Neuroanatomy Nanomaster

ADVANCED TRAINING IN NEUROSURGICAL APPROACHES

2023

EXPERIMENTAL CENTRE
UNIVERSITAS Miguel Hernández

3D NEUROANATOMY

Hospital General Universitari d'Alacant

Organization

- Department of Neurosurgery, HOSPITAL GENERAL UNIVERSITARIO DE ALICANTE.
- Anatomical Innovation Service of the UNIVERSIDAD MIGUEL HERNÁNDEZ CAMPUS DE SAN JUAN.
- Cyborg Experimental Center UNIVERSIDAD MIGUEL HERNÁNDEZ CAMPUS DE SAN JUAN.
- Neuronatomy teaching project: 3DNeuroanatomy.

Introduction

Knowledge of surgical neuroanatomy is a fundamental tool in the training of neurosurgeons. Currently, the training program of the specialty does not offer sufficient resources to achieve the objectives that we consider optimal. Different centers in our country offer the possibility of training internships based on neurosurgical practice with human cadavers. The postgraduate practice laboratory of the Faculty of Medicine of the UMH has been offering for years optimal facilities and instruments for the realization of practical training courses for this purpose and has been accredited for this purpose by the Spanish Society of Neurosurgery.

For two decades the Department of Neurosurgery of the Hospital General Universitario de Alicante has organized multiple neuroanatomy courses in collaboration with different societies and teaching platforms: Spanish Society of Neurosurgery (SENEC), 3D Neuroanatomy and the European and World Neurosurgery Societies (EANS and WFNS respectively).

At the same time, students have been accepted for training in the laboratory. However, these stays have not been certified or officialized by the University.

Objetive

- Improve surgical skills in neurosurgical approaches.
- To deepen the knowledge of advanced surgical neuroanatomy.
- To investigate new ways of approach.

Material

- Workstation equipped with table and chair in a place with adequate ventilation, air conditioning, access to water and drainage in the Postgraduate room of the Faculty of Medicine of the UMH (Severo Ochoa Building -San Juan de Alicante Campus).
- Basic instruments for cadaver dissection.
- One microscope (OPMI Zeiss)
- A Full HD Spies endoscope (one of the towers in the postgraduate room) including camera and light source.
- Nasal optics and basic endonasal surgery equipment (such equipment is not permanently available and must be ordered from Storz or Medtronic at least 2 months in advance).
- High speed motor with interchangeable cutters.
- Anatomical part fixation devices (craniostats)
- Suction system.
- Protective equipment: gloves, masks, gowns or pajamas (it is advisable to bring your own), goggles or protective visors.
- ANATOMICAL PIECE: The students will have 2 anatomical pieces corresponding to the cephalic limb.
- Thiel head: optimal preservation mode for soft parts and nasal mucosa. The disadvantage of these pieces is the poor preservation of the encephalic material.
- Head in formalin: classic mode of preservation. Contrary to the previous pieces, it preserves the brain very well but the soft parts and mucosa remain more rigid.

Duration and availability

- The course lasts between 1 and 2 months. Optimal duration 6 weeks.
- The course will be offered in different cycles or time periods.
- There are normally two annual cycles.
    - 1st cycle: from January to May (included)
    - 2nd cycle: from January to December (included)
- The number of students admitted in each cycle will vary from 1 to 3 depending on laboratory availability and specimen availability.
- Each year a place will be reserved for the 4th year resident of the Neurosurgery service of the Hospital de Alicante as part of their training program.

Admision and Registration

The student who usually applies for this course is a neurosurgery resident or attending in training.

- **DOCUMENTS** to be provided:

  Mandatory:

  - Application form. **Link**
  - Updated CV. - Send to jabarcaolivas@gmail.com

  Optional:

  - **Anatomical project** (in case of choosing options 1 or 3 of the type of practice described below). Title, introduction, objective, justification of the project, material needed, description of the project (recommended).
  - **Request for hospital rotation** from the teaching department of the service of origin (Recommended, since in this way the student continues to receive his salary from the service of origin and also, although the bulk of his rotation is the practice in the anatomy laboratory of the Faculty of Medicine of San Juan de Alicante, he will have the opportunity to attend and participate in the activity of the department of destination (Hospital General Universitario Dr Balmis de Alicante)).

