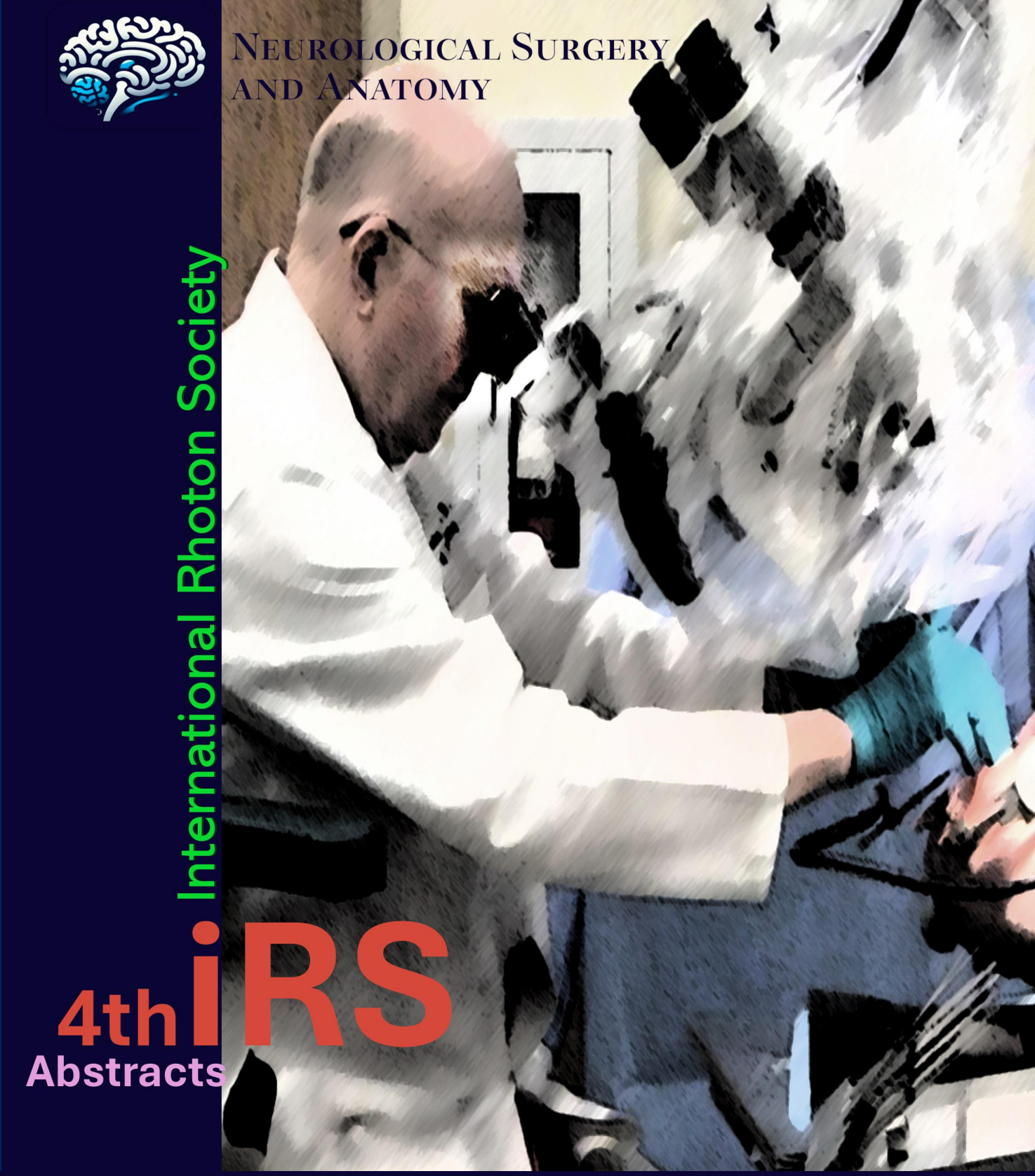

Neurological Surgery and Anatomy

International Rhoton Society

4th IRS Abstracts

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Proceedings of the 4th International Rhoton Society Meeting, November 5-7, 2024, Taiwan

We extend our gratitude to all those who contributed by submitting their work to be presented at the 4th International Rhoton Society Meeting, held from November 5-7, 2024, in Taiwan.

These valuable contributions were showcased through oral presentations, posters, and video sessions. The abstracts from these presentations are published on the following pages, offering insights and advancements in neurosurgery and neuroanatomy inspired by the legacy of Dr. Albert L. Rhoton Jr..

We hope these proceedings serve as a meaningful resource for practitioners and researchers, promoting continued growth and collaboration within the field.

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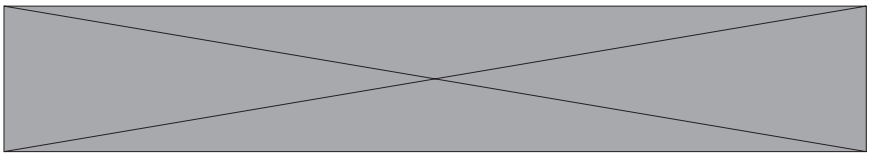

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O-1

The posterior auricular muscle as a superficial landmark for the sigmoid sinus and transverse-sigmoid sinus junction: an anatomical study

Juan J. Cardona[1], Carmine Antonio Donofrio[2], Lucia Riccio[2], Arada Chaiyamoon[1], Devendra Shekhawat[1], Joe Iwanaga[1], Aaron S. Dumont[1], Filippo Badaloni[3], Neal Jackson[1], R. Shane Tubbs[1], Antonio Fioravanti[2]

[1]Department of Neurosurgery, Center for Clinical Neurosciences, Tulane University School of Medicine, USA
[2]Department of Neurosurgery, ASST Cremona, Cremona, Italy
[3]Department of Neurosurgery, IRCCS Instituto Delle Scienze Neurologiche di Bologna, Bologna, Italy

Introduction
Neuronavigation systems coupled with previously reported external anatomical landmarks assist neurosurgeons during intracranial procedures.
Objective
We aimed to verify whether the posterior auricular muscle (PAM) could be used as an external landmark for identifying the sigmoid sinus (SS) and the transverse-sigmoid sinus junction (TSSJ) during posterior cranial fossa surgery.
Methods
The PAM was carefully dissected in ten adult cadaveric heads (20 sides; six males and four females), and after drilling the underlying bone, the relationships between its borders and the underlying SS and TSSJ were noted. The width and length of the PAM, and the distance between the muscle and reference points (asterion, mastoid tip,
and midline), were measured (Figs 1-2).
Results
The PAM was present in 18 sides (nine left, nine right). The first 20 mm of muscle length (median 28.28 mm; IQR 22.05-33.58 mm) consistently overlays the mastoid process anteriorly and the proximal half of the SS slightly posteriorly on all sides. The superior border was a mean of 2.22 mm (range 0.0-9.10 mm) inferior to the TSSJ, and especially when the muscle length exceeded 20 mm, this border extended closer to the transverse sinus; it was usually found at a mean of 3.11 mm (range 0.0-13.80 mm) inferior to the distal third of the transverse sinus. There were no statistically significant sex or side differences (Figs 3-4).
Conclusions
Superficial landmarks give surgeons improved surgical access, avoiding overexposure of the dural venous sinuses and reducing brain retraction. On the basis of our cadaveric study, the PAM, particularly its superior border, is a reliable and accurate landmark for identifying the SS and TSSJ.

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O-2

Revisiting the transorbital approach for emergency external ventricular drainage: an anatomical study of relevant parameters and their effect on the effectiveness of using Tubbs' point

Juan J. Cardona[1], Devendra Shekhawat[1], Arada Chaiyamoon[1], Erin McCormack[1,2], Samir Anadkat[1], Joe Iwanaga[1], Joseph Keen[1,2], Cuong J. Bui[2], Aaron S. Dumont[1], R. Shane Tubbs[1,2]

[1]Department of Neurosurgery, Center for Clinical Neurosciences, Tulane University School of Medicine, United States of America
[2]Department of Neurosurgery and Ochsner Neuroscience Institute, Ochsner Health System, New Orleans, Los Angeles, United States of America

Introduction
The transorbital approach (TOA) can provide immediate access to the lateral ventricles by piercing the roof of the orbit (ROO) with a spinal needle and without the need of a drill. Reliable external landmarks for the TOA ventriculostomy have been described, however, the necessary spinal needle gauge and other relevant parameters such as the thickness of the ROO have not been evaluated (Figure 1).
Objective
To determine what is the suitable spinal needle gauge to puncture the ROO successfully during the TOA. Also, to measure different parameters relevant to the approach.
Methods
Nineteen formalin-fixed adult cadaveric heads underwent the TOA. Spinal needles of different gauges were consecutively used in each specimen beginning with the smallest gauge until the ROO was successfully pierced. The thickness of the ROO at the puncture site and around its margins was measured. The length of the needle to the puncture point, and other distances between reference structures (anterior clinoid process-crista galli) were also measured. Statistical analyses were performed between sex and sides (Figures 1-3).
Results
The TOA was successfully performed in 14 cases (73.68%), where the most suitable needle gauge was 13 (47.37%), followed by a 10-gauge needle (36.84%). The mean thickness of the ROO at the puncture site, and the mean length of the needle to the puncture site were 1.7mm (range 0.2-3.4mm) and 15.5mm (range 9.2-23.4mm), respectively. A ROO thickness of greater than 2.0mm required a 10-gauge needle in seven cases, and in five cases, a 10-gauge needle was not sufficient for piercing the ROO. The presence of hyperostosis frontalis interna (HFI) (21.05%) was related to the failure of this procedure (80%; $p<0.00$).
Conclusions
Using a 13/10-gauge spinal needle at Tubbs' point for TOA ventriculostomy allowed for external ventricular access in most adult specimens. The presence of HFI can hinder this procedure. These findings are important when TOA ventriculostomy is considered.

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O-3

Why do dural venous sinus pathologies so often involve the transverse sinus? anatomical study with novel findings

Juan J. Cardona[1], Joe Iwanaga[1-5], Arada Chaiyamoon[1,6], Arthur Wang[1], Christopher M Nickele[7], Matthew R. Amans[8,9], Daniel M Heiferman[10], Kendrick D. Johnson[1], Marios Loukas[11], Aaron S. Dumont[1], R. Shane Tubbs[1-3,11-14]

[1]Department of Neurosurgery, Tulane Center for Clinical Neurosciences, Tulane University School of Medicine, New Orleans, Louisiana, USA.
[2]Department of Structural & Cellular Biology, Tulane University School of Medicine, New Orleans, Louisiana, USA.
[3]Department of Neurology, Tulane University School of Medicine, New Orleans, Louisiana, USA.
[4]Department of Oral and Maxillofacial Anatomy, Graduate School of Medical and Dental Sciences, Tokyo Medical and Dental University, Tokyo, Japan.
[5]Division of Gross and Clinical Anatomy, Department of Anatomy, Kurume University School of Medicine, Kurume, Japan.
[6]Department of Anatomy, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand.
[7]Department of Neurosurgery, University of Tennessee Health Sciences Center, Memphis, Tennessee, USA.
[8]Department of Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, California, USA.
[9]Department of Neurological Surgery, University of California San Francisco, San Francisco, California, USA.
[10]Department of Neurosurgery, Endeavor Health, Naperville, Illinois, USA.
[11]Department of Anatomical Sciences, St. George's University, St. George's, Grenada.
[12]Department of Neurosurgery and Ochsner Neuroscience Institute, Ochsner Health System, New Orleans, Louisiana, USA.
[13]Department of Surgery, Tulane University School of Medicine, New Orleans, Louisiana, USA.
[14]University of Queensland, Brisbane, Queensland, Australia

Introduction
The transverse sinus (TS) is often involved with pathology for structural reasons. The greater prevalence of thrombosis in the TS than in other venous sinuses has not been explained. Other pathologies involving the TS that have a multifactorial etiology and are associated with alterations in intracranial venous flow include venous sinus stenosis resulting in pulsatile tinnitus and/or idiopathic intracranial hypertension. We hypothesized that the morphology of the TS and the sigmoid sinus (SS) is associated with the reported pathologies.
Objective
The aim of this study was to improve understanding of the anatomy along the groove of the TS and SS, to elucidate the relationship between the bony features and pathologies affecting the TS.
Methods
Seventy dry skulls (140 sides) were used for detailed observation of the TS and SS grooves using gross investigation coupled with transillumination. Bony features such as the mastoid foramen (MF), occipital foramen (OF), granular foveolae, and absence of the TS were evaluated, and a classification based on numbers of findings was proposed. A novel finding defined as a bony prominence (BP) was identified and data from this finding were gathered. Sides were compared statistically and eleven BP-free specimens were used as controls for comparison with the BP group.
Results
The most common internal groove finding was MF (n=111, 79.3%), followed by absent TS (n=46, 32.9%), and OF (n=20; 14.3%). MF was statistically more frequent on the left side (n=64; 91.4%) than the right (n=47; 67.1%) (p=0.036); OF was statistically more frequent on the right side (n=17; 24.3%) than the left (n=3; 4.3%) (p=0.008). Absent TS was more prevalent on the left side (n=48; 54.3%) than the right (n=8; 11.4%) (p=0.000). A BP was identified in 15.7% (11 skulls) and there were significant differences from the controls. The type III class (three internal groove findings) was the most prevalent, followed by type II (two findings).
Conclusions
The complex and integral role of the bony features described here, and their particularities in normal patients or in those with DVS pathologies, is not well understood. The aim of this study was to elucidate this role; another internal groove finding was discovered.

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O-4

Angulation of the dural venous sinuses in the posterior cranial fossa: an anatomical study and its implications for venous circulation

Juan J. Cardona[1], Joe Iwanaga[1-5], Arada Chaiyamoon[1,6], Arthur Wang[1], Christopher M Nickele[7], Matthew R. Amans[8,9], Daniel M Heiferman[10], Kendrick D. Johnson[1], Aaron S. Dumont[1], R. Shane Tubbs[1-3,11-14]

[1]Department of Neurosurgery, Tulane Center for Clinical Neurosciences, Tulane University School of Medicine, New Orleans, Louisiana, United States of America
[2]Department of Structural & Cellular Biology, Tulane University School of Medicine, New Orleans, Louisiana, USA.
[3]Department of Neurology, Tulane University School of Medicine, New Orleans, Louisiana, United States of America
[4]Department of Oral and Maxillofacial Anatomy, Graduate School of Medical and Dental Sciences, Tokyo Medical and Dental University, Tokyo, Japan.
[5]Division of Gross and Clinical Anatomy, Department of Anatomy, Kurume University School of Medicine, Kurume, Japan.
[6]Department of Anatomy, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand.
[7]Department of Neurosurgery, University of Tennessee Health Sciences Center, Memphis, Tennessee, United States of America
[8]Department of Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, California, United States of America
[9]Department of Neurological Surgery, University of California San Francisco, San Francisco, California, United States of America
[10]Department of Neurosurgery, Endeavor Health, Naperville, Illinois, United States of America
[11]Department of Anatomical Sciences, St. George's University, St. George's, Grenada.
[12]Department of Neurosurgery and Ochsner Neuroscience Institute, Ochsner Health System, New Orleans, Louisiana, United States of America
[13]Department of Surgery, Tulane University School of Medicine, New Orleans, Louisiana, United States of America
[14]University of Queensland, Brisbane, Queensland, Australia.

Introduction
Cerebral vein and dural venous sinus thromboses (CVST) account for 0.5-1% of all strokes. Some structural factors associated with a potentially higher risk of developing CVST have been described. Angulation of the dural venous sinuses (DVS) has already been measured in skulls and proposed as an anatomical factor. Considerably, this variable could be related to alterations in venous flow, thus predisposing to a greater risk of CVST development and may impact the general venous intracranial hemodynamics leading to DVS flow-related pathologies.
Objective
The current study was performed to determine the angulation in soft tissue, to evaluate differences between types of tissue, and to discuss the potential influence of angulation on intracranial venous hemodynamics and related pathologies.
Methods
The angulations formed in different segments of the transverse (TS), sigmoid (SS), and superior sagittal sinuses (SSS) were measured in 13 adult human cadaveric heads (26 sides). Also, after the soft tissues were removed the parameters were measured on the underlying bone (grooves; 26 sides). The overall angulation of the TS was measured using two reference points. The DVS' lengths and widths were documented using microcalipers. Statistical analyses were performed based on sides, sex, and between types of tissue.
Results
The mean angulation of the SSS-TSJ was 116 degrees (range 107-132 degrees). The mean angulations of the TS-SSJ in medial and superior views were 108 degrees (range 90-124 degrees) and 114 degrees (range 96-131 degrees), respectively. The mean angulations of the entire TS at two different points (A: TSh angle and B: TSv angle) were 45 degrees (range 39-64 degrees) and 44 degrees (range 26-51 degrees), respectively. Statistically significant differences in the angulation were seen in some variables when they were adjusted to sides and sex, but not types of tissue.
Conclusions
Angulation is a paramount factor in blood hemodynamics. Certain angulations of the DVSs significantly differed among sides and sex, but not between types of tissue. Future research should determine its effects on intracranial venous circulation and its applicability to related pathologies.

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O-6

Fiber tract involvement in each approach for intracerebral hematoma evacuation procedure: A cadaveric study

Thitikan Wangapakul[1], Ambar Elizabeth Riley Moguel[2], Abdel Raouf Kayssi[3]

[1]Neurosurgical unit, Yala hospital, Thailand
[2]Neurosurgical Department, ISSSTE "1ro de Octubre", Mexico City, Mexico
[3]Arkansas Neuroscience Institute, Arkansas, United States of America

Introduction
Intracerebral hematoma evacuation has long been a common procedure in neurosurgical practice. From the past until present, many techniques have been developed and used. Nowadays, three common popular approaches were trans-temporal approach, transylvian trans-insular approach, and newly technique of endoscopic trans cortical approach. These three approaches have pros and cons either in feasibility, duration, blood loss, risk of vessels injury, etc. This article aims to study the fiber tract that will be involved and tends to be damaged to provide additional evidence supporting the use of each procedure.
Materials and Methods
Five cadaveric heads which were preserved by Klinger's technique were used. Simulation of each approach was made using 1 cm glass tube which is equal with diameter of endoscope tube projecting to putamen. Dye was flushed into cavity then white fiber dissection was done to reveal fibers that were damaged. All the study was done using cadaveric heads and equipment from laboratory in Arkansas Neuroscience Institute, Arkansas, USA.
Result
In trans-temporal approach, u-fiber of temporal cortex was damage following by inferior longitudinal fasciculus, occipitofrontal fasciculus before reaching the extreme capsule, external capsule and putamen. Transylvian-trans insular approach the damage began from extreme capsule and passing external capsule to putamen. Endoscopic trans cortical approach projecting from frontal cortex passing u fibers of frontal,superior longitudinal fasciculus, some of projecting fibers from cortical area were found damaged as well before the tract entered extreme capsule of insula. Area of damage was longest in endoscopic trans-cortial approach and shortest in transylvian- trans insular approach.
Discussion
In different approaches showed pros and cons. More fibers were involved in transcortical approach either microscopic or endoscopic. Long association fibers were damage in both trans temporal and trans frontal approach. By damaging these fibers there might be more additional problems with memory, behavioral, and cognitive deficits. Endoscopic trans frontal approach showed additional injury to projection fibers to brainstem and longer tract of injury causing more area of damage of frontal white matter fibers. However, even though transylvian- trans insular showed less fiber tract involvement. The major risk of this approach is still large vessels injury which will also cause significant damage as well.
Conclusion
White fibers damage in each approach for hematoma evacuation procedures is important and should be taken for consideration. Though motor tract can be damage from hematoma physically, we can still choose to preserve other fibers to avoid unnecessary deficits.

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P-7

Awake craniotomy insights: Mapping the SMA and DLPFC in a prehispanic speaker musician

Daniel Ballesteros-Herrera, Sergio Moreno-Jiménez, Rudradeep Datta-Banik, Axel Jared Carro-Gallegos, Paola Mariana Quiñones-Nájera, Alejandro Salazar-Pigeon

Background
Connectome based approach combined with awake brain stimulation is a valuable tool to individualize patient care preserving quality of life and extending the tumor resection. The supplementary motor area, primarily located in the dorsomedial aspect of the superior frontal gyrus, plays a critical role in the temporal organization and sequential execution of motor activities.
Objective
To present the case of a 47-year-old Nahuatl-speaking prehispanic musician who underwent microsurgical glioma resection under awake craniotomy.
Methods
The patient presented with focal seizures weeks before the surgery. During his diagnostic approach, MRI revealed an intra-axial supratentorial lesion involving the right posterior F2 gyrus (3.2 x 2.5 x 2.1 cm) without contrast enhancement. Preoperative neuropsychological testing revealed left hemispheric dominance in language with mild impairments in fluency, working and verbal memory, as well as deficits in the selection process and inhibitory control. The patient was considered for awake protocol for cortico-subcortical mapping of the SMA and DLPFC due to highly complex bimanual tasks for playing music.
Results
Supplementary motor area and DLPFC mapping was performed while playing prehispanic instruments and singing in Nahuatl (Mexican ancient language). Stimulation of these areas identified bimanual dexterity, with no language function. Supramaximal resection with aid of intraoperative fluorescein was achieved to functional margins. The right motor omega was identified at 4 mA, and subcortical stimulation revealed positivity in the most posterior part of the lesion at 5 mA. The patient was discharged two days after surgery. The histopathological study confirmed a diffuse astrocytoma grade 2 NOS (WHO 2021). At the outpatient clinic evaluation one month after surgery, MRI confirmed supramaximal resection. The patient showed no motor or speech deficits without epileptic seizures.
Conclusions
Photogrammetry offers new perspectives in surgical field documentation and residual tumor volume measurement, aiding the reliability of extent of resection estimation intraoperatively.

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O-8

Use of photogrammetry for surgical field documentation and intraoperative estimation of tumor residual in glioma patients

Daniel Ballesteros-Herrera, Sergio Moreno-Jiménez, Rudradeep Datta-Banik

Objectives
To compare the intraoperative measurements of surgical field volumes obtained in photogrammetry models with conventional measurements made in postoperative imaging studies and to determine the residual tumor volume.
Background
Photogrammetry is a scientific process for extracting 3D information from photographs. It involves recording, measuring, and interpreting photographic images and patterns of electromagnetic emissions to obtain reliable information about physical objects. Documentation and quantification of the surgical field and residual tumor volume from MRI sequences is difficult to obtain due to lack of MRI availability.
Methods
A quasi-experimental quantitative study conducted at the INNN in 2023 focused on patients undergoing glioma resection. Photogrammetry data was used to reconstruct 3D virtual reality models from postoperative surgical field images (n=4). These models volumes were compared with MRI measurements using the Wilcoxon test for paired samples, analyzing variables such as length of lesion border edges, perimeter, three-dimensional length, area of the largest dimension , and estimated volume . Additionally, Spearman correlation was employed to assess the relationship between measurements obtained by both methods.
Results
A Wilcoxon test was used to compare the measurements of lesion boundary edges (cm), perimeter (cm), area (cm2), and estimated volumes (cm3). The test yielded $W = 14$, $p < 0.3281$, indicating a statistically non-significant difference between photogrammetry and MRI measurements. In addition, the Spearman correlation coefficient of $rs = 0.92$, $p < 0.001$ was obtained, indicating a positive correlation between the dimensions estimated by both methods.
Conclusions
Photogrammetry offers new perspectives in surgical field documentation and residual tumor volume measurement, aiding the reliability of extent of resection estimation intraoperatively.

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P-9

Clinical characteristics and postoperative outcomes in patients with insular gliomas: a retrospective cohort study

Daniel Ballesteros-Herrera, Rudradeep Datta-Banik, Lilian Zavala-Romero, Alexis Ortiz-Altamirano, Jorge Abdiel Arias-Peñuelas, Daniela Gutiérrez-Coll, Sergio Moreno-Jiménez

Introduction
The insular cortex plays a central role in multiple higher brain functions. Resection of insular lesions is surgically challenging because of the multiple motor and language related white matter tracts surrounding it. The clinical presentation and prognosis of insular gliomas vary greatly due to their peculiar anatomic localization.
Objective
To analyze the clinical presentation and the postoperative outcomes of patients with insular gliomas in the Mexican population.
Materials and methods
This was an observational and retrospective study where patients with newly diagnosed insular gliomas between 2017 and 2023 were included (n=39). Baseline clinical features were described using central tendency and dispersion measures. Logistic regression models were used to analyze factors associated with the detection of giant insular gliomas, paralimbic involvement, postoperative clinical deterioration, and total resection. Survival analysis was conducted using Kaplan-Meier curves, the Mantel-Cox log-rank test and Cox regression models.
Results
The most common presenting features were seizures (28%), headache (26%) and somnolence (15%). Aphasia, personality changes, and seizures were the symptoms associated with detecting giant gliomas or paralimbic involvement. Postoperative clinical deterioration was strongly associated with basal ganglia involvement (OR=3.25), preoperative amnesia (OR=3.38), and Berger-Sanai zone 4 involvement (OR=2.11). A longer survival was observed among patients with low-grade gliomas, with preoperative KPS >70 and those who underwent total resection. Resection within 30 days of disease onset proved to be a protective factor for survival (HR = 0.60) meanwhile, the involvement of Berger-Sanai zone 3 (HR=1.65), giant glioma (HR =1.48), and hippocampal involvement (HR = 1.40) were the main predictors of shorter survival.
Conclusions
Some symptoms and imaging features are associated with poor prognosis in patients with insular gliomas, although early surgery is a protective factor for survival.

