oral assessment. However, there is limited research evaluating these methods in regards to student performance and perception. The National Undergraduate Neuroanatomy Competition (NUNC) is held annually for medical students throughout the UK. Prior to 2017, the competition asked open-ended questions (OEQ) in the anatomy spotter examination, and in subsequent years also asked single best answer (SBA) questions. The aim of a study of Merzougui et al. was to assess medical students' performance on, and perception of, SBA and OEQ methods of assessment in a spotter-style anatomy examination. Student examination performance was compared between OEQ (2013-2016) and SBA (2017-2020) for overall score and each neuroanatomical subtopic. Additionally, a questionnaire explored students' perceptions of SBAs. 631 students attended the NUNC in the studied period. The average mark was significantly higher in SBAs compared to OEQs (60.6% vs 43.1%, $P < 0.0001$) - this was true for all neuroanatomical subtopics except the cerebellum. Students felt they performed better on SBA than OEQs, and diencephalon was felt to be the most difficult neuroanatomical subtopic (n = 38, 34.8%). Students perceived SBA questions to be easier than OEQs and performed significantly better on them in a neuroanatomical spotter examination. Further work is needed to ascertain whether this result is replicable throughout anatomy education [1)].

Neuroanatomy education is a challenging field which could benefit from modern innovations, such as augmented reality (AR) applications. A study investigated the differences in test scores, cognitive load, and motivation after neuroanatomy learning using AR applications or using cross-sections of the brain. Prior to two practical assignments, a pretest (extended matching questions, double-choice questions and a test on cross-sectional anatomy) and a mental rotation test (MRT) were completed. Sex and MRT scores were used to stratify students over the two groups. The two practical assignments were designed to study (1) general brain anatomy and (2) subcortical structures. Subsequently, participants completed a posttest similar to the pretest and a motivational questionnaire. Finally, a focus group interview was conducted to appraise participants' perceptions. Medical and biomedical students (n = 31); 19 males (61.3%) and 12 females (38.7%), mean age 19.2 ± 1.7 years participated in this experiment. Students who worked with cross-sections (n = 16) showed significantly more improvement on test scores than students who worked with GreyMapp-AR ($P = 0.035$) (n = 15). Further analysis showed that this difference was primarily caused by significant improvement on the cross-sectional questions. Students in the cross-section group, moreover, experienced a significantly higher germane ($P = 0.009$) and extraneous cognitive load ($P = 0.016$) than students in the GreyMapp-AR group. No significant differences were found in motivational scores. To conclude, this study suggests that AR applications can play a role in future anatomy education as an add-on educational tool, especially in learning three-dimensional relations of anatomical structures [2)].

Learning complex neuroanatomy is an arduous yet important task for every neurosurgical trainee. As technology has advanced, various modalities have been created to aid our understanding of anatomy [3)].

For students beginning their medical education, the neuroscience curriculum is frequently seen as the most difficult, and many express an aversion to the topic. A major reason for this aversion amongst learners is the perceived complexity of neuroanatomy [4)].

The nervous system is segregated into the internal structure of the brain and spinal cord (together called the central nervous system, or CNS) and the routes of the nerves that connect to the rest of the body (known as the peripheral nervous system, or PNS). The delineation of distinct structures and regions of the nervous system has been critical in investigating how it works.

see Brain

see Cerebellum

see Cerebrovascular anatomy

see Fiber tract

see Nervous system

see Nucleus

see Spinal cord…

Neuroanatomy has entered a new era, culminating in the search for the connectome, otherwise known as the brain's wiring diagram. While this approach has led to landmark discoveries in neuroscience, potential neurosurgical applications and collaborations have been lagging.

History

Neuroanatomy History.

Links

http://www.neuroanatomy.ca/

http://www.atlasbrain.com/

https://www.kenhub.com/

The Whole Brain Atlas

Anatomy.tv

3D Neuroanatomy

3D Neuroanatomy

Books

see Neuroanatomy Books.

Journals

http://www.neuroanatomy.org/

Adequate training based on cadaveric head dissection is essential to acquire a practical knowledge of surgical neuroanatomy and microsurgical/endoscopic dissection techniques. Endoscopic procedures for the treatment of pathologies of the skull base are becoming increasingly common. The endoscopic training curve for tool handling and a detailed knowledge of the topographic anatomy of the skull base require intensive training on cadavers before approaching living patients, which is why cadaver laboratory experience should be mandatory for every resident and surgeon preparing to use microsurgical and endoscopic techniques.

Manfred Tschabitscher and Di Ieva describe the basic principles of the philosophy of anatomic dissection and the equipment necessary to set up an endoscopic cadaver laboratory [5)].

3D neuroanatomy

see 3D Neuroanatomy.

Plastination

Plastination

Microsurgical neuroanatomy

Microsurgical neuroanatomy.

Virtual reality-based learning of neuroanatomy

Virtual reality-based learning of neuroanatomy.

1)

Merzougui WH, Myers MA, Hall S, Elmansouri A, Parker R, Robson AD, Kurn O, Parrott R, Geoghegan K, Harrison CH, Anbu D, Dean O, Border S. Multiple Choice versus Open Ended Questions in Advanced Clinical Neuroanatomy: Using a National Neuroanatomy Assessment to Investigate Variability in Performance Using Different Question Types. Anat Sci Educ. 2021 Jan 8. doi: 10.1002/ase.2053. Epub ahead of print. PMID: 33420758.

2)

J H A Henssen D, van den Heuvel L, De Jong G, A T M Vorstenbosch M, van Cappellen van Walsum AM, M Van den Hurk M, G M Kooloos J, H M A Bartels R. Neuroanatomy Learning: Augmented Reality vs. Cross-Sections. Anat Sci Educ. 2019 Jul 3. doi: 10.1002/ase.1912. [Epub ahead of print] PubMed PMID:

31269322.

3)

Morone PJ, Shah KJ, Hendricks BK, Cohen-Gadol AA. A virtual, three-dimensional temporal bone model and its educational value for neurosurgical trainees. World Neurosurg. 2018 Nov 21. pii: S1878-8750(18)32624-X. doi: 10.1016/j.wneu.2018.11.074. [Epub ahead of print] PubMed PMID: 30471440.

4)

Larkin MB, Graves E, Rees R, Mears D. A Multimedia Dissection Module for Scalp, Meninges, and Dural Partitions. MedEdPORTAL. 2018 Mar 22;14:10695. doi: 10.15766/mep_2374-8265.10695. PubMed PMID: 30800895; PubMed Central PMCID: PMC6342347.

5)

Tschabitscher M, Di Ieva A. Practical guidelines for setting up an endoscopic/skull base cadaver laboratory. World Neurosurg. 2013 Feb;79(2 Suppl):S16.e1-7. doi: 10.1016/j.wneu.2011.02.045. Epub 2011 Nov 7. Review. PubMed PMID: 22120404.