- The **selection process** is carried out by the course faculty according to the following criteria:
  1. Curriculum Vitae 5 points maximum. Special consideration to the number and quality of articles related to neuroanatomy and the requested project.
  2. Anatomical project. 3 points. Originality, quality, usefulness in clinical practice and adaptation to the material and the course will be evaluated.
  3. The number of students accepted in each cycle offered

Faculty

- Javier Abarca Olivas (course coordinator / HGUA NCG physician / HGUA resident tutor)
- Pablo González López (associate professor UMH Department of Anatomy)
- Juan Antonio Nieto Navarro (head of NCG service of HGUA / associate professor UMH).
- Mario Gomar (Physician of NCG Hospital Torrecárdenas de Almería)
- Víctor Fernández Cornejo (head of the NCG section of the HGUA).
- Carlos Martorell Llobregat (Physician at NCG Hospital General de Elche)

Location of the Course

1-Hands-on. Laboratory.

Postgraduate room of the Severo Ochoa Building of the Sant Joan d'Alacant Campus.

Link

2-Hospital activity.

General University Hospital Dr Balmis of Alicante.

Street Pintor Baeza. CP 03550 - Neurosurgery Service. 6th floor.

Telephone 965913701

Link

Course Content

On-line theoretical material

The course has been designed based on teaching videos of 5-10 minutes duration.

It is recommended that it be viewed prior to the practical part.

It is divided into 5 modules or learning paths and, each one, in turn, into several classes.

After each class the student answers a 4-choice test question. The student has up to 3 opportunities or questions to consider the class completed.

Módulo	Autor	Titulo
1		**Introduction to the laboratory training**
1.1	M. Gomar	How I do it in the Neuroanatomy Lab (I): Introduction

1.2	M. Gomar	How I do it in the Neuroanatomy Lab (II): Material and methods
1.3	M. Gomar	How I do it in the Neuroanatomy Lab (III): Endoscopic skull base training
1.4	M. Gomar	How I do it in the Neuroanatomy Lab (IV): Transcranial skull base training
1.5	M. Gomar	How I do it in the Neuroanatomy Lab (V): Microsurgical training exercises
2		**Step by step dissection tricks**
2.1	C.Martorell	Step by step: fronto-temporal approaches (I)
2.2	C.Martorell	Step by step: fronto-temporal approaches (II)
2.3	C.Martorell	Step by step: postero-lateral approaches
2.4	C.Martorell	Step by step: posterior approaches
2.5	C.Martorell	Step by step: Endonasal - sphenoidal
2.6	C.Martorell	Step by step: anterior approaches
2.7	C.Martorell	Step by step: coronal expansion
2.8	C.Martorell	Step by step: dural opening
2.9	C. Martorell	Step by step: Transclival approach/Craneocervical junction
3		**Craniometric points of the skull and the brain cortical surface**
3.1	V. Fernández	Craniometric points of the skull and the brain cortical surface (I): main cranial landmarks
3.2	V. Fernández	Craniometric points of the skull and the brain cortical surface (II): anterior microneurosurgical keypoints
3.3	V. Fernández	Craniometric points of the skull and the brain cortical surface (III): posterior microneurosurgical keypoints
4		**Human brain anatomy for neurosurgeons**
4.1	P. González	Human Brain Anatomy for Neurosurgeons. Part 1: Phylogenetic Evolution of the CNS
4.2	P. González	Human Brain Anatomy for Neurosurgeons. Part 2: Frontal Lobe
4.3	P. González	Human Brain Anatomy for Neurosurgeons. Part 3: Central Lobe
4.4	P. González	Human Brain Anatomy for Neurosurgeons. Part 4: Parietal Lobe
4.5	P. González	Human Brain Anatomy for Neurosurgeons. Part 5: Occipital Lobe
4.6	P. González	Human Brain Anatomy for Neurosurgeons. Part 6: Temporal Lobe
4.7	P. González	Human Brain Anatomy for Neurosurgeons. Part 7: Insular Lobe
4.8	P. González	Human Brain Anatomy for Neurosurgeons. Part 8: Dorsal Limbic Lobe
4.9	P. González	Human Brain Anatomy for Neurosurgeons. Part 9: Ventral Limbic Lobe
4.10	P. González	Human Brain Anatomy for Neurosurgeons. Part 10: Lateral White Matter Tracts

4.11	P. González	Human Brain Anatomy for Neurosurgeons. Part 11: Mediobasal White Matter Tracts
5		**Skull base endoscospic endonasal anatomy**
5.1	J. Abarca	Skull base endoscopic endonasal anatomy (I): basic concepts and nasal anatomy
5.2	J. Abarca	Skull base endoscopic endonasal anatomy (II): intrasphenoidal anatomy
5.3	J. Abarca	Skull base endoscopic endonasal anatomy (III): intracranial view of the sellar region
5.4	J. Abarca	Skull base endoscopic endonasal anatomy (IV): endonasal-intracranial correlation

Hands-on Course

This is the purely practical activity of the course in the laboratory.