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O-10

The temporomandibular joint-preserving middle cranial fossa approach to the retrostyloid space: an anatomical study

Yandong Su

Department of Neurosurgery, Zhongshan Hospital, Xiamen University, Xiamen, China

Objective
This study aims to reveal the surgical anatomy of the temporomandibular joint-preserving middle cranial fossa approach (TMJp-MCFA) to the retrostyloid space (RSS).
Method
Ten formalin-fixed and red silicone-injected cadaveric heads were dissected under an operating microscope. Dissection steps were as follows: A frontotemporal craniotomy with a T- shaped zygomatic osteotomy was done, with subsequent partial peeling of the lateral wall of the cavernous sinus. The anterolateral triangle was drilled to expose the vidian canal and pterygoid base. The region of the middle cranial fossa, situated laterally to the sphenosquamosal suture and anterior to the temporomandibular joint, was meticulously rongeured off. Then the lateral pterygoid muscle was resected to identify the branches of the V3. Further removal of the lateral pterygoid plate and medial pterygoid muscle was done to expose the prestyloid space. The RSS was reached through the triangle bounded by the inferior alveolar nerve, auriculotemporal nerve and mandibular condyle. Finally, the structures within the RSS were dissected before and after the resection of the styloid process (SP). The length of the exposed parapharyngeal internal carotid artery (pICA) was measured using a vernier caliper, and Leksell stereotactic system was used to determine the spatial coordinates of the selected landmarks in the RSS, which were subsequently imported into AutoCAD software for area calculation.
Result
The stylopharyngeus and styloglossus muscles could be identified and traced to their points of entry into the pharyngeal wall. Without the resection of the SP, only the glossopharyngeal nerve and ascending pharyngeal artery could be exposed, and the length of the exposed pICA and area of the exposed RSS were 19.26±1.35mm and 2.66±0.39cm2, respectively. After the resection of the SP, the length of the exposed pICA and area of the exposed RSS increased to 47.95±2.26mm and 5.93±0.87cm2, respectively. Meanwhile, the vagus nerve and hypoglossal nerve could be well visualized and traced inferiorly to the superior laryngeal nerve and ramus descendens hypoglossi, respectively, thus extending the inferior boundary of the exposure of the TMJp-MCFA to the C2-C3 level. The superior cervical sympathetic ganglion could also be exposed on the medial aspect of the pICA, and branches of the ventral rami of C1 and C2 could be seen joining the dorsal aspect of the hypoglossal nerve. However, only limited portions of the proximal accessory nerve and internal jugular vein could be observed. Notably, it was difficult to expose the stylohyoid muscle irrespective of SP resection.
Conclusion
The anteromedial part of the RSS can be well targeted by the TMJp-MCFA. This approach may be suitable for lesions located anterior to the pICA, and further study to explore its clinical implication is needed.

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O-11

A new method to localize the temporal branch of the facial nerve and its application in temporoparietal fascia flap harvesting: an anatomical study

Yandong Su

Department of Neurosurgery, Zhongshan Hospital, Xiamen University, Xiamen, China

Introduction and Objective
Pitanguy line is widely used to localize the temporal branch of the facial nerve (TBFN) and guide the harvesting of the temporoparietal fascia flap (TPFF). However, this approach is unreliable and poses a significant risk of injury, especially when used in TPFF harvesting. Other methods of TBFN localization have been reported, requiring troublesome measurements in most cases. A safe and easy method is warranted in clinical practice.
Method
Six formalin-fixed cadaveric heads were used for TBFN dissection: Parotidectomy was performed first so that each TBFN could be identified and traced superiorly. Then the subgaleal fat pad (SGFP) and interfascial fat pad (IFFP) were dissected and their posterior boundaries were outlined, creating a new method for TBFN localization. The skin and subcutaneous tissue of the frontotemporoparietal scalp were elevated with a preauricular question-mark skin incision in another ten specimens, followed by the harvesting of the TPFF. The new method of the TBFN localization was applied to the incision of the anterior edge of the TPFF.
Result
Mean number of the TBFN at the upper edge of the zygomatic arch (ZA) was 6.00±0.63 on each side of the specimens, and all TBFN traveled within the SGFP. The posterior boundary of the SGFP started at the tragus and curved anterosuperiorly toward the superior temporal line (STL). The intersection of the horizontal line passing through the anterior end of the STL and the vertical line passing through the midpoint of the ZA, as well as the intersection of the horizontal line passing through the lateral canthus and the vertical line passing through the articular tubercle of the squamous bone, were located on the posterior boundary of the SGFP. Thus these two intersection points and tragus defined the posterior boundary of the SGFP and served as the critical landmarks for the TBFN localization. The distances from the anterior end of the STL to the posterior boundaries of the SGFP and IFFP were 27.60±2.17mm and 49.30±3.25mm ($p<0.001$), respectively; while the distances from the lateral canthus to the posterior boundaries of these two fat pads were 62.17±4.27mm and 71.34±4.88mm ($p<0.001$), respectively. When the new method was utilized to determine the anterior edge of the TPFF, no SGFP was exposed during the harvesting procedure.
Conclusion
Defining the posterior boundary of the SGFP serves as an accurate and safe method for TBFN localization and determination of the anterior limit of the TPFF, and the anterior end of the STL, the midpoint of the ZA, lateral canthus, articular tubercle, and tragus are reliable landmarks utilized in this new method. Moreover, given that the TBFN courses within the SGFP and the IFFP is consistently wider than the SGFP, the interfascial dissection is a safe technique for TBFN preservation during the skin flap elevation.

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P-12

Early surgery and high dose steroids in treating patients with indirect traumatic optic neuropathy: a meta-analysis and systematic review

John Emmanuel Y. Custodio, Oliver Ryan Malilay, Joseph Erroll Navarro

Jose R. Reyes Memorial Medical Center, Philippines

Introduction
Optic nerve injury is a devastating cause of permanent visual loss after blunt or penetrating injury occurring in up to 7% of head trauma cases. No single treatment strategy and timing of intervention has proved optimal. Timely and appropriate management is key to improving visual outcomes.
Objectives
We compared whether immediate surgical decompression or steroids would lead to improvement of visual outcomes in individuals with indirect traumatic optic neuropathy. We also compared improvement in visual outcomes among those who received early and late intervention.
Methods
We searched from the Cochrane Library, MEDLINE/PubMed, Embase database, HERDIN, and the WHO International Clinical Trials Registry Platform for studies to be included. Patients with direct optic nerve injury, those who received combined treatment with surgery and steroids, and those with delayed initiation of treatment were excluded.
Results
The final search yielded eleven eligible studies. Both interventions showed similar results in improvement of visual function (RR 2.35, 95% CI 0.87 to 6.34, p=0.09, I2 0%). Both early and late intervention also showed similar results in improvement of visual function (RR 1.72, 95% CI 0.89 to 3.35, p=0.11, I2 61%). Among patients who underwent early surgical decompression, the rate of visual acuity improvement was 73% with those who underwent transcranial surgery and 69% with those who underwent endoscopic surgery.
Conclusion
This study shows that immediate surgical decompression and early high-dose steroid administration are equally effective in improving visual function. Patients with NLP and LP pre-treatment resulted to better visual improvement with steroids while those with CF and more than CF pre-treatment, resulted to better visual improvement with surgical decompression. Furthermore, those who received both early and late intervention resulted in similar improvement in visual outcomes. A higher rate of visual improvement was noted with transcranial surgery than endoscopic surgery.

Keywords: Traumatic Optic Neuropathy, Steroids, Surgery

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O-13

A novel technique for skull base reconstruction in fibrous dysplasia surgery using 3D printing and dental alginate mold: insights from the developing world

Kirby C. Manigos, Joseph Erroll V. Navarro, Kenny S. Seng, Jose Carlos S. Alcazaren, Oliver Ryan M. Malilay, Tito Guillermo D. Rejante, Kevin Paul Ferraris

Section of Neurosurgery, Department of Surgery, Jose R. Reyes Memorial Medical Center, Manila, Philippines

Background
Fibrous dysplasia is a rare and benign skeletal lesion characterized by fibrous tissue proliferation due to an abnormal osteogenesis replacing normal bone. Craniofacial involvement can lead to pain, deformity, and functional impairment necessitating tumor removal and proper reconstruction of the surgical defect.
Objective
We present an 18-year-old male with fibrous dysplasia of the left sphenoid, ethmoid, orbit, and frontal bones.
Methods
Results
During excision, the involved bones was seen to be expanded, with a thinned-out cortex with a tan-gray, fibrous, and gritty intramedullary lesion. After complete removal of the tumor, the left periorbita, frontal, ethmoid and sphenoid sinuses, and part of the infratemporal fossa were exposed. Skull base reconstruction commenced by making a reverse temporalis flap and placing it over the opened paranasal sinuses for a robust vascularized graft, followed by an abdominal fat graft, then a pedicled pericranal flap was added to complete the multi-layer onlay graft. To recreate the skull base, a mirror image of the contralateral skull base was 3D-printed prior to the surgery and sterilized. Intraoperatively, it was then pressed onto dental alginate gel to make a negative mold. This was used to make an appropriate flap using polymethyl methacrylate for exact reconstruction of the skull base. Temporoplasty was also performed using polymethyl methacrylate to fill the defect left by the temporalis graft. The post-surgery course of the patient was unremarkable, and he was discharged after 7 days, and resumed school after 5 weeks.
Conclusion
Our study highlights a novel method of skull base reconstruction that can applied in limited-resource institutions.

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O-14

The Role of the Skull Base Surgeon in a Functional Procedure such as the Auditory Brainstem Implant: Anatomical Tips & Tricks

Diego F. Gomez[1], Santiago Fuentes-Tapias[1,3], Alexandra Ramos-Márquez[1,3], Juan Manuel García[2], Juan Fernando Ramon[1], Edgar G. Ordóñez-Rubiano[1], Fernando Hakim[1]

[1]Department of Neurosurgery, Fundación Santa Fe de Bogotá, Bogotá, Colombia
[2]Department of Otolaryngology, Fundación Santa Fe de Bogotá, Bogotá, Colombia
[3]Faculty of Medicine, Universidad de Los Andes, Bogotá, Colombia

Background

Most patients with Neurofibromatosis type 2 (NF2) will succumb to bilateral deafness, as the hallmark of this autosomal neoplastic syndrome is the development of bilateral vestibular schwannomas; present in up to 95% individuals with NF2. Although benign, these tumors cause significant hearing loss due to mass effect and altered anatomy. In 1979 Auditory Brainstem Implants (ABIs) were developed for adults with NF-2. This auditory prosthesis has been used when patients have profound sensorineural hearing loss not candidates for cochlear implants due to anatomically altered cochlear nerves or implantable cochlea. The surgical principle is similar to cochlear implantation, meaning that a segment of the auditory pathway is bypassed. A processor receives auditory signals and transforms them into an electrical signal, which is then transmitted to an electrode so the brain can recognize it.

Auditory Brainstem Implants (ABI) have been used as a treatment for NF-2 cophosis, showing improved awareness of surrounding sounds, and in some cases high levels of open-set speech recognition. FDA-approved indications remain exclusive for adult population with NF-2, nonetheless recent and ongoing studies have shown promising results in pediatric population. To achieve desired results inserting the electrode into the exact location at the dorsal cochlear nucleus, on the lateral recess of the brainstem is key to the procedure. However, this is a complex step of the surgery, given the anatomical distortions generated by associated tumors related to NF-2, and the detection of the structures covered by the flocculus. Several approaches have been described to provide access to the cochlear nuclei, including the translabyrinthine and retrosigmoid. The retrosigmoid approach has shown an improved route to provide a more posterior view of the lateral recess than the translabyrinthine route.

Objective

We present the case of an adult female patient diagnosed with NF-2 cophosis secondary to bilateral vestibular schwannomas.

Methods

After a preoperative evaluation with ENT and neurophysiology a retrosigmoid approach with intraoperative electrical auditory brainstem responses (eABR) monitoring was chosen. The ABI was placed with real-time eABR monitoring to confirm adequate positioning and to determine the exact location for the electrodes.

Results

The entry route was along the cerebellopontine angle, the foramen of Luschka and lateral recess, towards the dorsal cochlear nuclei. The implant was placed without major postoperative complications. One month after surgery the device was turned on in the intensive care unit. Evaluation with the Categorical Auditory Performance (CAP) criteria showed successful discrimination of speech sounds and understanding of common phrases without lipreading.

Due to the complex access route and multiple anatomical landmarks in a high-risk surgical area, ABI implantation is a demanding procedure for the surgeon. In essence, stimulating a brain area is the basis for functional neurosurgery, nonetheless we believe that skull base surgeons have the expertise to approach this area thanks to their anatomical knowledge and microsurgery skills.

Conclusion

The selected approach, the identification of cranial nerves in the cerebellopontine cistern, the recognition of Luschka's foramen and fourth ventricle, and arachnoid dissection are key steps for the placement of the ABI.

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P-15

Pretemporal transcavernous kawase approach for macrovascular decompression of a dolichoectatic basilar artery presenting with trigeminal neuralgia

Tzu-Chiang Peng

Background and importance
Trigeminal neuralgia (TN) secondary to dolichoectatic basilar Artery (DBA) compression is extremely rare. Macrovascular decompression is an option to address this condition. However, the unique anatomy surrounding the DBA and trigeminal nerve poses significant surgical challenges. Various approaches and techniques have been discussed in the literature. We describe the pretemporal transcavernous Kawase approach, utilizing the transposition method with Teflon and an artificial dura sling, to achieve effective decompression.
Clinical Presentation
We present a case of a 65-year-old male with left side medically-intractable trigeminal neuralgia secondary to vertebrobasilar artery compression. Strategy with pretemporal transcavernous Kawase approach was conducted. The trigeminal nerve was found to be pushed superiolaterally by ipsilateral deviation of DBA. The DBA was mobilized inferomedially with care to prevent perforating artery transection. A Teflon prosthesis and an artificial dura sling were interposed in a neurovascular conflicting area. The patient experienced a transient period of dysphagia, necessitating nasogastric tube feeding during the postoperative course. The left-sided TN abated immediately after the intervention, and the patient was free from medication upon discharge.
Conclusion
This case was effectively managed utilizing the pretemporal transcavernous Kawase approach, coupled with a unique transposition technique employing Teflon and an artificial dura sling. This approach offered significant advantages, notably enhanced visualization of the trigeminal root entry zone (REZ) and improved maneuverability for repositioning the dolichoectatic basilar Artery (DBA) inferomedially, away from the trigeminal nerve. The utilization of Teflon and an artificial dura sling as a transposition method ensured a safe distance between the VBA and the trigeminal nerve. Consequently, an outstanding surgical outcome was achieved, characterized by complete resolution of trigeminal neuralgia (TN) resulting from DBA compression.
Running Title:
Pretemporal Transcavernous approach for Macrovascular Decompression of a Dolichoectatic Basilar Artery

Keywords: Pretemporal Transcavernous Kawase Approach, Macrovascular Decompression, Dolichoectatic Basilar Artery, Trigeminal Neuralgia

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P-16

Focused ultrasound-mediated enhancement of blood- brain barrier permeability for brain tumor treatment - a systematic review

Honglin Zhu[1]†, Caitlin Allwin[1]†, Monica G. Bassous[2,3], Antonios N. Pouliopoulos[2]

[1]Faculty of Life Sciences and Medicine, King's College London, London, United Kingdom
[2]School of Biomedical Engineering & Imaging Sciences, King's College London. London, United Kingdom
[3]School of Cancer and Pharmaceutical Sciences, King's College London, United Kingdom

Introduction
Brain tumours, particularly glioblastoma multiforme (GBM), present significant prognostic challenges despite multimodal therapies, including surgical resection, chemotherapy, and radiotherapy. One major obstacle is the limited drug delivery across the blood-brain barrier (BBB). Focused ultrasound (FUS) combined with systemically administered microbubbles has emerged as a non-invasive, targeted, and reversible approach to transiently open the BBB, thus enhancing drug delivery.
Objective
This review examines clinical trials employing BBB opening techniques to optimise pharmacotherapy for brain tumours, evaluates current challenges, and proposes directions for further research.
Methods
The systematic literature search was conducted in PubMed and ClinicalTrials.gov from inception to 1st November 2023, searching for a combination of "ultrasound" AND "brain tumor". The search yielded 1,446 results. After screening by title and abstract, followed by full-text screening (n=48), 35 studies were included in the analysis.
Results
Our analysis includes data from 11 published studies and 24 ongoing trials. The predominant focus of these studies is on glioma, including GMB and astrocytoma. One paper investigated brain metastasis from breast cancer. Exploration of FUS in the pediatric population is limited, with no published studies and only three ongoing trials dedicated to this demographic.
Conclusion
FUS is a promising strategy to safely disrupt the BBB for enhanced drug delivery, enabling precise and non-invasive lesion targeting. However, pharmacokinetic studies are required to quantitatively assess the improvements in drug uptake. The majority of studies are currently in phase I clinical trials, and despite the innate poor prognosis of brain tumor patients, long-term follow-up investigating patient outcomes are essential to evaluate the clinical benefit of this treatment approach. Further studies involving diverse populations and pathologies will be beneficial.

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A study to find correlation between MRI sequence on tumour consistency with surgical findings in patient with intracranial meningioma

Yibenthung S Ezung[1], Raj S. Chandran[2]

[1]Department of Neurosurgery, Government Medical College Thiruvananthapuram, India
[2]Medical college and hospital, Thiruvananthapuram. Kerala

Introduction and Objective
This study investigates the correlation between MRI sequences and intraoperative findings of tumor consistency in patients with intracranial meningioma, a common primary tumor originating from arachnoid cap cells and prevalent among middle-aged adults.
Methods
The study, conducted at the Department of Neurosurgery, Government Medical College Thiruvananthapuram, India, from May 2022 to April 2023, aimed to evaluate how MRI sequences—specifically T2-weighted imaging (T2WI) and Fluid-Attenuated Inversion Recovery (FLAIR)—correlate with intraoperative assessments of tumor consistency. Secondary objectives included analyzing demographic factors, histopathological characteristics, and their relationship with surgical findings.
Results
Fifty-four patients with meningioma were enrolled, with data from 50 patients analyzed after excluding four cases due to incomplete information. The cohort predominantly consisted of patients aged 41 to 60 years, with females comprising 70%. Statistical analysis demonstrated a significant inverse correlation between T2/TC Ratio and FLAIR/TC Ratio with intraoperative consistency grades, quantified by CUSA intensity (Kendall's tau_b correlation coefficients of -0.642 and -0.785, respectively).
The study established cutoff values for T2/TC and FLAIR/TC ratios to predict tumor consistency: T2/TC >1.21 for soft tumors (85.00% sensitivity, 83.33% specificity) and ≤0.95 for hard tumors (85.71% sensitivity, 88.89% specificity); FLAIR/TC >1.12 for soft tumors (90.00% sensitivity, 96.67% specificity) and ≤0.86 for hard tumors (87.51% sensitivity, 90.82% specificity).
Conclusion
In conclusion, MRI sequences, particularly FLAIR, were found effective in preoperatively assessing meningioma consistency. This method provides a reliable and reproducible means of predicting intraoperative tumor characteristics, which can significantly aid in surgical planning. Integrating these imaging modalities into clinical practice is recommended to optimize surgical decision-making and improve patient outcomes.

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Feasibility of robotic posterior fossa skull base surgery

Min Ho Lee[1,2], Limin Xiao[1,3], Juan C. Fernandez-Miranda[1]

[1]Department of Neurosurgery, Stanford University School of Medicine, Palo Alto, California, United States of America
[2]Department of Neurosurgery, Uijeongbu St.Mary's Hospital, The Catholic University of Korea, Seoul, Korea
[3]Department of Neurosurgery, The First Affiliated Hospital of Nanchang University, Nanchang, China

Introduction
Despite its potential advantages, robotic surgery has yet to be applied to skull base surgery. Complex anatomy and restricted access have limited the development of robotic skull base surgery.
Objective
The aim was to conduct a feasibility study of robotic surgery for posterior fossa skull base surgery.
Methods
Six silicone-injected postmortem heads were prepared for the robotic surgery. Since there was no drilling tool with the robot, specimens were dissected using an endoscope and microscope, in advance. (1) Supra-cerebellar infra-tentorial approach, (2) retromastoid approach, and (3) posterior approach of the occipital-cervical junction were conducted. For each approach, specific anatomical landmarks were identified, and the surgical freedom (vertical distance, and angle between the tools) was measured.
Results
In the case of the supra-cerebellar infra-tentorial approach, we used three burrs with 1.5 cm of diameter: one paramedian, and two laterally. The view of the pineal region was visualized, and sufficient surgical freedom of both tools was secured. Vertical distance was 1.2 cm (1.1~1.8), and angle between the tools was 105 degree (92~110). On the other hand, in the retro-mastoid approach, with a single burr of 2.5 cm diameter, the root exit zone of the facial nerve was barely visible, and a space for tools to access was not secured. Vertical distance was 0.8 cm (0.6~1.0), and angle between the tools was 10 degree (6~12) In the case of the posterior approach of the occipital-cervical junction, we put the three tubular retractors, one in the middle, and two laterally. Even though the space was narrow, the medulla and adjacent nerves could be identified, and a moderate level of surgical freedom could be obtained for tool mobilization. Vertical distance was 1.6cm (1.2~2.5), and angle between the tools was 90 degree (88~95).
Conclusion
Though robotic surgery is yet to be applied to neurosurgery, it is expected to be helpful in posterior fossa skull base surgery if appropriate tools can be developed.

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When endoscopic met microsurgery: Pituitary transposition, a 360 view of the sellar and suprasellar anatomy in a infundibulum and third ventricle craneopharingyoma

Ivan A. Mendez Guerrero, Sheila Borrayo Dorado, Diego Mendez Rosito

Objectives
Demonstrate that contemporary endoscopic surgery is microsurgery. The so-called minimal invasive surgery (endoscopic) follows the same principles in dissection a resection as open surgery.
Background
For many authors endoscopic surgery is not considered microsurgery, however in later years the evolution of the endoscopic techniques has shown that it is mandatory to develop a complete recognition of anatomical structures in a 360-degree perspective and the acquisition of microsurgical abilities are fundamental for the opening of the new endoscopic corridors. The evolution of new technologies also brings new challenges for the traditional perspectives. The continuous training is fundamental for any neurosurgeon to overcome these obstacles. Sagittal and coronal approaches in endoscopic surgery as well as in open surgery assisted with endoscopy open a point of view in the decision making specially in sellar and suprasellar regions.
Methods
In the Skull Base Laboratory in Mexico City directed by Diego Mendez Rosito, the preparation of 4 cadaveric specimens with formaldehyde al 10% with previous canalization of carotids, vertebral arteries and jugular veins, and infiltration of silicon with acrylic paint (red for arteries, blue for veins). The dissection of these specimens for the anatomical review of the sellar and suprasellar regions with the identification of all anatomical structures in a 360 view previous a surgery of a 40 old man with an infundibular and third ventricle craniopharyngioma with no neurological symptoms
Results
After the cadaveric evaluation of the anatomical structures in a 360 degree view the endoscopic endonasal resection was planned as the best approach. The complete identification of the anatomical structures of the sellar and para sellar region with a full pituitary transposition and complete resection of the tumor with microsurgical technique shown in postoperative study with no neurological deficit.
Conclusions
Contemporary endoscopic surgery is not possible with a full understanding of the 360 anatomy. The microsurgical skills are as important in open surgery as in endoscopic surgery. Nowadays endoscopic surgery should be a synonym of microsurgical neurosurgeon.

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STA-MCA bypass for symptomatic moyamoya disease – Lessons learnt from 89 revascularisations

Amol Raheja[1], Sanjeev A[1]. Sreenivasan[2], Ashish Suri[1], Manmohan Singh[1], Shashwat Mishra[1], Vivek Tandon[1], Subash Phuyal[3], Leve J. Devarajan[3], Mani Kalaivani[4], P. Sarat Chandra[1], Shashank S. Kale[1]

[1]Department of Neurosurgery, All India Institute of Medical Sciences, New Delhi, India
[2]Department of Neurosurgery, All India Institute of Medical Sciences, Raipur, Chhattisgarh, India [3]Department of Neuroradiology, All India Institute of Medical Sciences, New Delhi, India
[4]Department of Biostatistics, All India Institute of Medical Sciences, New Delhi, India

Introduction
Efficacy of surgical revascularisation procedures over conservative management in moyamoya disease (MMD) has been established in the past. However there is dearth of literature on comprehensive evaluation of impact of age and Suzuki staging on clinical and angiographic outcome in symptomatic MMD patients undergoing direct revascularisation (DR) via superficial temporal artery – middle cerebral artery (STA-MCA) bypass.

Objectives
To comprehensively evaluate clinical and angiographic outcome in symptomatic Moyamoya-disease (MMD) patients undergoing STA-MCA bypass.

Methods
We analysed consecutive MMD patients who underwent direct-revascularisation (DR) via STA-MCA bypass. Primary outcome measures were mRS scale and stroke risk reduction. Secondary outcome measure was angiographic outcome score (AOS).

Results
70 patients (89 DR procedures), including 37.9% adults (>18yr), were operated over a duration of 8 years and followed up for 2 years (mean). Long-term bypass-patency rates were deemed 83.3% and 88.8% in children and adults respectively. In pediatric age group, median mRS scores improved from 3 to 2 (p=0.001), 97.3% were free of recurrent strokes and AOS scores improved significantly (p=0.002). Amongst adult MMD patients, median mRS score marginally improved from 3 to 2 (p=0.25), 100% were free of recurrent strokes and AOS improved significantly (p=0.02). On comparing pediatric and adult patients, improvement in mRS scores (p=0.14) and AOS scores (p=0.65) were similar across the two age groups. Overall late stage MMD patients (Suzuki stages IV-VI) showed better improvement in mRS scores when compared with early stage MMD patients (Suzuki stages I III; p=0.04). Recurrent stroke rates were similar in both groups (p=0.26). AOS scores improved significantly in both early and late stage MMD (p<0.001 in both), though the improvement amongst the two groups was similar (p=0.88).

Conclusions
Using a meticulous surgical technique, excellent long-term bypass patency rates can be achieved to facilitate optimal clinical and angiographic outcome in symptomatic MMD patients, irrespective of the age group and stage of disease.

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Meningiomas: Factors guiding its behaviour and our understanding - An institutional evaluation

Wajid Nazir, Hukum Singh, Anita Jagetia, Daljit Singh

Department of Neurosurgery, G.B. Pant Institute of Post Graduate Medical Education and Research & associated Maulana Azad Medical College, New Delhi, India

In recent years our understanding of intracranial meningiomas has changed drastically, making us wonder whether these seemingly benign lesions actually follow the WHO classification. Their behaviour seems to be guided by some other characteristics since the outcome and behaviour of different lesions in same grade is grossly different in regards to their presentation as well as excision, outcome and recurrence

We have evaluated this lesion in terms of age at presentation, location, size, gender of the patient, Karnofsky performance scale, duration of symptoms, cranial nerve involvement, seizures, fundus appearance, radiological features, intra-operative features and genetic associations, extent of surgical excision and complications, if any.

We concluded that the majority of features have no significant bearing of behaviour of these lesions. We found their radiological characteristics in terms of size, appearance in various sequences, relation to adjacent structures, extent of edema as well as intra-operative features like consistency, adhesiveness and vascularity along with presence and absence of various genetic alterations in the form of DCC (deleted in colorectal cancer) gene expression and mitotic index provide a good guide to establish prognostication, ease and completeness of excision along with outcome and recurrence estimation in the beginning and early post operative period itself.

We are working towards developing a better and more inclusive grading system to classify Meningiomas more holistically using parameters in close association to each other which will provide improved outcome by approaching the modifiable parameters after detailed pre operative evaluation of radiological findings, including tumor size, vascularity, tumor location, tumor shape, edema, mass effect, consistency, adhesiveness. At the same time, the patient can be counseled and prognosticated with possible outcomes and long-term expectations based on genetic composition/alterations detected.

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Cerebral abscess secondary to embolisation of arteriovenous malformation and coiling of left MCA aneurysm

Sajal Gupta, Anita Jagetia, Gd Singhal, Vikrant Sethia

G.B. Pant Institute of Post Graduate Medical Education and Research (gipmer), New Delhi, India

Background
Infectious complication of the central nervous system secondary to endovascular procedures have rarely been reported. However the number of complications has grown exponentially owing to the popularization of these procedures. The success rate of these procedures varies with the pathology, the patient, and surgical performance. Although brain abscesses have been extensively reported, their presence after endovascular procedures has not been described in detail in the literature.
Objectives
Primary -To enlist the possible sources of infection after an endovascular case.
Secondary - measures to prevent the infection and subsequent formation of abscess.
Materials and Methods
Case report of a single case of cerebral abscess secondary to embolization of arteriovenous malformation and coiling of left MCA aneurysm
Results
A 33-year-old male patient was treated using an endovascular embolization of left fronto-parietal AVM and coiling of left MCA aneurysm. After 18 months, he presented with a cerebral abscess. Antibiotic therapy was started and surgical excision was done with a favourable postoperative outcome.
Conclusion
Development of CNS infections after endovascular procedure is an extremely rare event. Extreme care should be taken to ensure proper catheter handling and asepsis during embolisation. Furthermore investigations for active infections in other parts of body are required and treating them properly before doing intervention.

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Tackling intracranial epidermoid cyst with eggshell technique – a case series and technical note

Hemant M Jawale , Aadil S Chagla , Srikant Balasubramaniam

Department of Neurosurgery, TNMC and BYL Nair Charitable hospital, Mumbai 400008

Objectives
Epidermoid cysts, originating from residual ectodermal cells, are rare intracranial tumors commonly found in the 3rd to 5th decade of life. Due to the adherence of the tumor capsule to surrounding eloquent brain tissue, their surgical excision poses a challenge to the operating surgeon. Therefore, we introduce a surgical technique termed the eggshell technique. The primary objective is to assess immediate treatment outcomes and investigate clinical parameters such as recurrence risk and postoperative complications.
Materials and Methods
This retrospective study includes 16 cases of central nervous system epidermoid cysts. Data were collected on demographic characteristics, clinical presentations, and anatomical distributions. The study introduces and describes the eggshell technique as an effective surgical approach.
Statistical analysis
Descriptive statistics were used to summarize demographic data, clinical presentations, anatomical distributions, and treatment outcomes. Measures of central tendency and dispersion were employed for continuous variables, while categorical variables were summarized using frequencies and percentages.
Results
The study identified demographic trends, common clinical presentations, and anatomical distributions of intracranial epidermoid cysts. The eggshell technique was successfully implemented in all cases with positive immediate treatment outcomes. Rates of recurrence and postoperative complications were also evaluated.
Conclusions
The study underscores the effectiveness and innovation of the eggshell technique for managing intracranial epidermoid cysts. The detailed description of this eggshell surgical technique fills a gap in the existing literature, providing valuable insights into surgical management strategies. Further follow-up and research are warranted to validate these findings and explore long-term outcomes and patient quality of life post-surgery.

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QEVO© assisted removal of a cerebellopontine epidermoid and its brain stem extension: more than a micro-inspection tool

Harsh Deora

Department of Neurosurgery, National Institute of Mental Health and Neurosciences, Bangalore, India-560029

Large epidermoids present a unique challenge. On one hand, they are completely benign, and any functional deficits to the patient would not be acceptable. On the other hand, if not completely excised, recurrence of symptoms is expected in the young. Hence, surgery needs to be done safely with a maximum chance of a complete cure.
Here we present a case of a large cerebello-pontine epidermoid with severe brain stem compression that was excised using the QEVO© inspection tool.
Conclusion
This tool allows us to look at blind spots without the need for extensive approaches thus maximizing safety while completing resection.

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Minimally invasive resection of cervical schwannoma (C1-C2 level) using tubular retractors

Harsh Deora, Madhusudhan Nagesh

Department of Neurosurgery, National Institute of Mental Health and Neurosciences, Bangalore, India-560029

Introduction
Cervical schwannoma excision usually involves laminectomy and violation of the facet joints which necessitates the need for fusion with consequent loss of cervical mobility.
We present the first video demonstration of an excision of the cervical schwannoma at C1-C2 level using minimally invasive spine tubular retractors, which allow direct access to the lesion and prevent the need for any bony removal. This also preserves the paraspinal muscles, which are important for spinal stability, especially at the C2 level.
Conclusion
Special attention is given to incision planning and pre-operative image analysis for preventing injury to critical neurovascular structures at this level.
Keywords
Schwannoma, En-bloc resection, Cervical spine, Minimally invasive spine surgery

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Free hand C1-C2 screw placement in CV junction anomaly: Does anatomical complexity matter?

Pawan Kumar Verma, Arun Kumar Srivastava

Background
Conventionally, C1-C2 fixation is being performed with the help of intra-operative C- arm and navigation systems etc. However, these modalities have been associated with high operating cost, increased operative time and radiation exposure to both the patient and healthcare personnel. Unlike other areas of spine, CV junction region harbors many anatomical landmarks which are really helpful for free hand screw placement. Here Author want to highlights the merits of free hand screw placement based on anatomical landmarks.

Aims and Objectives
To evaluate the accuracy of C1 C2 screws placement by free hand technique in craniovertebral junction anomalies
To evaluate the intraoperative anatomical complexity and screws malposition association

Material and Methods
We retrospectively reviewed and evaluated C1 Transpedicular, C1 lateral mass, C2 pars and C2 pedicle screws on post-operative CT scan of all patients who has undergone for posterior fixation in last 6 years. The patients of acute trauma of CVJ and purely sub-axial instrumentation were excluded (owing to their normal anatomical landmarks). The patient's demographic details, clinical details, radiological details, major intraoperative events and post-operative complications were also noted. We divided the whole patient in two groups, simple CVJ group (mobile or fixed atlantoaxial dislocation with symmetrical C1-C2 joints with normal course of vertebral arteries) and complex CVJ group (atlantoaxial dislocations with basilar invagination with or without platybasia) based in their anatomical characteristic on the preoperative dynamic computed tomography (CT) scan with CT angiography of CVJ region. The screws Malposition grades and direction were defined as per Hojo grading scale. The trajectory of malposition was further classified into medial, lateral, superior and inferior.

Results
Total 221 patients were included in the study. The mean age of presentation was 27.84 years. The major symptoms were spastic quadriparesis, restricted neck movements, sensory symptoms, LCN involvement, and autonomic involvement. On radiological evaluation 63(28.5%) patients were in simple CVJ anomaly group while 158 (71.5%) patients were in complex CVJ anomaly group. The accuracy of screws placement by freehand technique was 84.42%. In simple group total 220 C1-C2 screws were placed with 83.64% in grade 0 (correct placement). In complex CVJ group total 486 C1, C2 screws were placed with 84.77% in grade 0. Overall malposition rate was 15.58%. The rate of misplacement of screws in simple (16.36%) and complex (15.23%) groups were almost comparable (p value- 0.7007). The majority belongs to Grade-1(12.45%) followed by grade 2 in 2.83%. The most common malposition trajectory was medial (34.75%) followed by inferiorly (28.5 %).

Conclusions
The rate of accurate screw placement by free hand technique without use of fluoroscopic or neuro-navigation guidance is comparable to the large studies published in literature. This practice can significantly cut down the fluoroscopy hazards to both the patient and health care personnel. The study also highlights that anatomical complexity is no more contraindication for free hand technique and breaks the barrier of false perception about high rate of malposition in complex CVJ anomaly cases.

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V-29

Clival meningioma: Total excision by far lateral transcondylar approach

Shivashankar Marajakke

Siddhagiri Hospital & Research Center Kanerimath, Kolhapur, Maharashtra, India

Cervical schwannoma excision usually involves laminectomy and violation of the facet joints which Clival meningioma is one of the most complex & challenging lesions to treat surgically.
They require careful surgical manipulation as they are often located in proximity to critical neurovascular structures and the cranial nerves.
The general concept that is important for the successful removal of the clival meningioma include adequate bony exposure, maintenance of arachnoid plane and preserving critical neurovascular structures.
The far lateral approach facilitates the access to the anterior foramen magnum and reduces the retraction of vital structures.
It necessitates removal of the FM rim toward the condyle and excision of the ipsilateral atlantal arch.
In this surgical video, we have demonstrated a step-by-step approach to surgery for clival meningioma, including preop and postop imaging.

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P-30

Rethinking the role of adjuvant radiotherapy in the treatment of World Health Organization grade 2 meningioma: a divergent path

Rahul Gupta

National Institute of Mental Health and Neurosciences (NIMHANS), Bengaluru, India.

Introduction
Atypical, chordoid and clear cell meningiomas come under the category of World Health Organization (WHO) grade 2 meningiomas and are considered high-grade tumors; treatment includes mainly surgery and adjuvant treatment with radiotherapy (RT). The role of RT is controversial.
Objectives
Our aim is to study these lesions and analyze the effect of adjuvant RT and its timing on the tumor recurrence and overall survival.
Methods
This is a retrospective observational study from a tertiary care institution. It includes patients from January 2010 to December 2019. Patients were divided into three groups - No RT, Early (or immediate) RT (within 6 months of surgery), and Patients who received delayed RT (after 6 months of surgery).
Recurrence free survival and overall survival were seen in each group. Statistical analysis was done with IBM SPSS v23 (Armonk, NY, USA).
Results
A total of 212 patients were included, 62.3% females and 37.7% males, with a mean age of 48.2 years. Maximum tumors were from convexity and skull base region, 65.4%. The median length of follow-up was 82 months. A total of 24 patients died; 9 were directly tumor related. 25.9% of patients had a recurrence, with a significant number of patients who received RT (40.4%). Three and five-year OS were 88.2% and 68.9%, respectively, and the patients who had a recurrence and underwent surgery for the same had significantly lesser OS. Three and five-year RFS was 78.8% and 56.1%, respectively; females had significantly higher RFS than males (124.3 vs. 105 months; p=0.015). RFS was significantly less among patients with adjuvant RT (94.83 vs 126 months, p= 0.001). RFS was higher in the immediate RT group when compared with delayed RT group.
Conclusion
Surgery is the most effective treatment for these tumors. The role of adjuvant RT in the management may not be necessary if good resection is achieved, even in recurrent tumors. A prospective randomized trial will provide a better picture.

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Management of recurrent vasospasm in ruptured intracranial aneurysms: Continuous intra-arterial nimodipine and milrinone Infusion

Sanjay Maganbahi Teelala

Introduction
Cerebral vasospasm remains a significant challenge following subarachnoid hemorrhage due to intracranial aneurysm rupture. Despite advancements in medical therapy including intravenous nimodipine and Triple H (Hypertension, Hypervolemia, Hemodilution) therapy, severe and persistent vasospasm continues to pose clinical dilemmas.
Objective
We present a series of cases where patients with ruptured intracranial aneurysms developed severe vasospasm refractory to conventional treatments, necessitating a novel approach involving continuous intra-arterial infusion of nimodipine and milrinone.
Methods
Patients exhibiting persistent vasospasm post-coiling underwent continuous intra-arterial administration of nimodipine and milrinone via microcatheter, positioned at the petrous segment of the internal carotid artery, utilizing a pressure-controlled infusion system. This intervention was maintained for a period ranging from 48 to 72 hours, aiming to mitigate cerebral vasospasm and its associated ischemic complications.
Results
The outcomes observed were promising, indicating effective resolution of vasospasm in the treated patients. Continuous monitoring and aggressive management were crucial in preventing neurological deterioration and improving overall patient prognosis.
Conclusion
In cases where conventional therapies fail to adequately manage recurrent cerebral vasospasm following subarachnoid hemorrhage secondary to intracranial aneurysm rupture, continuous intra-arterial infusion of nimodipine and milrinone through microcatheter placement proved to be a viable therapeutic option. This approach offers a targeted and sustained delivery of vasodilatory agents directly to the affected cerebral vessels, potentially reducing ischemic complications and improving clinical outcomes. Further studies are warranted to establish standardized protocols and validate the long-term efficacy and safety of this intervention.

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Origin and course of the branches of the cavernous internal carotid artery from the endoscopic endonasal perspective: a cadaveric study

Edoardo Agosti[1,2,3], A. Yohan Alexander[1,2,4], Danielle Dang[5], Luciano Leonel[1,2], Carlos Pinheiro-Neto[1,6],Maria Peris-Celda[1,2]

[1]Rhoton Neurosurgery and Otolaryngology Surgical Anatomy Program, Mayo Clinic, Rochester, MN, United States of America
[2]Department of Neurologic Surgery, Mayo Clinic, Rochester, Minnesota, United States of America
[3]Division of Neurosurgery, Department of Medical and Surgical Specialties, Radiological Sciences and Public Health, University of Brescia, Brescia, Italy
[4]Medical School, University of Minnesota, Minneapolis, Minnesota, United States of America
[5]Department of Neurosurgery, Inova Neurosciences, Inova Fairfax Medical Campus, Falls Church, Virginia.
[6]Department of Otolaryngology, Mayo Clinic, Rochester, Minnesota, United States of America

Introduction
Increased utilization of endoscopic endonasal approaches (EEAs) to treat cavernous sinus lesions requires detailed knowledge of the origin, anatomical variations, and course of the branches of the cavernous internal carotid artery (cICA) as inadvertent avulsion can cause intraoperative ICA rupture. We aim to document the origin and course of the branches of the cICA from an endoscopic endonasal perspective and relate these branches to endoscopic endonasal anatomical references for guidance during surgery.

Methods
Thirty formalin-fixed latex-injected specimens were dissected to identify the origin, course, and localization of cICA branches, including inferolateral trunk (ILT), meningohypophyseal trunk (MHT) from which the inferior hypophyseal artery arises, anterior and inferior McConnel's capsular arteries (MCAs), and superolateral trunk (SLT).

Results
The ILT and MHT were present in 100% of cases, while anterior and inferior MCAs in 28% and 25%, respectively. Only in 3% of specimens a SLT was identified. The first branch of the cICA was the MHT in 80%. The MHT was on average 8.9 mm (6.3-15.2 mm) anterior to foramen lacerum and 3.8 mm (2.1-5.3 mm) superior to the sellar floor. In most cases MHT originated from the medial (97%) side of the posterior bend (62%) of the cICA. The ILT was the second branch (70%) of the cICA and originated with a mean distance of 6.4 mm (5.1-9.4 mm) from the MHT. The ILT originated 2.3 mm (1.2-3.6 mm) superior to the sellar floor at the lateral side (100%) of the horizontal segment (82%) of the cICA, mainly in its proximal portion. The MCAs were usually the third branch (47% and 43% of cases for anterior and inferior MCA, respectively) of the cICA, with a mean distance of 5.3 mm (3.9-8.4 mm) and 4.8 mm (3.2-6.9 mm) from ILT for anterior and inferior MCA, respectively. The anterior MCA originated at a mean height of 2.7 mm (1.8-3.9 mm) from the sellar floor, on the medial side (100%) of cICA anterior bend (53%). The inferior MCA arose at a mean height of 3.5 mm (3-4 mm) from the sellar floor, in most cases at the level of the horizontal segment (93%) and on medial side (100%) of the cICA. If present, the SLT was the second branch of the cICA, with a mean distance of 5.1 mm (3.9-7.4 mm) from the MDT. It originated at a mean height of 2.7 mm (1.8-3.9 mm) from the sellar floor, at the level of the lateral side of the horizontal segment of the cICA (100%). The ILT was complete in 68% of cases, while MHT in 77%.

Conclusion
The MHT and ILT are consistently present branches of the cICA. The MHA can be found approximately 4 mm superior to the sellar floor and 9 mm anterior to anterior aspect of the paraclival ICA, originating from the medial side of the posterior bend of the cICA, while the ILT originates on the lateral side of the horizontal cICA, 2.3 mm superior to the sellar floor and approximately 6 mm anterior to the MHT.

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Optimizing neurovascular-protective transposition of the pterygopalatine fossa through orbito-pterygo-sphenoidal ligament release and descending palatine canal decompression: Anatomical principles and surgical strategies

Edoardo Agosti[1,2,3], Luciano Leonel[1,2], Ronsard Mondesir[3,4], Stephen Graepel, Maria Peris-Celda[1,2], Carlos Pinheiro-Neto[1,4]

[1]Rhoton Neurosurgery and Otolaryngology Surgical Anatomy Program, Mayo Clinic, Rochester, Minnesota, United States of America
[2]Department of Neurologic Surgery, Mayo Clinic, Rochester, Minnesota, United States of America
[3]Division of Neurosurgery, Department of Medical and Surgical Specialties, Radiological Sciences and Public Health, University of Brescia, Brescia, Italy
[4]Department of Otolaryngology, Mayo Clinic, Rochester, Minnesota, United States of America

Introduction
The endoscopic endonasal transpterygoid approach (EETPA) stands as a versatile technique to access various intracranial and extracranial regions. Nevertheless, the presence of neurovascular structures within the pterygopalatine fossa (PPF) constrains the optimal surgical trajectory of this approach. As a result, the resection of both the vidian nerve and PPF contents has been detailed in EETPA, with common related complications such as dry eye syndrome. We present the anatomical foundations and surgical techniques for the neurovascular-sparing transposition of PPF content through the release of the orbito-pterygo-sphenoidal (OPS) ligament and the decompression of the descending palatine canal (DPC).

Methods
EETPA was performed on twelve sides of six formalin-fixed, latex-injected cadaveric head specimens. A 0-degree, 30-degree, and 45-degree endoscope were employed for visualization. Two measurements were obtained to assess PPF transposition: inferior PPF transposition, defined as the distance from the superior margin of the base of the pterygoid (BPP) to the superior margin of the PPF, recorded before and after maximal inferior retraction following OPS ligament release; lateral PPF transposition, defined as the distance from the Eustachian tube to the lateral margin of the PPF, documented before and after DPC decompression and maximal lateral retraction. The ImageJ® image processing program was utilized for measuring transposition rates.

Results
The posterior wall of the maxillary sinus and the perpendicular plate of the palatine bone were carefully drilled away, revealing the anterior edge of the PPF periosteal sac. The sphenoid process of the palatine bone was removed, exposing the pharyngeal artery and vidian nerve within their canal. By removing the orbital process of the palatine bone the opening of the infraorbital fissure and the OPS ligament were unveiled. While maintaining the integrity of the OPS ligament, an average inferior displacement of the PPF by 5 mm (2-7 mm) was recorded. After incising the OPS ligament, an average increase in inferior transposition by 7 mm (4-11 mm) was observed, with a total inferior transposition of 12 mm (6-15 mm). Upon achieving maximal inferior transposition, the superolateral portion of the BPP was drilled, accessing the superior aspect of the inferolateral recess of the sphenoid sinus (ILRS). Subsequently, the dissection progressed medially, maneuvering between the Eustachian tube cartilage and the PPF. Initially, the lateral transposition of the PPF content was carried out (average of 9 mm, range 6-15 mm). This was followed by the removal of the posterior half of the inferior turbinate and the decompression of the DPC, retaining only its posterior wall. This tactical maneuver resulted in an average increase of 11 mm (8-15 mm) in lateral transposition. Subsequent drilling facilitated the opening to the inferior part of the ILRS. Throughout all dissections, the vidian nerve, descending palatine bundle, infraorbital fissure neurovascular structures, and PPF content and its periosteal sac were meticulously preserved.

Conclusion
The EETPA with the preservation of PPF content emerges as a viable technique. The release of the OPS ligament and the decompression of the DPC yield significant advantages in effecting PPF transposition and facilitating the opening of the surgical pathway through the ILRS.

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Anatomical step-by-step dissection of complex skull base approaches for trainees: surgical anatomy of the microsurgical and endoscopic approaches to and through the orbit

Edoardo Agosti, MD[1,2,3], A. Yohan Alexander, BA[1,2,4], Luciano C. P. C. Leonel, PhD[1,2], Carlos Pinheiro-Neto, PhD, MD[1,2,5], Maria Peris-Celda, MD, PhD[1,2,5]

[1]Rhoton Neurosurgery and Otolaryngology Surgical Anatomy Program
[2]Department of Neurologic Surgery, Mayo Clinic, Rochester, Minnesota, United States of America
[3]Division of Neurosurgery, Department of Medical and Surgical Specialties, Radiological Sciences and Public Health, University of Brescia, Brescia, Italy.
[4]Medical School, University of Minnesota, Minneapolis, Minnesota, United States of America
[5]Department of Otolaryngology / Head and Neck Surgery, Mayo Clinic, Rochester, Minnesota, United States of America

Introduction
The orbit is a compact conical space containing a variety of complex neurovascular structures with intricate relationships to the intracranial compartment. Throughout the years, a multitude of surgical techniques have emerged to access the orbit, ranging from traditional orbitotomies and cranio-orbitotomies, to contemporary endoscopic transorbital (ETOAs) and endoscopic endonasal approaches (EEAs). In this study, our goal is to provide a didactic description of both microsurgical and endoscopic approaches to the orbit. These descriptions are presented in a step-by-step manner, anchored in anatomical foundations, and tailored for trainees in skull base surgery. Furthermore, clinical cases and indications are also presented.

Methods
Six formalin-fixed latex-injected cadaveric head specimens were dissected. In each specimen the following approaches were modularly performed: ETOAs, including preseptal lower eyelid approach, lateral cantotomy, precaruncular approach, and superior eyelid crease approach; EEAs, including EEA to the medial and inferior of the orbit and endoscopic endonasal optic canal decompression; Caldwell-Luc approach; orbitotomies and cranio-orbitotomies, including lateral cantotomy orbitotomy, supraorbital approach, fronto-orbital approach, and orbito-zygomatic approach. A 0-degree, 30-degree, and 45-degree endoscope (4 mm, 18 cm, Hopkins II, Karl Storz, Tuttlingen, Germany), attached to a high-definition camera were utilized for dissection. After each step was completed, the specimens were 3D photo documented.

Results
Endoscopic transorbital approaches provide a direct subperiosteal corridor along the orbital walls. Each approach is guided by distinct anatomical landmarks that are progressively identified, including the ethmoidal arteries, optic foramen, superior and inferior orbital fissures, and the meningo-orbital fold. By selectively drilling the orbital walls, it becomes possible to create openings towards the three cranial fossae and major extracranial regions. Endoscopic endonasal approaches grant accessible entry to the medial aspects of the orbital wall, apex, optical canal, and floor, offering advantages such as improved aesthetics and reduced external scarring, minimal displacement of orbital structures or extraocular muscle disinsertion, and enhanced visibility. The Caldwell-Luc approach harnesses the natural workable space of the maxillary sinus to access the orbit floor, utilizing the inferior and lateral rectus muscles for orientation in relation to the optic nerve. In contrast, orbitotomies and cranio-orbitotomies provide a direct and comprehensive view of the surgical field, facilitating precise manipulation and resection of orbital lesions. These approaches benefit from their well-established nature and clearly defined anatomical landmarks, empowering surgeons to navigate intricate neurovascular structures with heightened confidence.
Moreover, the adaptability of these methods allows for tailored adjustments to address diverse pathologies, ultimately fostering optimal surgical outcomes.