It can be approached in 3 ways:

1. Realization of a concrete and specific anatomical project.
2. Performance of multiple surgical approaches to complete a global training in endoscopic and microsurgical cranial approaches.
3. Mixed option of both.

For option 2, we recommend carrying out the dissection in an orderly fashion following a script created by the student or the one proposed in the APPENDIX.

Attendance at clinical and surgical activities of the Alicante NCG service

Students who have requested a hospital rotation through the teaching service may attend any of the service's assistance/teaching activities.

We recommend attending those surgeries that are of interest and under the recommendation of the tutors/teachers of the course.

In the same way, you will be able to perform on-call duty in our hospital under the supervision of the rest of the residents and attendings of the service. From the feedback of other previous students, this aspect is recommended as an exercise to get to know the functioning of other departments and to gain confidence for the "dreaded" moment of finding yourself alone on call as an attending.

Our attending shifts are localized, which further increases the sense of autonomy of the resident, which does not mean that the student is always supervised.

Recommended bibliography

- Transnasal endoscopic skull base and brain surgery. Aldo Stamm. Thieme.
- Surgery of the third ventricle. Apuzzo.
- Atlas of the cerebral sulci. Yasargil.
- Base de Cráneo: curso 360º. Diego Méndez.
- Microneurocirugia de Helsinki. Hernesniemi.
- Fukushima. Manual of skull base dissection.
- Microneurosurgery. Yasargil
- Operative cranial neurosurgical anatomy. A. Caputy
- Photo Atlas of skull base dissection. Fukushima.
- Cranial anatomy and surgical approaches. Rhoton.
- Microneurosurgical atlas. Sugita
- Microsurgery of cerebral aneurysms. Zentaro.

Operating Rules

- The student will be able to use the aforementioned facilities (material) of the faculty during the hours allowed by the technicians and the security service of the Severo Ochoa building.
- During the course the students have two very different blocks. Before each practical block they have a theoretical part that is taught by the teachers. After each theoretical block they have a practical part based mainly on self-learning tutored by the aforementioned teachers.
- If required, you may request the assistance of the laboratory technicians for needs related to the material described above.
- At the end of the stay, the student will receive a document certifying his or her training stay and the corresponding credits.
- The student must keep his workstation tidy and clean after his work sessions: cleaning of instruments and placement of dissection apparatus in its corresponding place. In case of breakdown or breakage of instruments, he/she will notify the technicians or tutors of the stay for their repair or replacement.
- In case the student makes a publication based on his or her stay in the laboratory, the professors involved in the project and his or her work center must be listed among the authors.

Course Fee

2.018 euros.

It is paid by means of a receipt issued by the University in the name of the student in the corresponding account at the end of the course.

Annex

GUIA RECOMENDADA DE DISECCIÓN

DURACIÓN aproximada: 1 MES: 24 DIAS hábiles. En caso de rotaciones más duraderas el contenido se puede dilatar en el tiempo o aprovechar el tiempo restante en realizar un proyecto anatómico más específico.

MATERIAL:

- Microscopio OPMI vario Zeiss.
- Motor Midas Rex Medtronic.
- Endoscopio Full HD tecnología SPIES de STORZ.
- Ópticas nasales Aesculap 0 y 30º
- Material de disección microquirúrgico.
- 1 Cabeza conservada en formol. (sin uso previo)
- 1 Cabeza conservada en Thiel. (usada previamente para abordajes endonasales)

Consejos prácticos de cara a la disección.

1- Visualizar los videos on-line para ver consejos prácticos de organización en el lab y "trucos" de disección. Sobre todo, los videos de Mario Gomar.
2- Cuando se realizan abordajes en la cabeza formolada y se accede a encéfalo es muy probable que éste esté duro y no nos permita tener una retracción suficiente para visualizar la anatomía profunda. En este caso te recomendamos:
   a) Usar endoscopio para acceder a la cavidad objetivo y así visualizar la anatomíal
   b) Una vez reconocidas las estructuras encéfalicas que cubren el abordaje, resecarlas en bloque para tener la visualización y poder fotografiar adecuadamente el espacio anatómico más profundo. Ej: en un abordaje retrosigmoideo es probable que cueste ver los pares craneales si el cerebelo está muy duro. Recomiendo realizar una resección de todo y la mitad de un

hemisferio cerebeloso a la altura del pedúnculo cerebeloso medio para tener una visión amplia del APC.