Conclusion
Considering the steep learning curve involved, this study aims to provide a succinct and instructive elucidation of the intricate surgical anatomy and fundamental procedural steps of the approaches to and through the orbit, along with their variants and applicable scenarios. The objective is to enhance the comprehension and learning journey for trainees specializing in skull base surgery.

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Cerebellar mutism syndrome following resection of posterior fossa tumor in pediatric patients: assessing pathophysiology, risk factors and neuroradiographic features

Monirah Zeya, Vikrant Setia, A. K. Srivastava, Anita Jagetia

Department of Neurosurgery, G.B. Pant Institute of Post Graduate Medical Education and Research, New Delhi

Background
Cerebellar mutism syndrome (CMS) is a post-operative syndrome of decreased speech seen in children, associated with neurobehavioral abnormalities the incidence of which may reach up to 40%.
Objectives
The aim of this study was to evaluate the pediatric patients with posterior fossa tumors for incidence, clinical characteristics, pathophysiology and risk factors and to assess the neuroradiographic features of this syndrome.
Methods
The study included 30 pediatric patients with a posterior fossa tumor who underwent surgery by telo-velar approach. Detailed pre and post operative clinical and radiological evaluation was done and patients with CMS were analyzed and compared with the patients without mutism to find risk factors for the CMS. The presentation and characteristics of CM were studied along with the following risk factors:

- Clinical – Age, sex, Cranial nerve deficit, Adjuvant treatment
- Radiological - Tumor location, hydrocephalus, brainstem invasion, extent of tumor resection, peduncular and brainstem edema, atrophy of post fossa structures
- Pathological - Histopathology of tumor
- The preoperative, immediate postoperative and 1-year postoperative imaging were reviewed to assess the neuroradiographic features in the two groups.

Results
The incidence of this syndrome was 20% (n=6); among the 30 children undergoing resection of posterior fossa tumors and 30% among the 20 treated for vermian or vermian lesions with lateral extension. The mutism was accompanied in majority with some degree of neurobehavioral abnormalities (p value = 0.05). The most significant finding was the presence in all cases of a period of cerebellar dysarthria after resolution of the muteness (p value <0.001). Brainstem and related structures involvement was the most significant risk factor (p value = 0.03) and so is medulloblastoma histology (p value = 0.04). Presence of brainstem and peduncular edema in immediate postoperative period (p value = 0.04) and gross atrophy of posterior fossa structures at 1 year (p value = 0.01) showed significance towards development of CMS. There was delayed neurological recovery in patients with CMS with poor Glasgow Outcome Score at 1 year of follow up.
Conclusion
The clinical presentation of this syndrome in context with neuroradiographic features suggest that this syndrome results from transient impairment of the afferent and/or efferent pathways of the dentate nuclei that are involved in initiating complex volitional movements. Advanced imaging techniques can be used to identify possible preoperative risk factors. High-risk patients can be recognized- proper counseling of the caregivers -potential sequelae, outcome. Periodical neurocognitive assessments of such patients especially of younger age, with malignancy, and potentiality for radiation therapy should be considered. This study demonstrates that CMS is associated with brainstem involvement of the tumor. It is emphasized that the overall cognitive outcome of this syndrome is not as favorable as previously thought.

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Carotid Endarterectomy as a feasible alternative to Stenting for Carotid artery stenosis

Rahul Zamad

Consultant Neurosurgeon, Wockhardt Hospital, Nagpur, India

Aim
To present Carotid endarterectomy as a safe and effective procedure for carotid stenosis and a feasible alternative to carotid stenting.
Methods
We are presenting two cases of carotid stenosis, one unilateral and another bilateral. A 70-year-old male patient who presented with multiple episodes of sudden loss of consciousness with no neurological deficit who was evaluated and had left CCA and ICA stenosis with good cross flow on DSA. The second 68-year-old gentle man had clumsiness over his left upper limb, and the rest of the neurological exam was within normal limits. His DSA showed bilateral severe carotid stenosis and had a failed carotid stenting attempt. Pre-op MRI of both patients did not show any significant diffusion restriction. They underwent Left and right carotid endarterectomy, respectively. Postoperatively, the first patient did well, while the other one had some residual weakness. On follow up both did well, with the second one recovering with an area of diffusion restriction on MRI.
Conclusion
Carotid endarterectomy is usually performed for stenosis of more than 70 percent or more in symptomatic patients when medical therapy like blood thinners fails. Patients usually present with episodes of transient ischemic attacks. The procedure significantly reduces the risk of a stroke and periprocedural stroke rates are less as compared to carotid stenosis in patients more than 70 years of age.
Carotid endarterectomy is the gold standard for patients with carotid stenosis and literature supports that it can be performed safely in patients above 70 years of age as a first line of treatment or in those who have a failed carotid stenting attempt. Also, patients with poor generalized conditions not fit for general anesthesia can be offered carotid endarterectomy done under local anesthesia.

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Pediatric multiple intracranial hydatid surgery and unexpected complication

Rahul Zamad

Wockhardt Hospital, Nagpur, India

Hydatid cysts commonly affect the liver and lungs but may affect the brain in rare cases. Not very often that we see hydatid brain cyst nowadays. We report a case of 7-year-old child with history of headache for one and half years, recent onset weakness over left upper and lower limbs, which progressed slowly, and the family members noticed an abnormal increase in the size of the head over the last 1 year. Her clinical exam revealed subtle weakness over the left side and no other significant deficit. CECT head was performed which showed multiple intracranial SOL largest of size 12x15 cm occupying right parieto-occipital region with significant midline shift toward left. She underwent right FTP parge craniotomy followed by excision of the large cystic lesion without rupture using hydro dissection (Dowlings technique) followed by removal of daughter cyst which were 3 in number. Postoperatively, she was continued on anthelminthic medication and antiepileptic and was discharged on POD 5.
She was asked to follow up after a week but lost to follow up and presented after 45 days with history of severe headache, altered sensorium and 2 to 3 episodes of vomiting. Urgent NCCT head was performed which showed large left sub-dural hematoma with mass effect. SDH was drained by single frontal and 2 parietal burr holes following which she did well. She was continued on Albendazole for 6 months post-op. She was followed up with scans at 6 months and 1 year with no recurrence of the disease. Post op development of the child was unaffected.
Retrospectively analyzing the case it was inferred that probably sudden decompression by removal of such a large mass lead to unexpected complication of subdural hematoma which was managed by another surgical intervention and a lesson learned.

This case has been published in International Journal of Current Sciences.

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Predicting pituitary adenoma consistency using radiomic data mining and machine learning on T2-weighted MRI: A multicenter retrospective study

Edoardo Agosti, MD,[1,2,3], A. Yohan Alexander, BA,[1,2,4], Luciano C. P. C. Leonel, PhD,[1,2], Carlos Pinheiro-Neto, PhD, MD[1,2,5], Maria Peris-Celda, MD, PhD[1,2,5]

[1]Division of Neurosurgery, Department of Medical and Surgical Specialties, Radiological Sciences and Public Health, University of Brescia, Brescia, Italy.
[2]Department of Advanced Biomedical Sciences, University of Naples "Federico II", Via Sergio Pansini 5, 80131 Naples, Italy.
[3]Department of Clinical Medicine and Surgery, University of Naples "Federico II", Naples, Italy.
[4]Unit of Otorhinolaryngology - Head and Neck Surgery, ASST Spedali Civili, Department of Surgical and Medical Specialties, Radiological Sciences, and Public Health, University of Brescia, School of Medicine, Brescia, Italy.
[5]Unit of Neurosurgery, ARNAS Ospedale Civico of Palermo, Palermo, Italy.
[6]Unit of Neurosurgery, Ospedale Ca' Foncello, Treviso, Italy.
[7]Division of Neurosurgery, Department of Neurosciences, Reproductive and dontostomatological Sciences, Università degli Studi di Napoli Federico II, Naples, Italy.
[8]Division of Neurological Surgery, Department of Biotechnology and Life Sciences, University of Insubria-Varese, ASST Sette Laghi, Ospedale di Circolo e Fondazione Macchi, Varese, Italy.

Introduction
The ease of removing a pituitary adenoma (PA) during surgery, particularly with a transsphenoidal approach, can be affected by the tumor's consistency. Standard qualitative magnetic resonance imaging (MRI) does not allow for the assessment of this consistency. However, radiomic texture analysis may provide quantitative tissue characteristics. This study aimed to assess the accuracy of using texture analysis along with machine learning techniques for the preoperative evaluation of PA consistency in patients scheduled for endonasal endoscopic surgery.
Methods
Data from patients with PA who underwent transsphenoidal surgery at the centers in Brescia, Naples, Varese, and Treviso were retrospectively reviewed. Pituitary adenomas (PAs) were classified based on intraoperative findings as soft, fibrous, or mixed (if they exhibited characteristics of both). Specifically, PAs that could be easily removed using standard maneuvers like curettage and suction were defined as soft. Those that were more resistant, difficult to remove, and required more complex procedures such as extracapsular dissection have been classified as fibrous. All patients underwent MRI exams either on a 1.5 or 3 T MR scanner. The imaging protocol always included a coronal T2-weighted Turbo Spin Echo sequence. Manual segmentation was performed with ITK-Snap software on T2-weighted sequence. After manual segmentation, radiomic texture features were extracted from the original and filtered MRI images. Stability analysis of features and multi-stage feature selection were performed. After oversampling to balance the classes, 80% of the data was used for hyperparameter optimization through 5-fold stratified cross-validation, while a 20% hold-out set was used for final testing, employing an Extra Trees ensemble meta-algorithm. The reference standard was based on surgical outcomes.
Results
A total of 400 patients were collected, of with 210 had a soft PA, 152 a mixed PA, and 38 a fibrous PA. A total of 1003 texture features were extracted, of which 678 were stable. After removing low-variance parameters (n=5) and highly intercorrelated features (n=591), recursive feature elimination identified a subset of 13 features. After hyperparameter tuning, the Extra Trees classifier achieved an accuracy of 94%, sensitivity of 100%, and specificity of 88%. The area under the receiver operating characteristic curve and precision-recall curves was 0.99.
Conclusion
The machine learning model, trained on radiomic features from T2-weighted MRI, can efficiently aid in distinguishing between soft and fibrous PAs preoperatively. Consequently, with further development and validation on larger datasets, this tool could be highly beneficial for pre-surgical planning in these patients.

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Deep learning for automatic segmentation of pituitary adenomas using narrow band imaging: Preliminary experience in a clinical perspective

Edoardo Agosti[1], Paderno Alberto[2], Andrea Pagnoni[1], Vittorio Rampinelli[3], Pier Paolo Panciani[1], Alessandro Fiorindi[1], Cesare Piazza[3], Marco Maria Fontanella[1]

[1]Division of Neurosurgery, Department of Medical and Surgical Specialties, Radiological Sciences and Public Health, University of Brescia, Brescia, Italy
[2]Unit of Otorhinolaryngology, Humanitas University, Rozzano, Italy
[3]Unit of Otorhinolaryngology - Head and Neck Surgery, ASST Spedali Civili, Department of Surgical and Medical Specialties, Radiological Sciences, and Public Health, University of Brescia, School of Medicine, Brescia, Italy

Introduction
Fully convolutional neural networks (FCNNs) applied to video analysis are of particular interest in the field of head and neck oncology. The application of video analysis to diagnostic endoscopy has been termed 'Videomics'. Recently, videomics has also been applied to endonasal endoscopy, but to our knowledge, no study has validated the possible role, advantages, and limitations of videomics in the intraoperative recognition of pituitary adenomas (PAs). The aim of this study was to test methods based on FCNNs for the semantic segmentation of PAs.
Methods
A dataset was retrieved from the institutional registry of a tertiary academic hospital. The inclusion criteria were adult patients with PA, who underwent endoscopic endonasal surgery for the first time with narrow band imaging (NBI) endoscopic videos recording. Three FCNNs (U Net, U-Net 3, and ResNet) were studied for segmenting the PA images. The performance of the FCNNs was evaluated for each network tested and compared with the gold standard, represented by manual annotation performed by expert physicians.
Results
A total of 20 Narrow Band Imaging endoscopic videos of PAs surgery has been analyzed. For each 35 frames were manually selected by two authors. Finally, the dataset consisted of 700 frames. The best results in terms of the Dice similarity coefficient (Dsc) were obtained by ResNet with 5 blocks (× 2) and 16 filters, with an average value of 0.6559. All tested FCNNs exhibited very high variance values, leading to very low minimum values for all evaluated parameters.
Conclusion
FCNNs show promising potential in the analysis and segmentation of video endoscopic images of PAs. All tested FCNN architectures demonstrated satisfactory results in terms of diagnostic accuracy. The inference time of the processing networks was particularly short, ranging from 14 to 115 ms, thus showing the possibility of real-time application.

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Endoscopic-assisted anterior petrosectomy for a recurrent petrous chondrosarcoma in Ollier disease

Edoardo Agosti[1,2], Michelle Grouls[2,3], Tingting Jiang[2,4], Dimitris Charitos[2], Jerold Justo[2], Thibault Passeri[2,5], Emmanuel Mandonnet[2,5], Sebastien Froelich[2,5]

[1]Division of Neurosurgery, Department of Medical and Surgical Specialties, Radiological Sciences and Public Health, University of Brescia, Brescia, Italy
[2]Laboratory of experimental neurosurgery and skull base, Lariboisière Hospital, Assistance Publique - Hôpitaux de Paris, University of Paris-Cité, 2 rue Ambroise Pare, 75010, Paris, France
[3]Department of Neurosurgery, University Medical Center Utrecht, Utrecht, the Netherlands
[4]Department of Neurosurgery, Sapienza University of Rome, Rome, Italy
5Department of Neurosurgery, Lariboisière Hospital, Assistance Publique - Hôpitaux de Paris, University of Paris-Cité, 2 rue Ambroise Pare, 75010, Paris, France

Petrous apex chondrosarcomas can be approached through transcranial or endoscopic endonasal approaches. The choice of the approach depends on tumor size and extent of the lesion. In this video we present a case of a 13-year-old female with an incidentally found petrous chondrosarcoma. Conservative management was initially attempted, but due to progressive symptoms and significant tumor growth, surgical removal through an endoscopic-assisted anterior petrosectomy was planned. Gross total resection of the lesion was achieved.

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Problem-based neuroanatomy of the cranial nerves

Carolina Martins, João Gonçalves Silva, Leíla Ferraz, Maysa Matos, Maria Clara Santiago Moreira, Antonio Cavalcanti de A. Martins

Federal University of Pernambuco - UFPE, Recife, Brazil
Medical School of Pernambuco - FPS, Recife, Brazil

Introduction
Neuroanatomy taught at Medical School needs to be clinically meaningful and guide future acquisition of knowledge that is significant to diagnosing and treating patients. Problem-based anatomy has been used to help bridge the gap between knowledge acquired in the anatomy lab and the requirements needed to daily medical practice.
Objective
This study evaluates the inception of data from an Anatomage© Table 10.0 combined with microsurgical dissection of cadaveric human injected specimens, acquired in 2D and 3D, as an auxiliary to the acquisition of the anatomical milestones required for the anatomy of the cranial nerves for graduation and post-graduation medical students.
Methods
The study was conducted at Medical School of Pernambuco, Brazil. The Anatomage© Table 10.0 was browsed for clinical cases, whose images would illustrate potential or overt pathological involvement of at least one segment of a cranial nerve. Each case was combined with microsurgical anatomy of the region to build an independent, question-lead, educational content, clarifying the anatomical milestones required to interpret, evaluate and treat similar patients.
Results
Seventeen illustrative clinical cases were selected for this purpose among 52 in-built cases at this version of the tridimensional anatomical table. The inclusion of clinical cases brought a new appeal for the cranial nerve content, since it could be included both at graduation or post-graduation levels. Beyond signaling the continuous, individual process of learning anatomy, it also offers support beyond the lab walls, for the student on his/her learning journey.
Conclusion
This study displays the potential of technological tools, when combined with other resources – namely microsurgical dissections – to allow for creation of new and clinically significant learning resources.
Keywords
Cranial Nerves, Medical Schools, Neuroanatomy

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What happens to the hippocampus during uncal herniation?

Carolina Martins, Pedro Luna Carvalho, Luiza de Sá Araújo, João V. Melo, Antonio Cavalcanti de A. Cavalcanti

Federal University of Pernambuco - UFPE, Recife, Brazil
Medical School of Pernambuco - FPS, Recife, Brazil

Introduction
Uncal herniation is a well-known epiphenomenon related to unchecked intracranial hypertension and associated with at least three well-defined neurological syndromes. Because of its clinical importance, it is an obligatory part of the curriculum for medical students. Besides, uncal herniation can be the main cause or an associated phenomenon, present at the moment of death. The tentorial notch marking is therefore a common finding that remains engraved into postmortem brain specimens.
Objective
This study describes the hippocampus anatomy using microsurgical anatomical and Anatomage© 10.0 data, evaluating the peri-mortem effects of uncal herniation.
Methods
Anatomage© Table 10.0, a technological tool for anatomy learning, provides an interface for students to interact with digitized data from human cadaveric donors.
Results
The brains of five cadaveric donors included at Anatomage© version 10.0 presented unilateral or bilateral signs of uncal herniation. The volume of tissue herniated related inversely with the age of the donor, possibly pointing to atrophic brain changes related to age, but also to the pathology that led to death. Anatomage© 10.0 allows layers of anatomical structures to be peeled away, highlighting relationships between uncal herniation and the hippocampus.
Conclusions
Although the hippocampus is expected to be affected during uncal herniation, it is infrequent for a medical student to reach this understanding while studying the anatomy of the limbic system. By using the Anatomage© 10.0 not only can this realization be expedited, but the regional anatomy can be explored. In order for the student to describe what they are seeing, a more detailed anatomical terminology becomes a necessity, fostering a better, deeper and clinically meaningful understanding of this area of the brain.
Keywords
Brain, Humans, Hippocampus, Limbic Lobe, Intracranial Hypertension

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Nucleus accumbens: Visiting the reward system of the brain during medical graduation

Carolina Martins, Vitor Julio L. Silva, Heitor Ian B. Medeiros, Bruna A. Nunes, Júlia L. Friedheim, Matheus P. Regueira, Antonio Cavalcanti de A. Martins

Federal University of Pernambuco - UFPE - Recife, Brazil
Medical School of Pernambuco -FPS - Recife-Brazil

Introduction
The nucleus accumbens, part of the ventral striatum, is crucial for understanding conditions like Tourette syndrome, addiction, and obsessive-compulsive disorders. However, it's often overlooked in the medical curriculum, which usually focuses more broadly on the basal nuclei.The basal nuclei are traditionally an anatomical subject whose study is made difficult by the limited number of plastinated specimens, the lack of durability of non-plastined prosections and the limited anatomical precision of more durable anatomical models commercially available.
Objective
The authors set out to investigate the ability to - combining microsurgical anatomy of cadaveric specimens and Anatomage© 10.0 data - create an anatomical module which includes the nucleus accumbens into the medical course anatomy curriculum.
Methods
Anatomage© Table 10.0 is a technological tool devised to help the anatomy learning process by providing an interface through which students can interact with digitalized data from human cadaveric donors.
The image sets acquired from donor's and available at this version were browsed for the ability to identify the nucleus accumbens and relate it to readily recognizable anatomical landmarks in prosections and anatomical models, in an attempt at verifying the complementarity and possible transfer of knowledge from one didactical medium to another.Anatomage© Table 10.0 enhances anatomy learning by providing interactive digitalized data from human cadaveric donors.
Results
The anatomy of the septal area was evaluated in five cadaveric donors using Anatomage© Table 10.0. This data was combined with 2D and 3D images obtained during microsurgical dissection of silicone-colored, human cadaveric heads. Because Anatomage 10.0 allows peeling layers of anatomical structures it relates to the "see-through" concept of neuroanatomical learning adopted by Rhoton microsurgical anatomy school.
Conclusion
Integrating anatomical data with images from Anatomage© 10.0 awareness about the ventral striatum, specifically the nucleus accumbens, can be elicited in medical students.
Keywords
Anatomy, Basal Ganglia, Humans, Medical Students, Ventral Striatum

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Bony bridges between the occipital bone and atlas: Expanded understanding through injected cadaveric regional anatomy

Carolina Martins, Luis FP Tabarelli, Antonio CA Martins, Marcelo M Valença, Hung T Wen, Albert Rhoton Jr.[In Memoriam]

Federal University of Pernambuco - UFPE, Recife, Brazil
Medical School of Pernambuco - FPS, Recife, Brazil
University of Sao Paulo, Sao Paulo, Sao Paulo, Brazil
University of Florida, Gainesville, US

Introduction
Fibrous or bony bridges connecting the occipital bone and the atlas, surrounding the horizontal, V3 segment of the vertebral artery, have been documented since 1959. The estimated prevalence varies from 7.4-21% for its complete form, to 2-60% for its incomplete form. The origins of these osseous formations are still unclear, as well as its functional impacts. Clinically, bony bridges are often found in asymptomatic patients but have been associated with symptoms such as headache, cervical pain, vertigo, and more. These symptoms may arise from compression of the vertebral artery and venous plexus, or irritation of surrounding nerves, indicating the need for careful consideration of the regional anatomy in their understanding and management.
Objective
This study examines the anatomical and morphological characteristics of these bony bridges and presents regional dissections of silicone-injected human cadaveric specimens, to enhance our understanding of the anatomical features playing a role in such cases.
Methods
The suboccipital region of ten adult, silicone-injected cadaveric specimens were dissected, using the surgical microscope (Zeiss Inc., US) and endoscope (Karl Storz Co., DE).
Results and Discussion
A combination of fibrous and osseous bony bridges could be found on both sides, in two specimens dissected. These bony bridges showed remarkably different morphology. While in one specimen it seemed related to the lips of the atlanto-occipital joint, in the other it followed the lateral edge of the atlanto-occipital membrane. In both cases, the bridges seemed a progressive, degenerative process, which reached different degrees on each side, although initiated in different structures. While one could be classified as a posteriorly limited ring, linking the atlanto-occipital joint to the lip of the vertebral sulcus on the posterior arch of atlas, the other span the posterior and lateral areas of C1. Bony bridges on the atlas have traditionally been classified as incomplete or complete, depending on the extent of ossification. However, our dissections show that although fibrous bridges may exert similar effects in the surrounding structures, the fact that they cannot be readily seen in radiological examinations, makes likely that prevalences derived from such studies are underestimated. Furthermore, the intricate venous anatomy comprising the vertebral and jugular venous plexus, their connections and distant effects caused by congestion, as well as the connections between the suboccipital and the accessory nerves may justify symptoms that have traditionally defied explanation.
Conclusion
Bony bridges are complex entities that most likely impact regional anatomical structures – particularly in dynamic situations – requiring reassessment of the microsurgical anatomy involved in the area.
Keywords
Osseous bridges, Occipital bone, Atlanto-Occipital Joint, Craniocervical Junction

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A handy tool to teach microneurosurgical anatomy of the uncus

Carolina Martins, Vicent Quilis Quesada, Antonio Cavalcanti de A. Martins, Hung Tzu Wen

Federal University of Pernambuco, Recife, Pernambuco, Brazil
Medical School of Pernambuco, Recife, Pernambuco, Brazil
University of Sao Paulo, Sao Paulo, Sao Paulo, Brazil
University of Valencia, Valencia-Spain

Introduction
Detailed anatomical knowledge of the parahippocampal gyrus and uncus is paramount to neurosurgeons. It allows adequate analysis and interpretation of neuroimaging data and safe and accurate performance of neurosurgical resections in the mesial temporal area. It is a requirement for neurosurgeons to stay updated with the many advances concerning this area and be able to communicate with other specialists in associated fields of knowledge. Mesial temporal and limbic anatomy are an integral part of microneurosurgical anatomy curriculum for neurosurgical residents and explored in theoretical as well as the theoretical-practical courses using microsurgical dissections of cadaveric brains around the world. It is intricate, detailed anatomy and several tools have been used to ease the learning curve on this subject. These include from sequential projection of 2D and 3D images depicting the stepwise dissection of this area in injected human cadaveric specimens, up to the actual performance of a guided dissection under the microsurgical microscope.
Objective
This study presents a low technological mnemonic to teach uncal anatomy.
Methodology
Holding the right hand with fingers and wrist flexed a resemblance of the uncal morphology can be appreciated.
Results
The index and second fingers represent the two gyri on the anterior surface of the uncus. The index resembles the ambiens gyri, the second finger stands for the semilunar gyrus, while the space between them accounts for the semiannular sulcus. The three following fingers represent the uncal external digitations seen once the parahippocampal lip is removed, following the uncal notch. The middle finger is the uncinated gyrus, the two phalanx standing for the squares this gyrus usually presents. The annular finger, with its interphalangeal joint, standing out the most represents the alignment of the band of Giacomini and the uncal apex, while its tip, pointing to the palmaris longus tendon, stands for its continuation with the dentate margin of the dentate gyrus. The pinky finger represents the intralimbic gyrus. The radial border of the flexed arm represents the fimbria of fornix, above which opens the choroidal fissure. The ulnar border of the arm, and the round aspect it assumes when the arm is flexed, stand for the subiculum of the parahipocampal gyrus. The sulci and gyri of the uncus are located over its anterior and posterior surfaces. While the ones located on the anterior surface of the uncus are related to the amygdala and readily seen when facing this region in an anatomical specimen, the posterior ones are partially covered by the inferior surface of the parahippocampal gyrus that extends inferiorly from the uncal notch and represent the external hippocampal digitations of the pes hippocampi.
Conclusion
Low technological mnemonics have proved useful to teach complex anatomy to surgical residents and medical students. It is a “handy”, portable reminder of the milestone required and a tool welcomed, readily understood, and repeated by trainees during our courses worldwide.
Keywords
Limbic lobe, Medial Temporal Lobe, Hippocampus, Amygdala

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Rhotonian microsurgical anatomy and headache: Revisiting anatomy to understand symptoms and improve procedures

Marcelo Moraes Valença, Antonio Cavalcanti de A. Martins, Juliana Ramos de Andrade, Carolina Martins

Federal University of Pernambuco - UFPE, Recife, Brazil
Medical School of Pernambuco - FPS, Recife, Brazil
Advances in Science LTDA, Brazil
Homo Docens LTDA, Recife, Brazil
Brazilian Headache Society, Brazil

Introduction
The study of headache disorders is a vast subespecialty in Neurology. Although it is mostly based in pharmacological treatments, interventional procedures have increasingly been used for both diagnosis and treatment in selected cases. Following Prof. Rhoton´s motto, The International Rhoton Society (iRS) mission states "we study microsurgical anatomy to make what is a delicate, fateful and awesome experience for our patients, more accurate, gentle and safe". This study presents the application of iRS mission to the field of headache management.
Objective
To describe the creation and implementation of the course Rhotonian Anatomy and Headaches, its rationale, contents and initial experiences with local, national and international audiences.
Methods
The core content of this course is the result of the combined experience in basic sciences, semiology, neurology, neurosurgery and applied anatomy of the authors. The contents have been divided into three parts, covering the main systems involved in headache origin: i) Cervical Plexuses System, ii) Trigeminal System, and iii) Intermedius System. Each of these modules comprises a 4-6h combination of microneuroanatomy in 2D and 3D, clinical and surgical application of knowledge, practical session and gamification.
Results
The implementation phase started with a pre-session for each module, to verify and align each author´s contribution in a coherent didactical module, test time allocation and check on material demands, and were followed by program adjustments. A soft-opening schedule for each module was then undertaken, using local groups, no larger than 12 participants. These groups included graduation and postgraduation students and professionals of several backgrounds including basic science research, physiotherapy, nursing, social assistants, and medicine. Doctors from different practices, including internal medicine, neurology and neurosurgery composed these groups. Previous knowledge of the content was on average 42%, and post course immediate retention was on average 81%. Further refinements were integrated, and the core course content run within the frame of a national event (I Symposium of Interventionist Management of Headaches) with an international participants, which expanded the previous participants to include odontologists, otorhinolaryngologists, radiologists, anesthesiologists and headache specialists, amounting to a group of 59 people and spanning three days as four sessions of five hours. Due to the success of this initial period and positive reviews received from international participants, the course is now under preparation to be presented in 3D format during the International Headache Society Congress, in 2025.
Conclusions
Detailed anatomical understanding is desirable in clinical as much as surgical fields and needs to be revisited every time basic science, technology or clinical understanding of a disease process progresses in order to ground established practices and allow for further improvement. Headache management is but one example of a field of knowledge that benefits from iRS mission.
Keywords
Applied Anatomy, Gamification, Neurology, Neurosurgery

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3D evaluation of the sylvian cistern: volume, dimensions, and surface area in healthy adults

Marcelo M. Valença, Florisvaldo José Morais Vasconcelos Junior, Ronaldo Lessa, Carolina Martins

Federal University of Pernambuco, Recife, Pernambuco, Brazil

Introduction
One of the primary corridors for intracranial access to the skull base is through the lateral sulcus, also known as the sylvian fissure. Surprisingly, there needs to be more research on the three-dimensional representation of this cistern, including its various surfaces and boundaries. Important arterial and venous vascular structures are located within this cistern, and a significant portion of the cerebral cortex serves as its boundary, with regions considered eloquent due to their motor and language functions.
Objective
To evaluate the sylvian cistern in 3D, examining its volume, diameters, and external surface area, and to compare these parameters between the right and left sides in healthy adults.
Methods
We used the Slice-3D software to assess the cisterns in MRI images of healthy adults who underwent scans to investigate primary headaches. A neuroradiologist confirmed the images were normal for the participants' age group. The study population consisted of 5 women and 5 men. The ethics committee approved the study.
Results
The volume (cm^3) of the right Sylvian cistern was 10.4 ± 0.3 (min 16.7 – max 17.3) in women and 12.1 ± 0.8 (min 10.3 – max 12.8) in men (p=0.183). There was no statistically significant difference between the right and left sides (p=0.348, paired t-test). The anteroposterior distance (cm) was 7.4 ± 0.4 (min 7.4 – max 7.9) vs. 8.4 ± 0.6 (min 7.7 – max 8.1) (p=0.013); mediolateral distance (cm) was 3.3 ± 0.2 (min 3.1 – max 3.5) vs. 3.8 ± 0.3 (min 3.4 – max 4.1) (p=0.005); superoinferior distance (cm) was 4.3 ± 0.2 (min 3.9 – max 4.5) vs. 4.4 ± 0.6 (min 3.7 – max 5.0) (p=0.749); and the external surface area (cm^2) was 88.9 ± 5.0 (min 83.1 – max 95.6) vs. 102.4 ± 8.6 (min 93.1 – max 112.5) (p=0.077) when comparing women to men.
Conclusion
Our findings reveal that the volume of the Sylvian cistern is similar between sexes. However, men have statistically larger anteroposterior and mediolateral distances, as well as a greater external surface area of the cistern. These results have significant implications for understanding the anatomical differences in the lateral sulcus cistern.
Keywords
Subarachnoid Cisterns, Microneurosurgery

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Development of retractors for cervical vagus nerve stimulation electrode placement in refractory epilepsy

Marcelo M. Valença[1], Luciana Patrízia A. Andrade-Valença[1], Martina Falcão Valença[2], Marcelo Andrade Valença[3], Carolina Martins[1]

[1]Federal University of Pernambuco, Recife, Pernambuco, Brazil
[2]Städtisches Klinikum Dresden, Dresden, Germany
[3]Serviço de Neurocirurgia, Hospital da Restauração, Recife, Pernambuco, Brazil

Introduction
The treatment of patients with epilepsy and frequent seizures is often refractory to pharmacotherapy. In such cases, continuous stimulation of the left cervical vagus nerve is an option to attenuate or even achieve complete control of epileptic seizures. This involves the implantation of helical electrodes to ensure optimal contact with the vagus nerve. However, placing these electrodes can be challenging due to the limited exposure of the nerve available to the surgeon, necessitating elevation of the vagus nerve to allow the electrode to pass underneath and wrap around it approximately three times. Many surgeons use cardiac tape to elevate the vagus nerve, but this occupies space, reduces the exposed area of the nerve for electrode placement, and interferes with surgical maneuvers needed to position the helical electrode properly.
Objective
Inspired by Professor Rhoton, who developed various surgical instruments, the aim of this study was to develop a pair of retractors (one for the distal portion and one for the proximal portion) to elevate the cervical vagus nerve.
Results
We developed a pair of retractors with hooks facing the surgeon that lift the nerve from below. Each hook is fixed to a vertical bar that connects at a 90-degree angle to another bar: the distal retractor's bar connects to the left of the surgeon, and the proximal retractor's bar connects to the right of the surgeon. The assistant operates these retractors with lifting, lowering, and lateral movements as needed to facilitate the surgeon's maneuvers.
Conclusion
These retractors significantly enhance the handling of the left cervical vagus nerve and the implantation of the helical electrodes, improving the overall surgical procedure.
Keywords
Microneurosurgery, Surgical Instruments, Vagal nerve

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Microsurgical anatomy of the superior sagittal sinus and draining veins

Mariano Anto Bruno J Mascarenhas, VG Ramesh, V Sundar, S Sundaram, JV Mahendran

Department of Neurosurgery, Madras Institute of Neurology, Madras Medical College and Rajiv Gandhi Government General Hospital, Chennai

Background
There are many anatomical and structural variations in superior sagittal sinus and draining veins which are of clinical and neurosurgical significance.
Aim
To study in cadavers, the variations in microsurgical anatomy of the Superior Sagittal Sinus and Draining Veins in Indian population.
Settings and Design
This study is based on dissection of fresh cadavers.
Methods and Material
57 fresh cadavers of both sexes were examined in autopsy theatre of the Institute of forensic medicine, Madras Medical College and Government General Hospital, Chennai between March 2011 to February 2013. Analysis in Epi-Info, MS-Excel.
Results and Conclusions
1. Superior Sagittal Sinus can be found up to 1 cm away on either side of the sagittal suture
2. The origin of the superior sagittal sinus may be at the level of foramen caecum or posterior to it.
3. The total length of the sinus varied from 321mm to 356.8mm with mean total length was 338.79mm
4. It was found that the cross section at the level of lambdoid suture was always greater than the cross section at the level of coronal suture and the flow was always towards posterior in all the 57 cases
5. Vertical Compartments of the sinus was found in three fourth of the cases studied
6. The total Number of tributaries on the right side varied from 14 to 19, while on the left side, it varied from 13 to 18
7. All cadavers studied had herringbone pattern (or dicot root pattern) like that of the duct system of pancreas
8. On both sides, the most common location for the largest draining vein is the Central Sulcus
9. The largest draining vein was found, at an average of 53.7 mm posterior to the Coronal Suture and 126.9 mm anterior to the Lambdoid Suture on the Right side and 54.1 mm posterior to the Coronal suture and 126.5 mm anterior to the Lambdoid suture on the Left side
10. In 41 cases (71.9 %) the sinus drained predominantly to Right Transverse Sinus
11. Position of Torcula was not exactly at the level of EOP. Position of torcula was variable; and more to the right and at a higher level in most cases 12. The Central Sulcus was found, at an average of 49.97 mm posterior to the Coronal Suture and 130.67 mm anterior to the Lambdoid Suture on the Right side and 49.99 mm posterior to the Coronal suture and 130.65 mm anterior to the Lambdoid suture on the Left side.

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Petrous chondrosarcoma: Surgical nuances and their management

Ashish Sharma, Anil Sharma

Department of Neurosurgery, All India Institute of Medical Sciences, Raipur, Chhatisgarh, India

Objectives
To evaluate clinical features and surgical nuances in the management of petrous chondrosarcoma
Methods
We had seen three patients of petrous chondrosarcoma. All patients were females, 22, 12 and 46 years, respectively. In first patient, there was extra-axial lobulated mass lesion with expansion of left meckel's cave and displacing the left temporal lobe and extending posteriorly with infiltration of petrous and extending in perimesencephalic cistern with shifting of brainstem posteriorly. Interval surgery was done, first posterior part was decompressed followed by extradural subtemporal approach and excision of lesion. Second patient had infiltrative lesion of retrolabyrinthine part of right petrous bone. Third patient had expansile lesion of posterior petrous bone. All patients histopathology suggestive of chondrosarcoma.
Results
The first patient had no new neural deficits, on 18 months follow up. Second patient, had grade 2 right sided facial weakness, same as preop. Third patient, had small residual lesion and follow-up with Radiation Oncology. On histopathology, all patient had chondrosarcoma of classical type.
Conclusions
Chondrosarcoma of the skull base is an rare abnormally malignant mesenchymal tumour. Surgical approach, grade of resection, aiming for maximal tumour resection with functional preservation must be adapted specifically for each patient, taking into account the surgical team expertise and preferences. Best approach consists of maximum safe resection followed by radiotherapy based on histological pattern, with focus on patient's quality of life and neurological function preservation.

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Quantitative analysis of the Kawase *versus* the modified Dolenc-Kawase approach for middle cranial fossa lesions with variable anteroposterior extension

Manjul Tripathi, Ashish Suri

Object
The surgical corridor to the upper third of the clivus and ventral brainstem is hindered by critical neurovascular structures, such as the cavernous sinus, petrous apex, and tentorium. The traditional Kawase approach provides a 10X5–mm fenestration at the petrous apex of the temporal bone between the 5th cranial nerve and internal auditory canal. Due to interindividual variability, sometimes this area proves to be insufficient as a corridor to the posterior cranial fossa. The authors describe a modification to the technique of the extradural anterior petrosectomy consisting of additional transcavernous exploration and medial mobilization of the cisternal component of the trigeminal nerve. This approach is termed the modified Dolenc-Kawase (MDK) approach.
Methods
The authors describe a volumetric analysis of temporal bones with 3D laser scanning of dry and drilled bones for respective triangles and rhomboid areas, and they compare the difference of exposure with traditional versus modified approaches on cadaver dissection. Twelve dry temporal bones were laser scanned, and mesh-based volumetric analysis was done followed by drilling of the Kawase triangle and MDK rhomboid. Five cadaveric heads were drilled on alternate sides with both approaches for evaluation of the area exposed, surgical freedom, and angle of approach.
Results
The MDK approach provides an approximately 1.5 times larger area and 2.0 times greater volume of bone at the anterior petrous apex compared with the Kawase's approach. Cadaver dissection objectified the technical feasibility of the MDK approach, providing nearly 1.5–2 times larger fenestration with improved view and angulation to the posterior cranial fossa. Practical application in 6 patients with different lesions proves clinical applicability of the MDK approach.
Conclusions
The larger fenestration at the petrous apex achieved with the MDK approach provides greater surgical freedom at the Dorello canal, gasserian ganglion, and prepontine area and better anteroposterior angulation than the traditional Kawase approach. Additional anterior clinoidectomy and transcavernous exposure helps in dealing with basilar artery aneurysms.

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Quantitative analysis of variable extent of anterior clinoidectomy with intradural and extradural approaches: 3-Dimensional analysis and cadaver dissection

Manjul Tripathi, Ashish Suri, Rama Chandra Deo

Background
Drilling of the anterior clinoid process (ACP) is an integral component of surgical approaches for central and paracentral skull base lesions. The technique to drill ACP has evolved from pure intradural to extradural and combined techniques.
Objective
To describe the computerized morphometric evaluation of exposure of optic nerve and internal carotid artery with proposed tailored intradural (IDAC) and complete extradural (EDAC) anterior clinoidectomy.
Methods
We describe a morphometric subdivision of ACP into 4 quadrangles and 1 triangle on the basis of fixed bony landmarks. Computerized volumetric analysis with 3- dimensional laser scanning of dry-drilled bones for respective tailored IDAC and EDAC was performed. Both approaches were compared for the area and length of the optic nerve and internal carotid artery. Five cadaver heads were dissected on alternate sides with intradural and extradural techniques to evaluate exposure, surgical freedom, and angulation of approach.
Results
Complete anterior clinoidectomy provides a 2.5-times larger area and 2.7- times larger volume of ACP. Complete clinoidectomy deroofed the optic nerve to an equal extent as by proposed the partial tailored clinoidectomy approach. Tailored IDAC exposes only the distal dural ring, whereas complete EDAC exposes both the proximal and distal dural rings with complete exposure of the carotid cave.
Conclusion
Quantitative comparative evaluation provides details of exposure and surgical ease with both techniques. We promote hybrid/EDAC technique for vascular pathologies because of better anatomic orientation. Extradural clinoidectomy is the preferred technique for midline cranial neoplasia. An awareness of different variations of clinoidectomy can prevent dependency on any particular approach and facilitate flex- ibility.

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Extramedullary hematopoiesis: A rare cause of spinal cord compression in a patient with thallasemia

Dr Souryav Sankar Mondal

Consultant Neurosurgeon,Institute of Neurosciences, Kolkata, India.

Background
Extramedullary hematopoiesis is a physiological process secondary to chronic anemia. Extramedullary hematopoiesis refers to formation of red blood cells outside bone marrow. It is common in spleen, liver and kidney. Rarely the spinal epidural space may be involved.
Methods
54 year old male patient, known case of thallasemia intermedia with h/o splenectomy presented with both lower limb weakness and difficult in passing urine since 2 months. On examination he had spasticity in lower limbs with both lower limb power of 0/5. Sensory loss was found below D6 and both knee and ankle jerks were exaggerated. Babinski were extensor on both sides.
Results
Mri revealed multiple T2 hypointense extradural lobulated lesions in posterior aspect of spinal canal from D4-D8 causing spinal cord compression. The patient underwent D4-D8 laminectomy and excision of lesion. Histopathology report was suggestive of extramedullary haematopoietic tissue.
Conclusion
Extramedullary hematopoiesis is a rare cause of spinal cord compression and should be considered in differential diagnosis, especially in patients with chronic anemia such as thallasemia.

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A giant sacrococcygeal chordoma: A case report

Sajag Kumar Gupta

Sacrococcygeal chordoma is an uncommon, malignant bone tumor. Despite the presence of strong membranes such as the periosteum and presacral fascia (which prevent tumor transgression), chordoma typically invades the rectal wall. The severe issue with these tumors is their late diagnosis and high chance of enlargement. The primary treatment options for this tumour are surgical excision, radiation, and chemotherapy. Because of the tumor's proximity to vital organs such as the bladder and its neurovascular systems, surgical removal is difficult. The purpose of this research is to describe a 50-year-old female who has a large sacrococcygeal mass. The peculiarity of this case report is the enormous and unusual size of the tumor, which has not been described earlier, as well as the specific surgical techniques used.

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Surgery of the anterior third ventricular lesions

Paurush Pasricha, Basant K Misra

P D Hinduja National Hospital & Medical Research Centre, India

Introduction
Anterior third ventricular lesions may present as neurosurgical emergencies because of acute hydrocephalus. Emergency excision of the lesion can lead to excellent outcome. Similarly, Preventive excision of the lesion would avoid an emergency. The vast majority of benign anterior third ventricular lesions can be treated with eradication of the lesion without a shunt procedure. The surgical experience with the management of anterior third ventricular tumor is presented.
Materials & Methods
Two hundred and sixty-six (266) anterior third ventricular lesions were operated from 1987 till October 2019. These were mostly primary intraventricular lesions. Eighty seven percent of third ventricular lesions were benign. Colloid cyst (198 cases) was the commonest third ventricular lesion.
Results
A transcallosal route was employed in majority of the third ventricular tumors. Following transcallosal transventricular entry there are four options to enter the third ventricle, transforaminal, interforniceal, subchoroidal & suprachoroidal subforniceal/ transchoridal. Our preferred route was the transforaminal followed by subforniceal suprachoroidal; the later was first time developed & reported in literature by the senior author in 1994. In general shunts were not inserted in benign lesions. A temporary CSF drain was utilized in most malignant lesions & significant number of those required a ventriculo-peritoneal shunt. Majority of the cases were endoscope assisted rather than purely endoscopic. There has been only one postoperative death in early part of the series.
Conclusions
The majority of the anterior third ventricular lesions are benign & eminently treatable by microsurgical means with excellent results.

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Quality of life in patients with skull base meningiomas treated with microsurgery: A prospective observational study

Reema Pradhan, Basant K. Misra

Department of Neurosurgery & Gamma Knife Surgery, P D Hinduja National Hospital & Medical Research Centre, Mumbai, India

Background
Skull base meningiomas are chronic conditions that can present with a wide variety of symptoms spanning from near normalcy to chronic and prolonged disability, often accompanied by treatment-related sequelae. Hence, it is necessary to investigate the quality of life (QOL) among patients with skull base meningioma and evaluate the impact of microsurgery on their overall well-being.
Methods
In this prospective observational study 36 patients undergoing microsurgery for skull base meningioma, were assessed for QOL using SF-36 questionnaires. Results were compared to the QOL of 36 patients with a non-neurosurgical chronic disease (diabetes mellitus) and 36 matched healthy volunteers.
Results
All QOL parameters in skull base meningioma patients were preoperatively significantly worse than in the healthy population. The most affected QOL domain were role limitation due to physical health (RLPH) and role limitation due to emotional problems (RLEP).
Within one year after surgery, skull base meningioma patients showed a significant improvement of all QOL parameters. The domains physical functioning (PF), emotional well-being (EWB), body pain (BP) and general health (GH) improved to similar values as their matched healthy controls. However, social functioning (SF), RLPH, and RLPE remained still significantly affected.
Compared to chronic diabetic patients, the domains PF, EWB, BP, and GH showed significantly better QOL values after one year in skull base meningioma patients, but RLEP and RLPH were worse.
Conclusion
Microsurgery can significantly improve all QOL domains in skull base meningioma patients within one year. Physical activity, overall health, and mental well-being have been observed to return to even normal levels. While certain QOL domains may still be affected post-microsurgery, it is evident that microsurgery can yield a substantial improvement, ultimately raising QOL to levels surpassing those seen in other non-neurosurgical chronic diseases, such as diabetes mellitus.
Keywords
QOL, Skull base meningioma, SF-36, Microsurgery.

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Brain structural alterations in vestibular schwannoma beyond tinnitus and hearing loss: A morphometric analysis

Abraham Ayodeji Adegboro, Ziyan Chen, Jens Jeshu Peters, Cyrille Dzoyem Dantio, Chubei Teng, Siyi Wanggou, Xuejun Li

Department of Neurosurgery, Xiangya Hospital, Central South University, Changsha, Hunan, 410008, China

Introduction
Brain tumours alter brain structures and functions. However, morphometric alterations induced by unilateral vestibular schwannoma (VS), a benign tumour of the vestibulocochlear nerve, have not been extensively explored, and it is most often ignored by neurosurgeons during management planning. This study investigates brain structural re-organisations in VS patients after controlling for hearing loss and tinnitus.
Methods
Data from 48 VS pathology-confirmed patients and a healthy control group of 30 volunteers were included in this study. The clinical and imaging data from these participants were processed. Voxel- and surface-based morphometric general linear models were designed to identify tumour-related brain alterations in grey matter (GM) volume and cortical thickness, alongside three other surface measures: sulcal depth (SD), gyrification index (GIx) and fractal dimension (FDi). The differences obtained were further analysed for correlation with tumour size and PTA.
Results
VS-associated GM volume increases were seen in the middle cingulate cortex, superior frontal gyrus (SFG), middle frontal gyrus (MFG), paracentral lobule (PCL), supplementary motor area, inferior frontal gyrus (IFG) and the precuneus. Additionally, cortical thickening was revealed in the SFG, postcentral sulcus, precuneus, supramarginal gyrus (SMG) and the IFG. The FDi was also increased in the superior and middle frontal sulcus (SFS, MFS) and the MFG, while SD and GIx had no significant difference. Furthermore, GM volume changes at the PCL and precuneus were positively correlated to the tumour size, while FDi at the SFS was negatively correlated. Finally, GM volume at the IFG and CT at the SMG were negatively correlated to PTA.
Conclusion
Our results emphasise the involvement of the precuneus, SFG and IFG in VS. Additionally, they suggest that factors beyond hearing loss and tinnitus contribute to brain structural alterations in VS, a better understanding of which might pave the way for targeted non-surgical symptomatic therapies.

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The virtual and real-time images in neurosurgery

Jimmy Ming-Jung Chuang, M.D. (莊銘榮)

Chief, Division of Brain Tumor, Department of Neurosurgery Chair of Neuro-oncology team, Kaohsiung Chang Gung Memorial Hospital and Chang Gung University College of Medicine, Kaohsiung, Taiwan

In today's era of creativity and technological advancement, neuroimaging has expanded well beyond its conventional role of image interpretation and differential diagnosis. From the perspective of a contemporary neurosurgeon, the application of modern neuroimaging in neurosurgery offers two significant functional enhancements that can significantly enhance surgical accuracy and safeguard neurological function.

One key advancement is the integration of mixed reality systems, such as virtual reality (VR) and augmented reality (AR), into neurosurgical practice. These systems play a crucial role in improving surgical planning, ensuring functional preservation, enhancing surgical precision, facilitating innovative treatments, and enriching resident education. They enable the augmentation of procedures requiring intricate dexterity, such as minimally invasive surgery, by integrating functional images with real-time intraoperative electrical stimulation and functional mapping during procedures like tumor excisions and awake surgery. The innovative software methodology described here has demonstrated remarkable effectiveness in generating precise 3D reconstructions from various types of Neuroimaging DICOM file inputs. These systems can serve as supplementary tools alongside established neuronavigation systems or as independent solutions in scenarios where a dedicated system is unavailable, empowering surgeons with a cost-effective approach to enhance preoperative planning and optimize surgical outcomes.

Another notable advancement is the utilization of intraoperative real-time imaging for Image- Guided Neurosurgery (IGNS). By leveraging techniques such as Magnetic Resonance Imaging (MRI) and Fluorescence-Guided Tumor Surgery with agents like 5-Aminolevulinic Acid or Sodium Fluorescein in procedures for High-Grade Gliomas and Brain Metastasis, the precision of tumor resection in brain surgery can be significantly improved. Image-guided surgery offers superior targeting precision, reduced invasiveness, and enhanced outcomes compared to conventional surgical methods.

The rapid evolution of imaging technology and artificial intelligence has democratized access to medical images beyond the realm of radiologists. Through advancements in image processing technology, neurosurgeons can integrate anatomical and functional images with intraoperative electrophysiological mapping, enhancing the accuracy and safety of surgical procedures. Real-time intraoperative imaging technology enables surgeons to directly visualize and confirm surgical results during procedures, empowering them to make informed decisions in the operating room. The adoption of hybrid operating rooms (ORs) in neurosurgical applications is on the rise, providing comprehensive imaging capabilities before, during, and after procedures, thereby enhancing surgical precision and reducing the necessity for postoperative imaging and corrective surgeries.

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Demystifying the cavernous sinus

Jeffrey Sorenson

University of Tennessee, Memphis, USA

A lecture on cavernous sinus anatomy will be presented using an animated 3D model. The model was constructed with high definition photogrammetry using skull bones belonging to the Rhoton Collection, and then enhanced with additional structures.
Animation of the model and correlation with anatomical dissections will help the viewer to better understand the three dimensional relationships of the cavernous sinus from all perspectives. The model will be available for download as part of the Rhoton Collection.