RECOMMENDED DISSECTION GUIDE

Approximate DURATION: 1 MONTH: 24 working DAYS. In case of longer rotations, the content can be extended in time or the remaining time can be used to carry out a more specific anatomical project.

MATERIAL:

- OPMI vario Zeiss microscope.
- Rex Medtronic Midas Rex engine.
- Full HD endoscope with STORZ SPIES technology.
- Nasal optics Aesculap 0 and 30º.
- Microsurgical dissection material.
- 1 Head preserved in formalin (without previous use).
- 1 Head preserved in Thiel (previously used for endonasal approaches).

Practical advice for dissection.

1. Watch the on-line videos for practical lab organization tips and dissection "tricks". (Mario Gomar's videos)
2. When approaches are made in the formolated head and access is gained to the encephalon, it is very likely that the latter is hard and does not allow us to have sufficient retraction to visualize the deep anatomy. In this case we recommend:
    a) Use endoscope to access the target cavity to visualize the anatomy.
    b) Once the encephalic structures covering the approach are recognized, resect them en bloc in order to have the visualization and to be able to adequately photograph the deeper anatomical space. E.g.: in a retrosigmoid approach it is likely to be difficult to see the cranial nerves if the cerebellum is very hard. I recommend resecting all and half of one cerebellar hemisphere at the level of the middle cerebellar peduncle to have a wide view of the APC.

PHASE 1: EXTRADURAL TRAINING

ITEM: THIEL HEAD (days 1-4)

SPECIMEN DISCOUNTED WITHOUT FORMED ENCEPHALUS (day 5)

OBJECTIVE: To train skin, muscle, and bone dissection of the most common approaches to the skull base. Extradural work exclusively.

DAY 1: FRONTO-TEMPORAL APPROACHES (I)

- Right pterional approach.
- Left supraorbital lateral approach.

DAY 2: FRONTO-TEMPORAL APPROACHES (II)

- Right pterional enlargement with orbitotomy and zygoma resection (FOTZ 3 pieces).
- Left extradural clinoidectomy.
- Middle fossa peeling from the opening of the meningo-orbital band.

DAY 3: POSTEROLATERAL APPROACHES

- Right retrosigmoid approach
- Left presigmoid approach (complete retrolabyrinthic mastoidectomy)

DAY 4: POSTERIOR MIDLINE APPROACH

- Suboccipital approach with atlas resection.
- Far lateral approach (from occipital condyle to hypoglossal canal on the right side).

DAY 5: Cavernous sinus - middle fossa

- Peeling of the middle fossa for recognition of structures of the cavernous sinus and clinoid region (SOF and optic canal).
- Endonasal correlation of cavernous sinus structures (This can be done at the end of the rotation when the endonasal approach has been learned).

PHASE 2: MICROSURGICAL APPROACHES TO THE BASE OF THE SKULL

PIECE: FORMALDEHYDE-TREATED HEAD.

OBJECTIVE: Training in microsurgical approaches to the skull base.

In the specimen the opening of skin and muscle can be difficult. Since this work has been practiced in the head of Thiel, this dissection phase can be done with less delicacy and practice cuts of skin and muscle en bloc especially in the nuchal region.

DAY 6: RIGHT PTERIONAL APPROACH.

- Interfascial dissection.
- Pterional craniotomy.
- Extradural drilling of the sphenoid wing.
- Sylvian fissure opening
- Exploration of suprasellar and *parasellar* spaces.
- Intradural clinoidectomy
- Optic canal unroofing.

DAY 7 : BILATERAL FRONTAL INTERHEMISPHERIC APPROACH TO SUPRASELLAR REGION

- Bilateral frontal craniotomy
- Frontal sinus scan (Draft III optional)
- Dural opening with sagittal sinus ligation.
- Dissection of interhemispheric fissure to suprasellar region.

DAY 8: RIGHT TRANSCALLOSAL ANTERIOR INTERHEMISPHERIC APPROACH.

- Craniotomy after suture recognition.
- Dural opening
- Dissection of interhemispheric fissure.
- Anterior callosotomy.
- Lateral ventricle floor scanning
- Choroidal fissure opening into the third ventricle.