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Efficacy of microvascular decompression for non-root entry zone Neurovascular contact in trigeminal neuralgia

Akmal Masyhudi[1], Achmad Fahmi1, Budi Utomo[2], Agus Turchan[1]

[1]Neurosurgery Department, Universitas Airlangga – Dr Soetomo General Academic Hospital, Indonesia
[2]Public Health Department, Universitas Airalngaa, Indonesia

Background
Trigeminal Root Entry Zone (REZ) neurovascular contact (NVC) is widely recognized as the primary cause of idiopathic Trigeminal Neuralgia (TN). Decompression of these areas is generally considered the optimal surgical treatment for TN, although compression can also occur in non-REZ areas, such as the mid-cisternal and juxtrapetrous regions. The effectiveness of Microvascular Decompression (MVD) for non-REZ NVC in TN remains a topic of debate among experts, with various studies reporting conflicting results.
Objective
To comprehensively evaluate the efficacy of MVD for Non-REZ NVC in TN patients.
Methods
A systematic review and meta-analysis were conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. PubMed, Cochrane Library, Science Direct, and Research Gate were systematically searched for studies comparing the outcomes of MVD for non-REZ NVC with those of MVD for REZ NVC in TN patients, published between 1988 and April 2022. The primary outcome measure was short-term and long-term pain relief without medication (i.e., Barrow Neurological Institute score of 1).
Results
A total of 856 patients' outcomes in 11 studies were analyzed. The short-term and long-term pain relief rates after Microvascular Decompression (MVD) in all subjects were 88.67% and 84.01%, respectively. The long-term pain relief outcomes of MVD on the Non-Root Entry Zone (REZ) and REZ were 85.98% and 82.67%, respectively. The meta-analysis study revealed similar results for both groups in short-term (OR = 1.25, 95% CI = 0.75-2.07) and long-term outcomes (OR = 1.02, 95% CI = 0.67-1.54).
Conclusion
Trigeminal neuralgia can be potentially caused by neurovascular compression (NVC) in both the trigeminal REZ and non-REZ areas. The outcomes after MVD in both regions are comparable. During MVD, it is crucial to meticulously examine the trigeminal nerve along its entire course, from the REZ to the cisternal and juxtapetrous segments, and decompress any visible compression. These findings may influence surgeon preference in patient selection and surgical technique for MVD in treating Trigeminal Neuralgia.

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Non Dysraphic cervical intermedullary lipoma with servere cord compression

Dr.Saravanan Murugesan - DrNB[1], Dr. Narasinga Rao Jannepalli MBBS., MCh.[2]

Neurosurgery resident,Yashoda superspeciality hospital,Malakpet,Hyderabad,India.
Ex Professor NIMHANS, Clinical Fellow in Skull Base Surgery (Osaka, Japan) - Senior Consultant Neurosurgeon,Yashoda super speciality hospital,Malakpet,Hyderabad,India.

Introduction
Non-dysraphic spinal intramedullary lipoma is a rare condition accounting for less than 1% of spinal cord tumours and is most common in the cervicodorsal region. Most of the cases are asymptomatic, but few cases present with slowly progressive neurological deficits. Here we present a case of microsurgically decompressed, cervical intramedullary lipoma under electrophysiological monitoring.
Case Description
A 37 years old male without any spinal dysraphism presented with progressive spastic quadriparesis(left > right) for the past 7 years and gait disturbances for the past 2 years. On examination, he had wasting of left triceps and left hand muscles, B/L hand grip weakness (left > right) without any sensory involvement, and with myelopathic signs. MRI cervical spine showed C5 - T1 intramedullary lesion with an exophytic component which was hyperintense on T1 and T2, hypointense on fat suppressed sequence. Features suggestive of intramedullary lipoma with exophytic component. As there were progressive neurological deficits C5 -T1 laminectomy and microscopic decompression of lipoma with CUSA were planned under electrophysiological monitoring, and transfacetal screw fixation was done.
Conclusion
Partial debulking of a cervical intramedullary lipoma in a patient who presented with progressive neurological deficits resulted in good neurological improvement.
Keywords
Cervical cord lipoma, Intramedullary lipoma, Subpial, Dysraphism.

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Endoscopic Denker's Approach to the Middle Cranial Fossa

Yun-Kai Chan[1], Kai-Chun Lin[1], Po-Kai Huang[2], Chia-Hsing Lin[2], Ying-Piao Wang[2, 3]

[1]Department of Neurosurgery, MacKay Memorial Hospital, Taipei, Taiwan
[2]Department of Otolaryngology-Head and Neck Surgery, MacKay Memorial Hospital, Taipei, Taiwan
[3]MacKay Medical College, Taiwan

Introduction
Tumors within the middle cranial fossa demand intricate surgical approaches, such as lateral craniotomy and the Endoscopic Endonasal Approach (EEA). The EEA provides benefits including minimal invasiveness, reduced brain manipulation, and decreased need for retraction. In certain cases, combining the EEA with extended approaches can enhance surgical exposure and reduce associated risks.
Patient
A 55-year-old woman presented with right-sided facial sensations of electric-like tingling, numbness, and paresthesia persisting for eight years, which had recently worsened. Brain MRI with and without contrast enhancement revealed a 4.8 cm lesion involving the right pterygopalatine fossa, infratemporal fossa, middle cranial fossa, and posterior cranial fossa. We performed an EEA with medial maxillectomy, combining the prelacrimal approach and the modified endoscopic Denker's approach, resulting in gross total tumor removal. The pathological report confirmed a schwannoma. Postoperative MRI showed no significant residual tumor. Her recovery has been satisfactory, with only minimal numbness and paresthesia remaining in the right V2 territory.
Comments
Trigeminal schwannomas, the second most common intracranial schwannomas after vestibular schwannomas, present complex surgical challenges due to their potential extensions. Key factors
to consider include exposure, visualization, brain retraction, the maneuverability of the endoscope and instruments, and reconstruction methods. The primary goal is to achieve gross total resection. The EEA with a transpterygoid approach and medial maxillectomy provides access to the middle cranial fossa, though visualization may be limited by obstructive bony structures and neurovascular elements. The prelacrimal approach is specifically designed for lesions in the maxillary sinus, pterygopalatine fossa, and infratemporal fossa, offering a broader exposure range, improved angles of attack, and preservation of nasal structures, including the nasolacrimal duct. However, the introduction of three or four instruments through the bony window remains challenging. The modified endoscopic Denker's approach provides an additional instrument port without requiring a sublabial incision, while preserving the pyriform aperture, thus preventing postoperative alar collapse and retraction.
Conclusions
Tumors affecting the pterygopalatine fossa, infratemporal fossa, middle cranial fossa, and posterior cranial fossa present significant challenges for skull base surgeons. Utilizing the EEA with medial maxillectomy, combined with the prelacrimal approach and the modified endoscopic Denker's approach, can lead to favorable surgical outcomes with minimal complications. A multidisciplinary skull base team familiar with the intricate anatomy of these regions is essential when managing such lesions.

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A laboratory in Chalcedon where Herophilus was born; The Yeditepe Microneurosurgery Laboratory

Aysu İyigün Kabakcı[1], Abuzer Güngör[2], Sima Cebecik Çakır[3], Gökberk Erol4, Uğur Türe[5]

[1]Department of Neurosurgery, Republic of Türkiye Ministry of Health Ankara Etlik City Hospital, Türkiye
[2]Department of Neurosurgery, İstinye University, Faculty of Medicine, İstanbul, Türkiye
[3]Department of Neurosurgery, Republic of Türkiye Ministry of Health Ankara Bilkent City Hospital, Ankara, Türkiye
[4]Department of Neurosurgery, Ministry of Health Elmadağ Dr. Hulusi Alatas State Hospital, Ankara, Türkiye
[5]Department of Neurosurgery, Yeditepe University School of Medicine, İstanbul, Türkiye

Background
Chalcedon, a small town on the Asiatic side of the Bosphorus, is now known as Kadıköy and is the birthplace of Herophilus. Herophilus of Chalcedon and his student Erasistratus were the first in human history to perform systemic dissection and vivisection of the human body. Thousands of years after his death, on the same land, the Yeditepe University Microneurosurgery Laboratory was founded as a center for microneurosurgical dissection.
Objective
The aim of this abstract is to introduce how the laboratory works and shed light on its contributions to the evolution of microneurosurgery.
Method
We analyzed the archives of the Yeditepe University Microneurosurgery Laboratory from 2008 to 2024 and documented the records of the İstanbul Microneurosurgery Courses. We defined the anatomy of the laboratory by dividing it into four sections based on their purposes; archive, workstation, anatomy wetlab, and photodocumentation station. We also reviewed the fellow training curriculum along with the publications produced in the laboratory and tributaries to neurosurgical training
Results
The laboratory has hosted the İstanbul Microneurosurgery Courses since December 2010, with the 12th edition took place this year. To date 540 people have participated in the course, and Dr. Rosmarie Frick has consistently served as an honorary guest, showing participants the key points of microsuturing and vascular anastomosis.
As a laboratory open 24/7, it has trained more than one hundred fellows/observers worldwide and has hosted several hundred visitors. The learning objectives for fellows include; neuroanatomical photography, three dimensional photography, microsurgical dissection, mastery of anatomy and proficiency in microdissection. Following online meetings and ongoing collaboration with co-authors, professional illustrators, radiologists, fellows have conducted significant research that has been published both internationally and nationally. The laboratory has pioneered 70 publications on surgical approaches, white matter dissection, surgical techniques, tractography, and 3D modeling in neurosurgery education while the department has added 42 more. It collaborates with the Neurosurgical Atlas on a fellowship program.
Conclusion
The Yeditepe University Microneurosurgery Laboratory significantly impacts the field of neurosurgery, preparing the next generation to lead and innovate. In the words of Yaşargil, “Working only during the daytime is not enough for neurosurgery.” which embodies the laboratory’s motto.

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Intraoperative augmented reality fiber tractography: Pearls and tenets

Sabino Luzzi, MD, PhD, FACS[1,2]

[1]Department of Clinical-Surgical, Diagnostic, and Pediatric Sciences University of Pavia, Italy
[2]Neurosurgery Unit Fondazione IRCCS Policlinico San Matteo, Pavia, Italy

Background
Augmented reality (AR) fiber tractography is an innovative technology in neurosurgery that enhances visualization and navigation during the resection of brain tumors, particularly in critical regions such as supratentorial high-grade gliomas (HGGs) and the primary motor area (M1). Traditional surgical techniques, while effective, often struggle to fully visualize and preserve essential white matter tracts, which are crucial for maintaining neurological function. The integration of AR with high-definition fiber tractography (HDFT) and diffusion tensor imaging (DTI) aims to overcome these challenges by providing real-time, anatomically precise guidance, thereby potentially improving the extent of resection (EOR) and overall patient outcomes.
Objective
This study aimed to evaluate the impact of AR-based HDFT, combined with DTI, on surgical outcomes in patients with supratentorial HGGs and M1 tumors. The primary focus was on assessing the technique's effectiveness in maximizing EOR, preserving motor function, and improving progression-free survival (PFS) rates. The safety profile of AR HDFT compared to conventional surgical methods was also examined.
Methods
Data from patients who underwent AR HDFT for supratentorial HGGs and M1 tumors were retrospectively analyzed and compared with those who underwent traditional white-light surgery assisted by infrared neuronavigation. The EOR was measured, and postoperative outcomes were evaluated using the Neurological Assessment in Neuro-Oncology (NANO) and Medical Research Council (MRC) scores. The study also assessed PFS and complication rates. Statistical significance was determined with a p-value of less than 0.05.
Results
The study included a total of 54 patients in the AR HDFT group and 63 in the control group for supratentorial HGGs, along with 34 patients in the AR HDFT group and 31 patients in the control group for M1 tumors. AR HDFT significantly enhanced the EOR compared to conventional techniques, with higher rates of gross-total resection and near-total resection observed in the AR HDFT group. Postoperative NANO and MRC scores indicated better preservation of motor function in patients treated with AR HDFT. Additionally, the AR HDFT group demonstrated a longer PFS compared to the control group, with a statistically significant improvement in PFS rates. Importantly, the complication rates were comparable between the AR HDFT and control groups, indicating that the enhanced resection capabilities did not come at the cost of increased surgical risk.
Conclusions
AR-based HDFT, when combined with DTI, proves to be a feasible, effective, and safe approach for neurosurgical resection of supratentorial HGGs and M1 tumors. The technique offers significant advantages in maximizing the EOR while preserving motor function and extending PFS. Despite some limitations related to the accuracy of diffusion tensor imaging and potential parallax errors, AR HDFT represents a promising advancement in neurosurgery. Further research and larger studies are recommended to validate these findings and refine the technology for broader clinical application.

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Anterolateral approach for extracranial jugular foramen schwannomas

Sabino Luzzi, MD, PhD, FACS1,2[1,2]

[1]Department of Clinical-Surgical, Diagnostic, and Pediatric Sciences University of Pavia, Italy
[2]Neurosurgery Unit Fondazione IRCCS Policlinico San Matteo, Pavia, Italy

Background
Schwannomas in the superior parapharyngeal space, particularly those involving the jugular foramen (JF), present formidable surgical challenges due to the intricate anatomy and close proximity to vital neurovascular structures. Traditional surgical approaches often carry significant risks and high morbidity.
Objective
The primary objective of this study was to assess the technical nuances, advantages, and clinical outcomes of the anterolateral approach (ALA) in the surgical treatment of retrostyloid superior parapharyngeal space schwannomas involving the JF, based on a 20-year institutional experience.
Methods
This retrospective study reviews 38 consecutive patients who underwent surgery for retrostyloid superior parapharyngeal space schwannomas involving the JF via the ALA between 1999 and 2023. Key surgical details, the extent of tumor resection, postoperative complications, and long-term outcomes were evaluated. Preoperative imaging, including CT, MRI, and angiography, guided surgical planning, while intraoperative neuromonitoring was employed to reduce the risk of lower cranial nerve injury.
Results
Gross total resection (GTR) was successfully achieved in 89.4% of cases. The ALA provided excellent exposure and access to the tumors, with a low morbidity profile. The approach enabled a comprehensive 180-degree exposure of the extracranial JF, expandable to 270 degrees, through the utilization of three key working corridors: pre-carotid, pre-jugular, and retro-jugular. Postoperative complications were minimal, affecting only six patients (15.7%), most of whom experienced transient issues. Recurrence was observed in three patients (7.9%) after an average follow-up of 80.5 months, primarily in cases where GTR was not achieved.
Conclusions
The ALA h has proven to be a highly effective and versatile surgical technique for treating retrostyloid superior parapharyngeal space schwannomas involving the JF. Over a 20-year institutional experience, this approach has consistently demonstrated success in achieving GTR with minimal morbidity. Its ease of execution, combined with low complication rates and significant surgical exposure, underscores its value as a standard approach for these challenging tumors. This extensive experience from 1999 to 2023 supports the continued use of the ALA.

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Enhancing surgical freedom in posterior skull base surgery: Variations and extensions of the suboccipital approach

Sabino Luzzi[1,2]

[1]Department of Clinical-Surgical, Diagnostic, and Pediatric Sciences University of Pavia, Italy
[2]Neurosurgery Unit Fondazione IRCCS Policlinico San Matteo, Pavia, Italy

Background
The suboccipital approach is a cornerstone in posterior skull base surgery, providing versatile access to a wide range of bony, extradural, cisternal, vascular, parenchymal, and ventricular targets. Despite its broad application, a thorough understanding of its indications, surgical planning, anatomical considerations, and execution nuances is crucial for optimizing surgical outcomes and minimizing complications.
Objective
This narrative review, grounded in the author's personal experience, aims to offer an in-depth overview of the variations and extensions of the suboccipital approach. The focus is on the approach's indications, detailed surgical planning, anatomical considerations, possible variations and extensions, and critical principles for avoiding complications. By highlighting the approach's adaptability and key preoperative factors, this study underscores its utility in managing a diverse array of lesions involving the posterior skull base.
Methods
An exhaustive analysis of the suboccipital approach and its various extensions was performed, highlighting the systematic progression of bone resection that allows for different approach modifications. The anatomical focus spans the squamosal and condylar regions of the occipital bone, the axial cervical spine, and the ventral foramen magnum area. Preoperative planning included a detailed assessment of craniovertebral junction anatomy, variations in the vertebral artery and PICA, infratentorial dural sinus anatomy, and the angioarchitectural configuration of the Torcula Herophili.
Results
The suboccipital approach, through its numerous variations and extensions—such as median, paramedian, lateral suboccipital, far lateral retrocondylar, far lateral transcondylar, supracondylar, and paracondylar—offers extensive surgical flexibility. These modifications enable surgeons to tailor access according to the lesion's specific location and characteristics. Meticulous preoperative planning, particularly in assessing the need for spinal fixation and determining optimal patient positioning, which may vary from prone to semi-sitting, Concorde, or three-quarter prone positions, is crucial for optimal execution. The three principal intradural routes (median, paramedian, and lateral suboccipital) are analyzed, with a focus on the median suboccipital approach and its four key working corridors: the telovelar, cerebellomedullary fissure, tonsillo-uvulary fissure, and tonsillo-biventral fissure.
Conclusions
The suboccipital approach is among the most versatile in posterior skull base surgery. When combined with an in-depth knowledge of both normal and variant anatomy of parenchymal and neurovascular structures of the craniovertebral junction region and meticulous preoperative planning, this approach allows for the safe and effective treatment of complex tumoral and vascular lesions. Its adaptability, through various variations and extensions, allows surgeons to tailor the approach to specific surgical targets.

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Anatomy of the medial orbit and various approaches to access it

Osamu Akiyama[1], Yuzaburo Shimizu[1], Mario Suzuki[1], Noritaka Komune[2], Satoshi Matsuo[3], Akihide Kondo[1]

[1]Department of Neurosurgery, Juntendo University Faculty of Medicine, Tokyo, Japan
[2]Department of Otorhinolaryngology, Graduate School of Medical Sciences, Kyushu University, Fukuoka, Japan
[3]Department of Neurosurgery, Fukuoka Tokushukai Hospital, Fukuoka, Japan

Background
The medial orbit can be the site of several pathological lesions such as cavernomas, neurinomas, and lymphomas. However, approaching the medial orbit remains a challenging task because of the narrow surgical corridors, surrounding critical neural structures, and complicated vascular relationships.
Objective
To examine the microsurgical anatomy of the medial orbit and compare the various surgical approaches to access it.
Methods
Ten adult cadaveric specimens were examined using magnifications ranging from 3X to 40X after perfusion of the arteries and veins with colored silicone. The microsurgical anatomy of the medial orbit and surgical approaches to it were examined. The
transsinus approach was performed using 0° or 45° rigid endoscopes, and other approaches were performed using the surgical microscope.
Results
The surgical approaches to the medial orbit can be classified into three categories: (1) transcranial approach, (2) trans-sinus approaches: transethmoidal and transmaxillary approaches, and (3) transorbital approaches: precaruncular and medial orbital approaches. The transcranial approach exposes the superior and medial surfaces of the orbit and the optic apex widely. The trans-sinus approach exposes the medial and inferior surfaces of the orbit and optic nerve. The tranorbital approach exposes the anterior and medial surfaces of the orbit, but the surgical corridor to the optic canal and apex in this approach is relatively narrower and deeper compared to that in the previous two approaches.
Conclusion
The knowledge of the microsurgical anatomy of the medial orbit and surrounding critical structures and the selection of an appropriate surgical approach will make surgical procedures safe and precise.
Keywords
Medial orbit, Orbital tumor, Transorbital approach

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Clinical, anatomical, and histological features of the rhomboid lip and considerations for surgery using a retrosigmoid approach

Osamu Akiyama[1], Yuzaburo Shimizu[1], Mario Suzuki[1], Noritaka Komune[2], Satoshi Matsuo[3], Akihide Kondo[1]

[1]Department of Neurosurgery, Juntendo University Faculty of Medicine, Tokyo, Japan
[2]Department of Otorhinolaryngology, Graduate School of Medical Sciences, Kyushu University, Fukuoka, Japan.
[3]Department of Neurosurgery, Fukuoka Tokushukai Hospital, Fukuoka, Japan

Objective
The rhomboid lip is a neural tissue encountered during cerebellopontine angle surgery, with differing shape and extent among individuals. This study aimed to investigate the variation of rhomboid lips during posterior fossa surgery.
Methods
In this retrospective study, we examined posterior cranial fossa surgeries performed using a retrosigmoid approach. Rhomboid lips were classified according to thickness, extent, and appearance, with some subjected to histological analysis. T2-weighted magnetic resonance imaging (MRI) of rhomboid lips was conducted.
Results
Among 304 surgeries, rhomboid lips were observed in 75 patients who underwent schwannoma or meningioma resection, facial spasm-related neurovascular decompression, and other surgeries (37, 2, 32, and 4 patients, respectively). Rhomboid lips were categorized based on apparent thickness: thin membranous type, resembling an arachnoid membrane, and thick parenchymal type. Rhomboid lip extension was classified by position relative to the choroid plexus: non-extension, lateral extension, and jugular foramen (41, 22, and 12 patients, respectively). Veins were observed on the rhomboid lip surface in 37 cases. The rhomboid lip was visible in only one case (parenchymal jugular foramen type) on MRI. Histologically, the rhomboid lip comprises an ependymal cell layer, a glial layer, and connecting tissue. The glial layer thickness determined the rhomboid lip thickness, which was greater in the parenchymal type than in the membrane type. In 42 patients, the rhomboid lip was dissected, with no complications observed.
Conclusions
Morphological classification of the rhomboid lip and understanding of its anatomical details contribute to safe surgical field development for neurosurgeons.

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Surgical resection of hybrid nerve sheath tumor involving the orbit and lateral wall of the cavernous sinus

Satoshi Matsuo, MD, PhD

Department of Neurosurgery, Fukuoka Tokushukai Hospital, Fukuoka, Japan

Hybrid peripheral nerve sheath tumors (HPNST) are defined as benign PNSTs with combined features of more than one type of PNSTs including schwannoma, neurofibroma, and perineurinoma. They rarely arise from the orbit. This video shows the microsurgical resection of HPNSTs involving both the orbit and lateral wall of the cavernous sinus. A left frontotemporal craniotomy with superolateral orbitotomy was performed to remove the tumor. No intact nerve fibers of the frontal and ophthalmic nerves can be identified, making the diagnosis of the tumor originating from both nerves. The pathology was consistent with HPNST containing schwannoma and neurofibroma. This work has been published in the following journal. Satoshi Matsuo, MD, PhD; Rio Higaki, MD; Koichiro Matsukado, MD, PhD.Microsurgical Resection of Hybrid Nerve Sheath Tumor Involving the Orbit and Lateral Wall of the Cavernous Sinus: 2-Dimensional Operative Video. Operative Neurosurgery 21(6):p E551, November 2021. DOI: 10.1093/ons/opab308

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Modification of anterior transpetrosal approach

Shunsuke Shibao[1], Yusuke Morinaga[1], Takeshi Hongo[1], Ryu Kurokawa[1], Kazunari Yoshida[2], Masahiro Toda[2], Hiroyoshi Akutsu[1]

[1]Department of Neurosurgery, Dokkyo Medical University, Tochigi, Japan
[2]Department of Neurosurgery, Keio University School of Medicine, Tokyo, Japan

Background
The anterior transpetrosal approach (ATPA) is a well-established surgical method for accessing the petroclival region. Various modifications of ATPA have been developed to address specific surgical challenges. This study presents modifications of ATPA based on our surgical experience.
Methods
We retrospectively reviewed 15 cases of ATPA performed between June 2019 and July 2024. The focus was on the purpose and techniques of the modifications applied in these cases.
Results
The mean age of the patients was 58.9 years, with a male-to-female ratio of 3:12 (20% male, 80% female). The pathologies included meningiomas (n = 12, 80%), epidermoid cyst (n = 1, 6.7%), chondrosarcoma (n = 1, 6.7%), and metastatic brain tumor (n = 1, 6.7%). Standard ATPA was performed in 7 cases (46.7%), while modifications were applied in 8 cases (53.3%). The modifications included vein-sparing techniques in 3 cases (20%), simplification without superior petrosal sinus (SPS) or tentorial dissection in 2 cases (13.3%), and combined approaches for lesions extending beyond the typical limits of ATPA in 2 cases (13.3%). Vein preservation involved two cases of combined epi- and subdural anterior petrosectomy to preserve veins draining into the foramen ovale and one case of subdural anterior petrosectomy for preserving a vein that precluded dissection of the middle cranial fossa dura mater. Combined approaches included one case with nasal endoscopic surgery and one with Trautmann's triangle resection. Gross total resection (GTR) was achieved in 8 cases (53.3%), and subtotal resection (STR) in 7 cases (46.7%). Permanent complications included trochlear nerve palsy in 3 cases (20%) and facial nerve palsy in 1 case (6.7%). Venous complications consisted of transient cerebral swelling in two cases (13.3%), both of which resolved with time.
Conclusion
ATPA can be modified in various ways to enhance safety and effectiveness depending on the specific surgical goals. Tailoring the approach to the surgical objectives is crucial for optimizing outcomes.

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Video competition material: Modification of anterior transpetrosal approach

Shunsuke Shibao[1]

[1]Department of Neurosurgery, Dokkyo Medical University, Tochigi, Japan

A 68-year-old female presented with a headache, leading to the diagnosis of a right petroclival meningioma extending to Meckel's cave. Preoperative CT venography revealed a sphenobasal-type superficial middle cerebral vein, increasing the risk of venous injury during surgery. A subdural anterior transpetrosal approach was performed, involving careful dissection to preserve the greater petrosal nerve and other critical structures. The tumor was successfully removed, though some residual remained around the trochlear nerve. Postoperative MRI confirmed gross total removal with no cerebrospinal fluid leakage, and venous preservation was verified. The patient experienced transient synovial nerve palsy, which improved over nine months.

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Long-term outcomes of total Corpus Callosotomy: a tertiary care center experience

Vikrant Sharma, Dhrumil Shah, Manas Panigrahi, Sita Jayalakshmi, Anuja Patil, Shanamukhi S

KIMS Hospitals, Secunderabad, Telangana, India

Background
Corpus Callosotomy (CC) is a palliative surgery indicated for generalized seizures like drop attacks. It is effective in toddlers and young children of early school-going age. Most of these children have multiple seizure types apart from drop attacks. Congenital causes are common in the west, whereas acquired perinatal insult in developing nations. One of the causes for the burden of Epilepsy in developing nations may be lack of awareness for this surgery.
Aim and Objectives
In a retrospective data analysis of consecutively operated patients at our institute, we aimed to establish the long-term outcome of total CC. The primary objective was to establish control of drop attacks, and other associated seizures on follow-up. As a secondary objective, we tried to establish associations between post-surgical complications, seizure semiology, and initial radiological findings with the outcome after surgery.
Material and methods
We retrospectively analyzed data from consecutively operated patients at our institute from 2009 to 2024 (n=20). These patients belonged to different parts of India. The following were the methods adopted:
1. Surgery
All patients underwent total Corpus Callosotomy, through standard open microsurgical technique.
2. Outcome assessment (primary)
a. Control of Drop Attacks
b. Control of Disabling Seizures
c. Control of other Seizures (except drop attacks)
Engel surgical outcome scale (1993) and Seizure frequency score were used.
3. Outcome assessment (secondary)
a. Number of AED reduction (mean) at last follow-up
b. Seizure type association with Surgical outcome (last follow-up)
c. Initial Radiological finding association with Surgical outcome (last follow-up).
Developmental screening tests, Vineland Social Maturity Scale, Childhood Autism Rating Scale, and QOLCE (personality/emotional) were used for Neuropsychological outcomes.
Initial MRI findings were considered for Radiological association.Results were subject to the calculation of mean, and median. Continuous data were plotted on the histogram and their association was subject to chi-square test and combined association was plotted on ROC curve to know AUC, hence determining the most important factor affecting the surgical outcome. The significance of the variables was decided based on the p-value, where a p-value <0.05 was considered significant.
Results
80% of our patients were males. The mean age of onset of seizures was 19.5 days after birth. 6 patients had significant perinatal history. The mean age at surgery was 13.04 years. 4 patients (20%) had only drop attacks, others had multiple types of seizures at presentation. The initial MRI suggested bilateral Gliosis in 50% of cases suggesting an acquired perinatal insult, 30% had cortical malformation suggesting a congenital etiology and 20% had normal MRI. Initial Neuropsychological assessment revealed the mean IQ as 29.923, i.e., severe intellectual disability. All patients were followed for at least 1 year. 1 patient died on 1-year follow-up after surgery. 3 out of 20 patients had chronic disconnection syndromes, 6 had acute disconnection syndrome. 3 out of 4 patients (75%) of drop attacks were completely seizure-free at the end of 1 year (Engel-I). 10 out of 15 (67%) patients with multiple seizure types were seizure-free at the end of seven years (Engel-I). 4 out of these 15 (27%) patients achieved Engel-III and one patient is Engel-IV at present, although drug-responsive with a significant decrease in the seizure frequency. Hence, the mean seizure frequency score reduced from 12.285 to 8.2 at the end of 1 year and to 4.33 at the end of 7 years. The mean number of AEDs initially was 3.666 which reduced to 1.666 at the end of 10 years.
Conclusions
The current study supports the fact that total CC works well as a palliative surgery for the control of drop attacks. It also controls other types of seizures commonly seen in such patients which makes them less dependent on AEDs over time. Bilateral Gliosis on initial MRI may suggest poor surgical outcome. Awareness of preventing perinatal insults and the benefits of CC may help reduce the burden of Epilepsy in developing nations.

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Utilizing augmented reality to develop artificial intelligence model for neuro-navigation: A leap ahead of the future

Vikrant Sharma, Manas Panigrahi

KIMS Secunderabad, Telangana, India

Background
Neurosurgeons have been dependent on craniometry, imaging, and surgical expertise to achieve successful surgery and better patient outcomes. Augmented Reality (AR) is useful in simulating patient-specific anatomy and radiology with Virtual implementation of important anatomic relations of the lesion. It also helps in patient education and resident training. Machine Learning (ML) is already being applied in Neurosurgery. The conventional Neuro-navigation system partly depends upon the surgeon, who must combine the axial, sagittal, and coronal images in his mind to imagine the lesion's actual morphology and anatomical relations to plan the skin and bone flap. The patient needs to be induced with GA, to be fixed with a skull-clamp; overall, the process is time-consuming. We have tried to utilize AR to minimize the subjective bias for flap planning and make the registration process faster. The said technology was used to develop a model of supervised Machine Learning to evolve Artificial Intelligence (AI) in Neurosurgery.
Objectives
We utilized this technology in various sub-specialties of neurosurgery and used the specific data to supervise Machine Learning and develop our AI model for Neuronavigation. The objective was to make the 'machine' learn the registration process to minimize the subjective bias and time required to register during neuro-navigation.
Material and Methods
72 patients were operated on from 20th March 2024 to 25th July 2024 in various sub-specialties of Neurosurgery. For AR data acquisition, the portable device known as 'SKIA' was used. It was used to pre-operatively mark the important bony landmarks, vascular structures, and lesions. We used AR technology for supervised Machine Learning and the development of our AI algorithm of Neuro-navigation, to minimize subjective bias and time to register.
Results
25 cases (38.5%) were registered with RGB (e, n) only. 40 cases (61.5%) were registered with improved RGB input (e, n, c). 10 patients could not be registered. The mean percentage of matching was significantly higher (90.25±7.42) % when the ear(c) was added as an additional label in the RGB input when compared to the RGB input of only eyes and nose (86.80±6.29) %; p=0.04. The bias (b) was significantly lower among the patients with improved RGB (0.43±0.07) as compared to before (0.02±0.08); p<0.0001. The median time to register (t1) was significantly lower in patients with improved RGB input (11 minutes) as compared to before (15 minutes); p=0.012. The mean satisfaction score was higher among the patients with improved RGB input (3.96±0.79) as compared to before (4.31±0.73); p=0.083. As the bias decreased and the matching percentage increased, the t1 decreased. One-way analysis of variance (ANOVA) showed that the mean satisfaction score was the highest (4.24 ±0.734) for supratentorial cases.
Conclusion
AR in Neurosurgery is helpful in the planning and execution of the surgical plan, its data, and the errors serve as food for machine learning and the development of AI algorithms for Neurosurgery. The neuron of Artificial Intelligence learns in a similar way as neuron of Human Intelligence, by forming networks and synapses. As more and more vivid inputs are being fed, the Neural network of our AI model is evolving daily by learning to ignore errors. It is potentially becoming a worthy assistant in the future. Apart from faster Neuro-navigation, it has given us ease of flap planning and patient positioning, reduced overall time of GA and surgery, and a tool to educate and train.

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Total corpus callosotomy

Vikrant Sharma, Manas Panigrahi

KIMS Hospitals, Hyderabad, Telangana, India.

Corpus Callosotomy is a palliative surgery indicated mainly to control drop attacks. Studies have shown that it controls drop attacks, as well as other seizure types, and makes patients less dependent on AEDs over time. The mechanism is prevention of bilateral hemispheric synchrony as corpus callosum is the main route of transmission of epileptic discharges between two hemispheres. Total CC has significantly better results, although few studies have favored Anterior CC and others have favored Posterior CC. The most accepted extent of CC is from A2 ACA anteriorly up to visualization of the Vein of Galen posteriorly. The complications include disconnection syndrome, rarely mesial hemispheric infarcts, hemispheric edema, and hemiparesis.

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STA-MCA bypass

Vikrant Sharma, Manas Panigrahi

KIMS Hospitals, Hyderabad, Telangana, India.

EC-IC bypass surgery is effective for cerebral artery occlusive disease. The recipient artery was selected based on the site of blood flow reduction and ease of anastomosis. Marking of STA was performed using a hand-held Doppler and Augmented Reality technology which superimposes the CT dicom and scanned images and the craniotomy site is hence marked. The frontal branch is dissected, and the main trunk is skeletonized. The end of the elevated STA is cut and tied with silk, heparinized, and passed through the temporalis muscle tunnel. The anastomosis is performed using the continuous, running suturing method. Vessel patency is confirmed using ICG video angiography. The bone is replaced with a tunnel to allow passage of the temporalis through it.

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Recurrent brainstem epidermoid (Video description)

Vikrant Sharma, Manas Panigrahi

KIMS Hospitals, Hyderabad, Telangana, India.

There are very few reported cases of brainstem epidermoid cysts. Moreover, they are rarer if they are recurrent. We present a case report of a 3-year-old male child, who was operated on twice for a pontomedullary epidermoid cyst. He presented with cortico-spinal and CN involvement (bilateral 6th nerve). The cyst was excised gross total, and the patient had very few residual deficits on follow-up. Adherence to microsurgical principles is the key to successful surgery of the brainstem.

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Extended subtemporal transtentorial approach for resection of an epidermoid cyst

Ju-En Nien, Ya-Jui Lin, Cheng-Chi Lee

Department of Neurosurgery, Chang-Gung Memorial Hospital at Linkou, Taoyuan, Taiwan

In this 2D video, we review a case of a 43-year-old woman with an epidermoid cyst presenting as a one-year history of intermittent headache. The cyst was located in the middle cranial fossa floor, extending to the cerebellopontine angle. Gross total subcapsular removal was completed through a subtemporal transtentorial approach. The inferior extension of the tumor to the cerebellopontine angle was managed by a linear tentorial division, which provided an excellent surgical access to the lateral surface of the pons around the trigeminal nerve entry zone. The video highlights several technical pearls relevant to this surgical approach.

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Microsurgical anatomy of the common tendinous ring and its opening by incising the lateral tendinous connection: anatomy study and case illustration

Ying Huang

Department of Neurosurgery, Samii Clinical Neuroanatomy Research & Learning Center, Capital Medical University Xuanwu Hospital, China International Neuroscience Institute (China-INI), Beijing, China

Background And Objectives
The Common Tendinous Ring (CTR), also known as the common annular tendon or annulus of Zinn, is a critical anatomical structure located at the convergence of the orbital apex, superior orbital fissure, optic canal, and the anterior aspect of the lateral sellar compartment. It plays a vital role in both neurosurgical and neuro-ophthalmological interventions. This study aims to delineate the complex three-dimensional (3D) topography of the CTR and to explore the surgical technique for opening the CTR by incising the lateral tendinous connection, supported by anatomical studies and case illustrations.
Methods
Ten formalin-fixed skull base specimens from adult Chinese cadavers were meticulously dissected to investigate the morphology of the CTR, focusing on its relationship with the four extraocular rectus tendons, the optic strut, the superior orbital fissure, and the optic canal. Additional skull base specimens were subjected to 3D surface scanning, computed tomography, and histopathological examinations to deepen our understanding of the CTR's structural complexities. Detailed anatomical analyses and case illustrations were also included to demonstrate the surgical technique for safely opening the CTR by incising the lateral tendinous connection.
Results
The CTR forms a 3D tendinous assembly, encompassing four rectus tendons, two tendinous connections, and a common tendinous root. These components create a dual-ring configuration featuring the optic foramen and the oculomotor foramen. The posterior part of the superior rectus tendon demarcates the common boundary between these two foramina. Precise incisions of the medial and lateral tendinous connections are essential for safely opening the CTR. Case illustrations underscore the role of the lateral tendinous connection in this procedure.
Conclusion
The structural composition and dual-ring configuration of the CTR are crucial for precise and safe surgery of the orbital apex and adjacent regions. The study highlights the importance of the lateral tendinous connection incision as a key approach in these surgical interventions.

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Topographic anatomy and step-wised harvest of intermuscular occipital artery in far lateral approach

Xu Wang

Department of Neurosurgery, Samii Clinical Neuroanatomy Research & Learning Center, Capital Medical University Xuanwu Hospital, China International Neuroscience Institute (China-INI), Beijing, China

Background
The occipital artery (OA) is an important donor artery for intracranial and extracranial bypass surgery, but its path is tortuous, making it difficult to harvest. Part of the traditional intermuscular OA is not covered by muscle and is easily damaged during surgery. Currently, there are few reports on how to protect this segment of the OA.
Objectives
To clarify the course of the intermuscular OA and its positional relationship with different muscles through anatomical measurements, and to explore how to quickly and safely harvest the occipital artery in the far lateral approach.
Methods
Thirty-three sides of seventeen formalin-fixed adult cadaveric heads (n=33) were used for anatomical measurements to clarify the positional relationship between the OA and the splenius capitis muscle (SCM) and the superior nuchal line (SNL). A "reverse C-shaped" surgical incision through the far lateral approach was used to find the attachment of the uppermost muscle fiber of the SCM to the SNL, the site where the OA passed through the SCM, and the site where the OA crossed the SNL. The distances between these three points were measured, and the proximal and distal diameters of the OA were also measured. We proposed how to safely and quickly harvest the OA using the SCM as a landmark in the far lateral approach.
Results
In all specimens, part of the intermuscular OA ran below the tendons and connective tissues in the superficial layer of the muscle. This area was located on the medial side of the uppermost muscle fibers of the SCM, below the SNL, and on the surface of the sternocleidomastoid muscle or trapezius muscle tendons. There were no dense muscle fibers on the surface of the OA in this area, which we referred to as the posterior segment of OA of the SCM, with the length of 29.3 ± 12.1mm.
Conclusion
Through the far lateral approach, the SCM is a useful landmark to expose the OA. We can safely, quickly and accurately find the OA by dissecting within 13.6 ± 5.2mm below the uppermost muscle fiber of the SCM.

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Utilization and patterns of awake craniotomy for tumor resection in a large series from a single-center tertiary and international referral center of over 250 cases

Jan T. Hachmann[1], David. S. Sabsevitz[2], Sanjeet S. Grewal[1], W. Christopher Fox[1], Rabih G. Tawk[1], Richard W. Byrne[1], Kaisorn L. Chaichana[1], Alfredo Quiñones-Hinojosa[1]

[1]Department of Neurosurgery, Mayo Clinic Florida, Jacksonville, Florida, United States of America, 32224
[2]Department of Neuropsychology, Mayo Clinic Florida, Jacksonville, Florida, United States of America, 32224

Introduction
Awake craniotomy with cortical and/or subcortical mapping can help prevent postoperative language and motor deficits. Awake craniotomy is commonly used for eloquent regions including perirolandic sensorimotor cortices and dominant hemisphere language pathways. White matter tracts are now routinely and comprehensively mapped and other complex cognitive functions beyond motor and language are increasingly being tested intraoperatively. Despite the more widespread adoption of awake craniotomy, few large series exist.
Methods
All awake craniotomies performed at a single tertiary and international referral center performed between 2017-2024 were retrospectively reviewed. Awake procedures other than craniotomy were excluded. Awake craniotomies for indications other than neoplasms were also excluded. Medical data including baseline demographics, imaging pathology, and perioperative course were extracted from the electronic health record.
Results
A total of 264 awake craniotomies for tumor were performed. 25 patients underwent multiple awake craniotomies. Tumors were newly diagnosed in 173 patients (65.5%), and recurrent progressive in 91 patients (34.5%). 110 patients (41.7%) had received prior cranial procedures including resections or biopsies. Mean age was 50 +/- 16 years (range 16-93 years). 96 patients were female (36.4%). Mean radiographic follow-up was 1.93 +/- 1.71 years. Most surgeries were Left-sided (n = 186, 70.5%). Locations included frontal (37.5%), temporal (25.4%), deep seated and/or multilobar (16.3%), parietal (9.8%), insular (5.7%), and other (3.4%). Extent of resection included gross-total or near-total resection in 170 patients (64.4%), subtotal resection (STR) in 89 patients (33.7%), and biopsy in 4 patients (1.5%). 12.5% experienced transient neurological worsening, resolved by first or second postoperative visit; new neurological deficits persisting beyond 3-months occurred in 3.4%. No mortalities occurred. Mean time to discharge was 2.67 +/- 3.15 days (range 1-44), with the majority discharged to home (92%; 7.6% discharged to inpatient rehabilitation). Pathologies included glioblastoma, IDH-wildtype (34.1%), astrocytoma, IDH-mutant (6.4% WHO grade 4; 11.4% WHO grade 3, 6.4% WHO grade 2), oligodendroglioma (6.4% WHO grade 3, 10.2% WHO grade 2), low-grade glial and glioneuronal neoplasms (4.5%), cavernous malformation (4.5%), metastases (4.2%), radiation necrosis (3.4%), meningioma (2.7%), epidermoid (1.5%), and other (4.2%).
Conclusions
Awake craniotomy with a combination of cortical and subcortical mapping can facilitate maximal safe resection with favorable safety profile in complex eloquent region tumors.

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The “midpoint” of optic tract as a key landmark for localizing center brain base structures: an anatomy study and case illustration

Mingchu Li

Department of Neurosurgery, Samii Clinical Neuroanatomy Research & Learning Center, Capital Medical University Xuanwu Hospital, China International Neuroscience Institute (China-INI), Xicheng District, Beijing 100053, China

Objective
To study the microsurgical anatomy of the center brain base, and to analyze the validity of the “midpoint” of optic tract as a key landmark for localizing the midbrain, dorsal thalamus, hypothalamus, temporal stem and anterior perforating substance.
Background
The center brain base is located above the center skull base and is composed of the midbrain, dorsal thalamus, hypothalamus, temporal stem, anterior perforating substance and other structures. The anatomy of this area is very complex and difficult to expose in microneurosurgical procedures. For deep located lesions in the center brain base, it’s also difficult to choose a reasonable surgical corridor and relative “safe” entry zone. In previous anatomy prosection and operations, we found the optic strut, in particular its “midpoint” is a key landmark in this kind of surgery.
Methods
Ten formalin-fixed brain base specimens from adult Chinese cadavers were meticulously dissected to investigate the morphology of the “midpoint” of optic tract, focusing on its relationship with midbrain, dorsal thalamus, hypothalamus, temporal stem, and anterior perforating sustance. Associated measurements were also conducted. Two center brain base cavernous malformation cases were also presented, showing how to use the “midpoint” of the optic tract to localize the lesion and deep structures, and the relative “safe” entry zone.
Results
The “midpoint” of the optic tract is defined as the intersection of the optic tract and midbrain. It is located at the junction of the midbrain, dorsal thalamus, hypothalamus, temporal stem, and anterior perforating substance. The “midpoint” of the optic tract is the anterior limit of the midbrain, the anteroinferior limit of the dorsal thalamus, the posterolateral limit of the hypothalamus, the medial limit of the temporal stem, and the posteromedial limit of the anterior perforating substance. By using the “midpoint” of optic tract as the landmark, the center brain base structures and deeply located lesions could be reliably localized in microneurosurgical operations.

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From virtual world to real world: 3D printing of digitalized cadaveric specimens

Betül Yaman[1], Abuzer Güngör[2], Hüseyin İkbal Akdemir[3], Semih Fidan[4], Berkan Darbaz[5], Maximiliano Alberto Núnez[6], Uğur Türe[7]

[1]Department of Neurosurgery, Ministry of Health, Etlik City Hospital, Ankara, Türkiye
[2]Department of Neurosurgery, Faculty of Medicine, Istinye University, Istanbul, Türkiye
[3]Department of Neurosurgery, Goztepe Prof. Dr. Suleyman Yalcın City Hospital, Istanbul, Türkiye
[4]Department of Neurosurgery, University of Health Sciences, Bakırköy Research and Training Hospital for Neurology, Neurosurgery, and Psychiatry, Istanbul, Türkiye
[5]Liv Hospital Group, Istanbul, Türkiye
[6]Department of Neurosurgery, Stanford University School of Medicine, Palo Alto, United States
[7]Department of Neurosurgery, Yeditepe University School of Medicine, Istanbul, Türkiye

Objective
The aim of this study is to create three-dimensional (3D) prints of cadaveric brain dissections through 2D photography of cadaveric brains and the creation of 3D models using photogrammetry.
Background
Three-dimensional models created through photogrammetry, which helps overcome limitations in neuroanatomy education such as the procurement of cadaver human brains, financial constraints, and inadequate laboratory conditions. 3D printing of these models, along with their practical use, contributes to neurosurgical surgical planning or the easy understanding of the complex structure of neuroanatomy.
Methods
In this study, as per Klingler's method, specimens designated for fiber dissection. After dissection, a photogrammetry system was utilized, involving the setup of a specialized photo studio. 2D photographs of cadavers were captured using a rotary table with an advanced single camera, and 3D models were subsequently generated using an independent software application and exported to a free application for further editing. Subsequently, 3D models were transferred to 3D printer.
Results
The 3D printed models we obtained are as follows: Model 1 is whole brain model, allowing for the detailed examination of the depth and height of all sulcal and gyral structures; Model 2 is dissected brain model, the dissections proceeded systematically, starting from the lateral aspect and progressing towards the medial aspect.
Conclusion
The 3D printed models are a cost-effective method that enables visual and spatial understanding of neuroanatomy, is easily accessible, and does not require digitalization during use.
Keywords
Neuroanatomy, Education, 3D virtual modeling, 3D printed modeling

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The use of Decorin to prevent cerebral vasospasm following experimental subarachnoid hemorrhage in rabbits

Betul Yaman[1], Cengiz Tuncer[2], Şahin Hanalioğlu[3], Husamettin Bulut[4], Ata Turker Arikok[5], Cem Dinc[6], Bora Gurer[7], Erhan Turkoglu[1]

[1]Department of Neurosurgery, Republic of Turkey, Ministry of Health, Etlik City Hospital, 06170, Ankara, Türkiye
[2]Department of Neurosurgery, Duzce Univesity, School of Medicine, 81620, Duzce, Türkiye
[3]Department of Neurosurgery, Hacettepe University, School of Medicine, 06230, Ankara, Turkey
[4]Neurosurgery Clinic, Private Edremit Körfez Hospital, 10325, Balıkesir, Turkey
[5]Pathology Clinic, Republic of Turkey, Ministry of Health, Etlik City Hospital, 06170, Ankara, Türkiye
[6]Department of Neurosurgery, Bagcilar Medipol Mega University Hospital, School of Medicine, 34214, Istanbul, Türkiye
[7]Neurosurgery Clinic, VM Medical Park Mersin Hospital, 33200, Mersin, Türkiye

Introduction
The development of cerebral vasospasm in patients with subarachnoid hemorrhage (SAH) is a major complication and a leading cause of death and disability. Studies indicate that changes in the vasospastic segment include smooth muscle and myofibroblast proliferation, cellular necrosis, and remodeling. Collagen storage and fibrosis are markers of intimal hyperplasia in the vascular wall. Transforming growth factor-beta (TGF-β1), released from coagulated blood in the subarachnoid space after SAH, contributes to vasoconstriction by stimulating fibroblast proliferation in the adventitia, and vascular smooth muscle cells in the media layer. Decorin, a natural inhibitor of TGF-β1, has not been explored for its potential to prevent SAH-induced vasospasm.
Objective
The aim of our study is to investigate the effects of decorin on vascular structure and neuronal damage in hippocampal regions in an experimental rabbit model of SAH-induced vasospasm.
Methods
In this study, male New Zealand white rabbits (2.5-4 kg) were divided into four groups: Control (n=8), SAH (n=8), SAH+decorin (n=8), and SAH+TGF-β1(n=8). Except for the control group, all other groups were induced with SAH. Decorin (0.1 mg/kg) was administered intraperitoneally once daily for three days in the decorin group. In the TGF-β1 group, 50μg of TGF-β1 were injected into the cisterna magna with autologous cerebrospinal fluid (CSF). After 72 hours, brain-cerebellum-brainstem was removed for histopathological examination. Basilar artery cross-sectional areas and wall thicknesses were measured using an analysis system. Vascular wall structure and neuronal degeneration in the hippocampus were evaluated immunohistologically in all groups (Figure-1) (Figure-2).
Results
Treatment with decorin significantly increased the basilar artery cross-sectional area compared to the SAH and TGF-β1 groups. The basilar artery wall thickness in the decorin group was significantly smaller than in the SAH and TGF-β1 groups (Table-1) (Figure-3a,3b). Hippocampal neuronal degeneration scores significantly decreased in the decorin and control groups compared to the SAH and TGF-β1 groups (Table-2). There was no significant difference in proliferating cell nuclear antigen-(PCNA) levels between the control and treatment groups.
Conclusion
In an experimental SAH model in rabbits, decorin treatment mitigated TGF-β1-induced vasospasm, reduced cerebral vasculopathy associated with vascular wall fibrosis, and decreased vessel wall thickness.
Keywords
Subarachnoid hemorrhage, cerebral vasospasm, decorin, TGF-β1

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Female sex is a negative predictive factor for treatment success after radiosurgery in vestibular schwannoma - a comparative study on sex-related differences

Sophie Shih-Yüng Wang[1], Albertus van Eck[2], Georgios Naros[1], Gerhard Horstmann[2], Marcos Tatagiba[1]

[1]University Hospital Tübingen, Tübingen, Germany
[2]Gamma Knife Center Krefeld, Krefeld, Germany

Objective
Sex-related differences in patients with sporadic, unilateral vestibular schwannoma (VS) are poorly investigated so far. In studies focusing on natural history, tumor growth was described to be indifferent in either sex. However, it remains unclear whether patient's sex affects the treatment response to stereotactic radiosurgery (SRS) or microsurgical resection (SURGERY). This study elucidates sex-related differences in VS care.
Methods
This is a retrospective two-center cohort study. Patients being treated for their VS between 2005 and 2012 were included. Previously treated VS and patients with neurofibromatosis were excluded. Clinical state was reported by House and Brackmann (H&B) and Gardner-Robertson (G&R) scale (with H&B<3 and G&R 1-2 considered as good outcome), and Recurrence-free-survival (RFS) was assessed radiographically by contrast-enhanced MR imaging. Data on VS-associated symptoms like trigeminal affection, tinnitus, and vertigo/imbalance were also collected.
Results
From the whole patient cohort of N=1,118, the majority of VS patients were female with 56%. Overall, the majority was treated with SRS (62%), there was no different in both sex groups (p=.072). When comparing provided care modality in either sex within same sized tumors, there was a significant lower rate of choice for SURGERY for women with 14% in KOOS I compared to men with 32% (p=.009). The rate of STR was significantly higher in women with 7% compared to men with 2% in men (p=.041). Mean follow-up time was 6.12 (±SD4.26) years. The incidence of recurrence was significantly higher in women treated with SRS compared to men with 14% treatment failure in women and 8% in men (p=.004).
Conclusion
The incidence of recurrence is higher in women with VS, when treated with SRS compared to men, although tumor characteristics were similar. Additional research is needed to elucidate sex-related difference in tumor biology affecting the response to VS treatment.