DAY 9: LEFT SUBTEMPORAL APPROACH WITH ANTERIOR PETROSECTOMY "KAWASE BOARDING".

- Craniotomy.
- Extradural exploration of the middle fossa and recognition of Kawase rhomboid references.
- Anterior petrosectomy and dural opening to ambiens and crural cisterns.

DAY 10: RIGHT RETROSIGMOID APPROACH.

- Craniotomy.
- Exploration of different anatomical "floors" of the APC.
- IAC and recognition of complex VII-VIII
- Suprameatal tubercle drilling for access to Meckel's cavum.

DAY 11: RIGHT PRESIGMOID APPROACH. Anterior to the retrosigmoid performed.

- Mastoid survey to identify landmarks: fallopian canal, semicircular ducts.
- Translabyrinthine approach to IAC and cochlea.
- Temporal craniotomy approach enlargement for combined supra-infrapetrosal approach.

DAY 12: SUBOCCIPITAL APPROACH MIDLINE TO THE FOURTH VENTRICLE.

- Suboccipital craniotomy
- Atlas resection.
- Dural opening and exploration of cerebello-medullary fissure.
- Telovelar attachment to the IV ventricle.

DAY 13: SUPRACEREBELLAR INFRATENTORIAL APPROACH TO THE PINEAL REGION

- Incision enlargement and craniotomy at torcular level from the previous one.
- Pedicled dural opening to torcula.
- Dissection of the supracerebellar space towards the quadrigeminal cistern.
- Recognition of the anatomy of the pineal region.
- Exploration of the transtentorial occipital approach to the pineal region (comparative views and angles).

DAY 14: LEFT LATERAL APPROACH

- We extended suboccipital craniotomy with a left retrosigmoid.
- Extradural left occipital condyle extradural drilling towards the hypoglossal canal.
- Complete dural opening of the lateral far. (We recommend drilling the hypoglossal canal with intradural vision orientation).
- Examination of the entire retrosigmoid anatomy, condylar region, jugular tubercle and craniocervical junction (entry of vertebral artery, dentate ligaments and C1).

PHASE 3: ENDONASAL ENDOSCOPIC APPROACHES TO THE SKULL BASE

PIECE: FORMALDEHYDE-TREATED HEAD.

OBJECTIVE: Training in endonasal approaches to the skull base.

DAY 15: NASAL PHASE

- Right middle turbinate resection
- Recognition of the middle meatus (unciform and bulla) - maxillary sinus opening.
- Performance of right nasoseptal flap.
- Posterior septostomy.
- Anterior sphenoidotomy

DAY 16: SPHENOIDAL PHASE

- Intrasphenoidal septum drilling
- Recognition of intrasphenoidal references.
- Selar opening.
- Parasellar drilling.
- Drilling tuber selar.

DAY 17: ANTERIOR FOSSA ANATOMY PHASE

- Ethmoidectomy and recognition of ethmoidal arteries.
- Frontal recess exploration.
- Complete upper septostomy.
- Sphenoidal planum frenulum and olfactory sulcus. Resection of crista galli.

DAY 18: CORONAL EXPANSION PHASE OF THE APPROACH

- Opening of the posterior wall of the right maxillary sinus.
- Recognition of pterygopalatine fossa anatomy.
- Recognition of the vidian nerve.
- Sphenoid and pterygoid floor drilling following vidian.

DAY 19: SELAR AND PARASELLAR DURAL OPENING

- Selar and parasellar dura mater opening.
- Exploration of cavernous sinuses and their contents.
- Correlating endonasal anatomy with intracranial vision on the side where we performed intradural clinoidectomy (right).
- Dural opening at tuberculum and planum level.

- Dural opening of the olfactory sulcus region.

DAY 20: TRANSCLIVAL APPROACH

- Clivus drilling optimizing the frame between both paraclival carotids.
- Use vidian nerve to locate ICA lacerum segment .
- Dural opening and exploration of the retroclival region.

DAY 21: ENDONASAL CRANIOCERVICAL JUNCTION APPROACH

- Opening of the muscular plane of the lower clivus and nasopharynx. Recommended with chisel or electric scalpel.
- Atlas drilling
- Odontoid drilling.
- Dural opening and intradural space exploration.
- Endonasal occipital condyles.

DAY 22:

25 minute lecture summarizing the work done with photographs and the most relevant conclusions of the anatomical work done.
It will take place in a clinical session of the Neurosurgery department.


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