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Surgical monotherapy in vestibular schwannoma: the impact of distinct extent of resection grades on long-term tumor control numbers

Sophie Shih-Yüng Wang, Georgios Naros, Marcos Tatagiba

University Hospital Tübingen, Tübingen, Germany

Background
Residual tumor after vestibular schwannoma (VS) resection has been associated with higher incidence of recurrence despite VS benign tumor biology. However, the definition of residual tumor is very heterogenous. Subtotal resection (STR) is most frequently used on its own, only seldom near-total-resection (NTR) and decompressive surgery (DS) are distinguished. This study aims to analyze tumor control parameters in NTR, STR, DS and gross total resection (GTR).
Methods
This is a retrospective cohort study of solitary VS patients treated with microsurgical resection by retrosigmoid resection between 2005 and 2012. Patients were contacted 10 years after surgery report on radiographic tumor control by contrast-enhanced magnetic resonance imaging (MRI).
Results
N=426 patients met the inclusion criteria. Overall, the rate of GTR was 94%, with 3% NTR and 3% STR. Mean time of follow-up was 5.6 years. The rate of STR and NTR rose with tumor size. The highest rate of STR was present in Koos IV with 6% STR and 2% NTR. In GTR, the long-term recurrence rate was 5%, which was significantly lower compared in NTR (16%) and STR (54%). The recurrent event per one million patient days was 16 in GTR, 62 in NTR and 130 in STR. The median time to recurrence was the longest in NTR (7.2 years) and GTR (6.2 years), compared to STR (5.6 years).
Conclusions
The rate of recurrent events was significantly more frequent in STR and NTR. However, there is a difference in time to recurrence and frequency of recurrent events between NTR and STR themselves – therefore a more detailed classification in EOR of VS should be put forward to differentiate these clearly different patient groups with different postoperative oncological behavior.

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The impact of internal auditory canal extension on functional outcome in vestibular schwannoma treatment

Sophie Shih-Yüng Wang[1], Georgios Naros[1], Albertus van Eck[2], Gerhard Horstmann[2], Marcos Tatagiba[1]

[1]University Hospital Tübingen, Tübingen, Germany
[2]Gamma Knife Center Krefeld, Krefeld, Germany

Objective
Both stereotactic radiosurgery (SRS) and microsurgical resection (SURGERY) are valuable treatment options in vestibular schwannoma (VS) patients. However, surrogate markers for the oncofunctional outcome are needed to guide treatment decision. This study aims to analyze the impact of the tumor extension into the internal auditory canal (TE-IAC) on the outcome after SRS or SURGERY.
Methods
This is a retrospective dual-center cohort study (n=717) including patients with unilateral VS treated by either SRS (n=504/717, 70%) or SURGERY (n=213/717, 30%). All patients were treated between 2005 und 2011 to enable long-term follow-up. Imaging and clinical data were analyzed by independent reviewer to classify TE-IAC (OHATA), tumor size (KOOS), facial (House-Brackman, H&B) and hearing (Gardner-Robertson, G&R) function.
Results
Patients were categorized in the following subgroups: Group A (35%): small tumors (Koos I-II) with widespread TE-IAC (OHATA A-B); Group B (15%): small tumors (Koos I-II) without TE-IAC (OHATA C-E); Group C (27%): large tumors (Koos III-IV) with widespread TE- IAC (OHATA A-B); Group D (23%): large tumors (Koos III-IV) without TE-IAC (OHATA C-E).In the SRS group, there was a good facial (H&B<3, 97-100%) and hearing outcome (G&R1-2, 40- 63%) independent of the OHATA grading (p>0.05). In contrast, unfavorable facial functional outcome (H&B ≥3) of VS surgery was significantly worse in tumors with extensive TE-IAC (Group A/C, 13% and 25% , p=0.0179). Hearing preservation after VS surgery was lowest in Group C (27%), with similar values (43-56%) in the other groups.
Conclusion
Functional preservation was independent of OHATA Classification, when VS is treated by SRS. However, extensive TE-IAC (OHATA A-B) is associated with worse postoperative facial function after VS surgery, in both small and larger VS. Small tumors with widespread TE-IAC (OHATA A-B) were associated with higher rate of postoperative CSF fistulas, probably due to the need for extensive IAC drilling.

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Tumor size and treatment success/failure after stereotactic radiosurgery in vestibular schwannoma

Sophie Shih-Yüng Wang[1], Georgios Naros[1], Albertus van Eck[2], Gerhard Horstmann[2], Marcos Tatagiba[1]

[1]University Hospital Tübingen, Tübingen, Germany
[2]Gamma Knife Center Krefeld, Krefeld, Germany

Background
Stereotactic Radiosurgery (SRS) is a valid minimally-invasive treatment option in vestibular schwannoma. However, it has been shown that not all VS respond positively to SRS (treatment success). This study aims to correlate treatment success/failure to initial tumor volume to identify potential surrogate marker to identify non-responder VS to SRS.
Methods
This is a retrospective cohort study. The patient collective was identified by a prospectively kept registry and the clinical data was retrospectively collected. Only solitary VS was included, VS associated with neurofibromatosis was excluded.
Results
The study cohort included N=928 VS patients treated with SRS between 1998 and 2019, who met the above-mentioned inclusion criteria. Mean follow-up time was 6.37 (±3.96) years. The rate of treatment failure was different in the different Koos-subroups with the lowest rate in Koos I at 4%, 10% in Koos II, the highest in Koos III with 13% and 10% in Koos IV. Mean time to recurrence was 4.49 (±2.64) years overall, with the longest mean time to recurrence in Koos I at 5.46 (±4.14) years, 4.97 (±2.85) years in Koos II, 4.52 (±2.70) years in Koos III, and 4.75 (±4.50) years in Koos IV. However, Postinterventional tumor shrinkage was the highest with 60% of the initial tumor volume in Koos IV, 52% in Koos III, 42% in Koos II and 40% in Koos I.
Conclusion
There is a clear correlation of treatment success/failure to tumor volume: The rate of treatment success decreases with increasing tumor size after Stereotactic Radiosurgery in vestibular schwannoma. SRS treatment strategy for should be improved in order to better treatment response in large vestibular schwannoma.

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Recovery of post-operative facial palsy after microsurgery (retrosigmoid approach) of vestibular schwannoma

Sophie Shih-Yüng Wang, Georgios Naros, Marcos Tatagiba

University Hospital Tübingen, Tübingen, Germany

Background
Postoperative facial palsy after microsurgical resection of vestibular schwannoma (VS) is often only temporary. This study aims to in detail analyze the long-term recovery rates and development of facial motoric function after surgical tumor resection according early post-operative motoric facial status.
Methods
Patients treated between 2008 and 2015 for vestibular schwannoma via retrosigmoid approach with anatomical preservation of the facial nerve were included. Facial motoric function was quantified by House-Brackman (HB) scale and patients photographs were taken prospectively. Other clinical information was retrospectively analyzed. HB I-II was defined as good and HB III-VI as poor facial outcome.
Results
N=521 patients were included. Overall, long-term good facial outcome was achieved in 85%, while 15% presented with long-term relevant facial palsy. 46% (N=241/521) of all patients presented with early post-operative HB I. 20% (N=106/521) presented with a slight post-operative deterioration of HB II, of which 94% (N=100/106) recovered spontaneously after one year to HB I. 11% (N=58/521) had an early post-operative HB III, of which 84% recovered spontaneously at one year follow-up to good facial outcome. 16% (N=82/521) presented with early post-operative HB IV, of which 50% had recovered to good facial outcome at 1-year-FU. HB V was present early-post operative in 6% (N=31/521), of which 32% recovered to good facial outcome. 0.6% (N=3/521) presented with HB VI, of which only one recovered to HB II. Post-operative facial palsy recovery was independent of patient sex, and patient age (p=0.432; p=0.458).
Conclusions
Long-term post-operative recovery rate after VS surgery of a direct postoperative status of HB II to HB I is 94%. If severe facial deterioration (HB III-IV) occurred, the best recovery rate was at HB III with 84%, followed by 50% at HB IV, and only 32% at HB V. Postoperative facial palsy recovery was independent of patient demographics (age, sex, etc).

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Time after vestibular schwannoma treatment: annual risk of tumor recurrence after radiosurgery or microsurgery

Sophie Shih-Yüng Wang[1], Gerhard Horstmann[2], Albertus van Eck[2]; Marcos Tatagiba, Georgios Naros[1]

[1]Department of Neurosurgery, Eberhard Karls University, Tubingen, Germany
[2]Gamma Knife Center, Krefeld, Germany

Background
Although vestibular schwannoma (VS) is a benign tumor entity (CNS Grade I), both available treatments radiosurgery (SRS), and microsurgery (SURGERY), must be followed up for potential tumor recurrence/progression. However – the estimated risks are imprecise and predictors for tumor recurrence/progression remain uncertain. We aimed to obtain estimates of annual risk of tumor recurrence during post-interventional follow-up in VS.
Methods
This is a retrospective dual-center cohort study enrolling consecutive patients with sporadic VS between 2005 and 2012. Recurrence-free-survival was assessed radiographically by contrast-enhanced MR imaging. Extent of resection was classified in the 3 months postoperative MR imaging according to residual tumor (STR) or gross-total-resection (GTR).
Results
N=1,230 patients were included in this study. 66% were treated with SRS and 34% with SURGERY. The overall incidence of tumor progression in SRS-treated VS was 11%. In SURGERY, the incidence of tumor recurrence was significantly lower at 5%. The risk for VS recurrence was 1,68% per year in SRS-treated VS compared to 1.29% per year in SURGERY. However, in SURGERY, the risk for recurrence was significantly lower in VS patients, where GTR was achieved (0,98% per year) compared to STR (6.29% per year). In SRS-treated VS, the yearly-risk was increased with tumor size yielding in an annual risk of 0.39% in Koos I, 1.85% per year in Koos II, 2.08% per year in Koos III, and 1.56% per year in Koos IV.
Conclusions
The overall annual risk for tumor progression was lower in SURGERY compared to SRS, especially in GTR. The risk for tumor progression in SRS-treated VS rose according to tumor size.

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Selctive posterior callosotomy

Thomas Frigeri, William Martins, Rafael Paglioli, Fernanda Schu, Andre Palmini, Eliseu Paglioli, Mauricio Marchiori, MD.

This video is about the selective posterior technique for treatment of refractory generalized epilepsy that clinically presents itself with drop attacks (or sudden falls). It is a new approach different from the long performed anterior callosotomy. By cutting the posterior 2/3rds of the corpus callosum we treat the drop attacks with excellent results and spare the pre-frontal fibers essential to cognitive and planning functions. We have proved and reported in previous papers that the disconnection of the primary motor and dorsal supplementary motor areas is enough to practically cease the drop attacks without any neurological deficits.

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Subpial en bloc resection microsurgical technique for gliomas has superior oncological and functional outcomes in hemispheric infiltrating gliomas

Aliasgar Moiyadi[1,3], Prakash Shetty[1,3], Vikas Singh[1,3], Amit Janu[2,3]

[1]Neurosurgical Oncology services, Dept of Surgical Oncology, Tata Memorial Centre, Mumbai, India
[2]Department of Radiodiagnosis, Tata Memorial Centre, Mumbai, India
[3]Department of Health Sciences, Homi Bhabha National Institute, India

Background
Surgery remains the mainstay of glioma therapy and the extent of resection is an important prognostic factor. Optimization of surgical outcomes is essential, and to this end, the technique of resection can potentially play an important role. Based on patterns of glioma growth and extrapolating from other solid cancer surgical principles, a subpial dissection combined with an en-bloc resection (SPER) technique has substantial advantages
Methods: A propensity matched analysis was performed to compare gliomas that were resected using SPER versus a standard piecemeal debulking technique at our centre. Potentially confounding factors (including eloquent location, use of intraoperative imaging, surgeon experience) were adjusted for in the matching of the two cohorts. Outcomes included postoperative morbidity and blinded radiological review documented postoperative ischemia (on diffusion weighted MR imaging - DWI) as well as extent of resection. Illustrative cases are presented.
Results
In 57 gliomas (23 SPER and 34 standard), the gross total resection (GTR) rates were significantly higher with SPER (91% vs 65%). Postoperative DWI revealed significant ischemia in almost 50% of cases in either group, though many did not have postoperative deficits. Arterial ischemia was higher in the standard surgery group and this was associated with a significantly higher risk (seven times) of resulting in prolonged neurological deficits.
Conclusions
SPER microsurgical technique increases the GTR rates in hemispheric gliomas undergoing resection without any added neurological morbidity. It is also associated with a lower incidence of arterial ischemia in the postoperative period. This should be considered the gold standard for such gliomas.
Previous publication
Mishra A, Janu A, Trivedi K, Shetty P, Singh V, Moiyadi A. Subpial en bloc resection improves extent of resection in infiltrating gliomas - A propensity matched comparative cohort analysis. Clin Neurol Neurosurg. 2022 Apr;215:107197. doi: 10.1016/j.clineuro.2022.107197. Epub 2022 Mar 5. PMID: 35305392.

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Surgical treatment and outcomes of skull base meningiomas: a 10-year experience from a single center

Zhen Wu

Department of Neurosurgery, Beijing Tiantan Hospital, Capital Medical University, Beijing, China

Objective
To explore the surgical treatment strategies and functional prognosis for skull base meningiomas.
Methods
A retrospective analysis was conducted on 1,546 patients with skull base meningiomas who underwent surgical treatment in the skull base unit of Tiantan Hospital from 2007 to 2017. Clinical data, imaging findings, and long-term clinical outcomes were evaluated through follow-up.
Results
Among the 1,546 cases, 394 were male (25.5%) and 1,152 were female (74.5%), with a mean and median age of 49.3 and 50 years, respectively. A history of prior surgery or radiotherapy was present in 104 cases (6.7%). The mean preoperative disease course was 28.0 months. Initial symptoms included non-specific symptoms in 698 cases (45.1%), cranial nerve symptoms in 580 cases (37.5%), and pyramidal tract signs in 70 cases (4.5%), with 64 patients reporting no subjective discomfort. The most common initial symptoms were headache (462 cases, 29.9%), dizziness (201 cases, 13.0%), visual impairment (188 cases, 12.2%), and facial sensory reduction (114 cases, 7.4%). The preoperative, postoperative, and follow-up Karnofsky Performance Scale (KPS) scores were 80.5, 73.3, and 81.4, respectively. Tumor distribution included the anterior, middle, and posterior cranial fossa in 63, 355, and 1,128 cases, respectively, with the petroclival region accounting for the largest number of cases (531 cases, 34.3%), followed by the sellar region (155 cases, 10.0%), foramen magnum region (149 cases, 9.6%), and sphenoid ridge (143 cases, 9.2%), with an average tumor size of 3.6 cm. Surgical approaches were chosen based on tumor location, including preauricular subtemporal transtentorial (323 cases, 20.9%), frontotemporal (264 cases, 17.1%), anterior to the sigmoid sinus (187 cases, 12.1%), and posterior to the sigmoid sinus (171 cases, 11.1%). Gross total resection (Simpson grade I-II) was achieved in 1,162 cases (75.2%), near-total resection (Simpson grade III-IV) in 336 cases (21.7%), and partial resection (Simpson grade III-IV) in 48 cases (3.1%). The complication rate was 24.7%, with 6 (0.4%) and 9 (0.6%) surgical deaths within 1 and 3 months postoperatively, respectively. Postoperative radiotherapy was administered in 72 cases (5.2%). During an average follow-up period of 58.2 months, 83 cases (6.0%) experienced recurrence, and 48 cases (3.5%) died, with tumor recurrence being the cause of death in 32 cases (2.3%). The 1-, 3-, 5-, and 10-year progression-free survival rates were 99.4%, 97.9%, 94.6%, and 90.0%, respectively, while the overall survival rates were 99.8%, 99.4%, 97.0%, and 92.1%.
Conclusion
Surgical treatment of skull base meningiomas offers favorable outcomes. An individualized treatment strategy should be developed based on tumor location and imaging characteristics to achieve maximal resection and minimize complications. Close follow-up is required for cases with incomplete resection, and surgical intervention or radiotherapy should be considered in case of tumor recurrence to control disease progression.

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Preservation of the lateral branches of the supraorbital nerve during frontotemporal craniotomy

Yandong Su

Department of Neurosurgery, Zhongshan Hospital, Xiamen University, Xiamen, China

Objective
Preauricular curvilinear incision extending to the midline is widely used for frontotemporal craniotomy, and the lateral branches of the supraorbital nerve (lb SONs) are routinely sectioned during the skin incision. Here I presented the detailed anatomy of the lb-SONs and described the surgical techniques for lb-SONs preservation.
Method
i) Layer-by-layer dissections of the scalp over the bilateral frontotemporoparietal regions were performed on six formalin-fixed, red silicone-injected cadaveric heads using an operating microscope.
ii) The surgical techniques for preserving the lb-SONs were as follows: Initially, the incision area was infiltrated with a properly diluted epinephrine solution. The frontal scalp layers above the periosteum were then incised to expose the lb-SONs. The skin flap was carefully separated as close to the periosteum as possible to preserve the lb-SONs and avoid damaging the temporal branches of the facial nerve
(TBFNs). Finally, the periosteum was incised along the superior temporal line and pushed medially to expose the frontal bone, allowing for the craniotomy. These techniques were consecutively applied in ten patients.
Result
i) The supraorbital nerve divided into medial and lateral branches after exiting the supraorbital foramen. In two sides (2/12, 16.67%), the lb-SONs left the skull through a separate bony canal. Adjacent to the superior temporal line, the lb-SONs traveled along the outer surface of the periosteum for a variable distance and extended posteriorly toward the parietal eminence. Within a short distance, the lb SONs penetrated the loose areolar connective tissue and the frontalis muscle, reaching the subcutaneous layer. The number of lb-SONs varied at different levels and distinguishing them from the medial branches was sometimes challenging. In frontal region, all TBFNs traveled within the loose areolar connective tissue and the frontalis muscle.
ii) Anatomical preservation of the lb-SONs was achieved in two cases, with no numbness noted in the area supplied by the lb-SONs, and symmetrical bilateral frontal creases maintained both postoperatively and during follow-up in both cases. In the remaining eight cases, the lb-SONs were sectioned due to their short courses along the periosteum or posterior located incision attributed to the patients' high hairlines.
Conclusion
The lb-SONs course along the outer surface of the periosteum for a variable distance before penetrating into the subcutaneous layer. By carefully elevating the scalp, it is possible to preserve the lb-SONs, provided that the sites where the nerves exit the periosteum are located posterior to the incision.

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Effectiveness of woven endobridge device for the treatment of intracranial bifurcation and wide neck aneurysms: a systematic review and meta-analysis

Leopoldo Pérez García, Jorge Alberto Cantu Hernandez, César Bigran Espinosa, Pablo Adrián Luna Pérez, Maurilio Ochoa González, Jesús Alberto Morales Gómez, Angel R. Martínez Ponce De León

Servicio de Neurocirugía y Terapia Endovascular Neurológica. Hospital Universitario "Dr José Eleuterio González", Universidad Autónoma de Nuevo León, México

Background
The use of Woven Endobridge (WEB) is a contemporary and effective approach to wide neck and bifurcation aneurysm. We compared clinical and angiographic outcomes between WEB and other endovascular devices in terms of safety and efficacy.
Aims
To assess the efficacy and safety of the WEB in wide neck bifurcation aneurysms compared with other endovascular devices.
Methods
A systematic review was conducted by screening non-randomized interventional studies that compared the use of WEB with any other endovascular device for the treatment of bifurcation and wide neck intracranial aneurysms. Main outcomes included angiographic occlusion classification (rated by RROC), good functional status after embolization (mRS ≤2), and post-surgical complications (related or not to the procedure). Outcomes were analyzed pooling the treatment effect as Odds Ratios (OR) through a random-effecs model using the Mantel-Haenszel method. Cochran's Q and I2-statistics were used to assess heterogeneity. Statistical analysis was made employing RStudio software.
Results
Among 751 studies screened, only 11 references were considered for the final review and 8 for quantitative synthesis. A total of 1,658 patients were included, and 432 of these were treated with the WEB device. Meta-analysis of the safety-related outcome showed an overall significant decrease in the complications rates of patients treated with WEB compared with Stent-Assisted Coiling (Overall OR [CI95%] 0.34 [0.14-0.83], p=.02). Clinical and radiological assessment at discharge showed that patients treated with WEB presented an overall significant higher proportion of mRS score ≤2 (Overall OR [CI95%] 1.47 [1.01-2.13]; p=.04), but a significantly lower proportion of adequate occlusion (Overall OR [CI95%] 0.07 [0.01-0.70]; p=.03) compared with coiling. Subgroup analysis showed a significant heterogeneity (Q=19.61; p=<.001) between the overall effect in mRS score in unrupted (Overall OR [CI 95%] 2.78 [1.10-6.98]) compared with ruptured aneurysms (Overall OR [CI 95%] 1.39 [0.76-2.52]).
Conclusion
The WEB device demonstrated acceptable efficacy and safety compared with other endovascular devices, but there is still not enough high-quality evidence that justifies a preference for a specific device in the treatment of wide-neck bifurcation aneurysms. This decision should still be relied on the surgeon's personal and clinical experience.

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Surgical outcome of cerebellopontine angle meningiomas via a retrosigmoid approach: a single-center experience in Vietnam

Luan Trung Nguyen Dao[1], Hong-Hai Do[1,2], Minh-Anh Nguyen[1,2], Thanh-Lam Nguyen[1]

[1]Department of Neurosurgery, University Medical Center, Ho Chi Minh City, Vietnam
[2]Faculty of Medicine, University of Medicine and Pharmacy, Ho Chi Minh City, Vietnam

Objectives
Evaluate the surgical results of cerebellopontine angle (CPA) meningiomas via a retrosigmoid approach at the Department of Neurosurgery, University Medical Center at Ho Chi Minh City, Vietnam.
Methods
This study investigated the outcomes of the retrosigmoid approach for CPA meningiomas in 36 patients. Demographic characteristics and surgical outcomes were recorded on admission, post-operation for 3-month, and 12-month follow-up. Surgical outcome was measured by using the Glasgow Outcome Scale (GOS), the extent of resection (EOR), and the reservation of cranial nerves. Statistical analysis was conducted to identify the factors influencing outcomes.
Results
The data showed 69.4% of the patients had a CPA meningioma with a size over 30 mm. Intraoperatively, the most common site of dural attachment was supra-meatal (33.3%) and only one patient had a tumor centered on internal acoustic meatus (IAM). Gross total resection was achieved in 25 patients (69.4%). Good functional status (GOS 4-5) at discharge was 77.8% and at 12-month follow-up was 88.9%. Large tumors (>30mm) with brainstem compression, brainstem edema, flow-void within tumor, and invasion of cranial foramina (Meckel's cave, jugular foramen) significantly impacted the outcome ($p<0.05$). Tumors invading the IAM were associated with a significantly higher risk of facial palsy compared to those without IAM involvement. Besides, aspiration pneumonia was strongly related to poor outcomes ($p<0.05$).
Conclusion
Most CPA meningiomas can safely be resected via a retrosigmoid approach, highlighting the importance of meticulous surgical technique and post-operative care. However, careful consideration of factors like tumor size, flow-void within tumor, brainstem compression, brainstem edema, and potential complications (due to invasion of cranial foramina) can help optimize surgical strategy and improve long-term functional outcomes.
Keywords
CPA meningiomas, Retrosigmoid approach, Surgical outcomes
Abbreviations
CPA – cerebellopontine angle; GOS – Glasgow outcome scale; EOR – extent of resection; IAM – internal acoustic meatus

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Post-traumatic cerebral infarction

Karthik Nandam

This case report challenges the conventional association of post-traumatic cerebral infarctions solely with severe traumatic brain injuries, emphasizing the critical consideration of such infarctions in children with mild traumatic brain injuries. While the incidence of post-traumatic cerebral infarctions in mild cases is notably rare, this report underscores the necessity of this consideration, particularly in cases involving persistent low Glasgow Coma Scale (GCS) and enduring deficits post-trauma. The conventional causes fail to explain the pathophysiology in the case presented here as CT cerebral angio and DSA negative. However, a high degree of suspicion and aggressive intervention helped save the child.