**MS1-1-1** Chordoma: Can we achieve cure?

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**MS1-1-2** Cranial chordomas: A pre-operative grad system and correlation with resection and outcomes

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A new grading system for cranial chordomas has been designed by the senior author (LNS) using parameters obtained from pre-operative imaging and the patient’s previous clinical history. Its purpose is to enable comparison of different tumors with a similar pathology, and evaluating the degree of resection more accurately to design appropriate surgical approaches, compare postoperative outcomes, and adequately plan postoperative radiotherapy.

The grading system utilizes the following parameters: tumor size, site of the tumor, vascular involvement, intradural extension, brain stem invasion and recurrence of the tumor either after surgery or radiotherapy; with a range of 2-27 points. The grading system was used in 42 consecutive patients and the scores obtained allowed us to perform a statistical analysis.

The patient’s grades were classified into three groups: low-risk 0-7 points, intermediate-risk 8-13 points and high-risk ≥14 points in the grading system. Our grading system was statistically correlated with: cranial base or combined approach against purely endonasal endoscopic approach (p=0.008); extent of resection (partial, subtotal, or complete) (p<0.012); number of operative stages to achieve removal (p<0.014); tumor recurrence (p<0.011); and post-operative Karnofsky Performance Status (KPS) (p<0.001). We found that this system correlated very well with all of the parameters examined statistically.

We believe that wide application of this system will help surgeons to predict the difficulty of the case and know which areas of the skull base will need attention to plan the therapy.

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**MS1-1-3** Treatment of clival and craniocervical junction chordomas

David Choi
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Clival and craniocervical chordomas are difficult to treat due to the proximity of tumour to eloquent structures, limited surgical access, and tendency to recur. Maximal surgery is the mainstay of treatment, with post-operative radiation therapy or heavy particle therapy.

We present our experience of chordomas at the craniocervical junction and clivus, treated by endoscopic endonasal surgery, transoral surgery, and other miscellaneous techniques. Overall surgical trends have changed with time, together with complication profiles. Transoral surgery has lower risk of CSF leakage, and minimal risk of infection, but usually requires occipitocervical fixation. Endoscopic surgery has allowed greater extent of tumour removal in the clival region, but with an increased CSF leak rate. Transoral surgery is now used for tumours presenting below the level of the hard palate, whereas endoscopic surgery is used for mid and upper clival tumours.

The increasing role of proton beam therapy has influenced the surgical management and use of metal-work stabilisation, and long-term outcomes are awaited.

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**MS1-1-4** Chordomas

Sebastien Froelich
Department of Neurosurgery, Lariboisiere Hospital, France

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**MS1-1-5** Proton radiotherapy for adult cases with clival chordoma

Koji Tsuboi1, Masashi Mizumoto1, Tetsuya Yamamoto2, Shingo Takano2, Toshiyuki Okumura1, Hideyuki Sakurai1, Akira Matsumura2
1 Departments of Radiation Oncology, University of Tsukuba, Japan, 2 Departments of Neurosurgery, University of Tsukuba, Japan

Objectives: To evaluate the hyperfractionated high dose proton beam therapy (PBT) for patients with clival chordomas.

Methods: Records for 19 patients with pathologically verified clival chordomas treated with surgery followed by hyperfractionated PBT were retrospectively reviewed. The first 9 consecutive patients were treated with 77.44 cobalt Gray equivalents (CGE) in 64 fractions, and the latter 10 patients were treated with 78.4 CGE in 56 fractions.
Results: The median follow-up period of all 19 cases was 61 months with a range from 24.9 to 88.8 months. At 5 years, the local control, cause-specific, and overall survival rates for all 19 cases were 75, 94, and 81.5%, respectively. Whereas the 5-year local control and cause specific survival rates of the latter 10 cases were both 100% with a median observation period of 48.1 months. One of the first 9 patients demonstrated bilateral temporal lobe radiation necrosis, who was successfully treated conservatively. In the latter cohort, two cases showed transient neurological symptoms probably due to brain stem ischemia, but both cases recovered completely with conservative treatment.

Conclusions: In a long-term observation period, high dose proton beam radiotherapy using a hyperfractionation scheme yielded a more favorable outcome compared to previous reports.

MS1-2-1 Endoscopy versus craniotomy: Where are we on Scott’s Parabola in 2016?
Jacques Morcos
Department of Neurosurgery, University of Miami, USA

MS1-2-2 Management of craniopharyngiomas: Open vs. endoscopic techniques
Fred Gentili
Department of Neurosurgery, University of Toronto, Canada

MS1-2-3 Appropriate surgical indication of endoscopic endonasal approach for complicated skull base tumors
Takeo Goto
Department of Neurosurgery, Osaka City University Graduate School of Medicine, Japan

Object: As the recent advancement of endoscopic surgical technique, some kind of complicated skull base tumors start to be successfully resected via endoscopic endonasal approach (EEA). But surgical radicality of EEA to skull base tumors remains unclear for less surgical experience of EEA compared with that of transcranial approach (TCA). In this paper, we will present our surgical results of EEA to complicated skull base tumors and would like to consider appropriate indication of EEA to these tumors.

Materials and methods: Since January 2013, 39 complicated skull tumors except pituitary adenomas were resected via EEA in our institute. 39 tumors were composed of 15 cranio-pharyngiomas, 9 chordomas, 7 chondrosarcomas, 4 clival meningiomas, 1 trigeminal schwannoma, 1 vidian nerve schwannoma, 1 hypoglossal schwannoma and 1 cholesterol granuloma. Through our experience of skull base tumors via transcranial and endonasal approach, we made a hypothesis that skull base tumors located within the skull base circle which connects all cranial neural foramen from optic canal, then to superior orbital fissure, to foramen rotundum, to foramen ovale, finally reaching to hypoglossal canal can be safely excised via EEA. Our surgical selection of EEA or TCA was decided on this hypothesis.

Results: In the 15 cases with craniopharyngioma, total resection was achieved in 14 cases. Tumors in the third ventricle and posterior fossa were safely removed with upper clivectomy in addition to drilling of the tuberculum sellae. All chordomas and chondrosarcomas involving clivus, petrous bone and cavernous sinus were gross totally removed even they had intradural invasion. Wide exposure of the petrosal internal carotid artery and extended bony drilling of pterygoid process and anterior part of petrous bone allowed us to meticulously remove the tumors like microscopic maneuvers. In 4 cases of clival meningiomas, wide clivectomy was effective for early dural detachment of the tumor. Other tumors occupying pterygopalatine fossa, petrous bone and hypoglossal canal also could be totally removed via endonasal route.

CSF leakage appeared in initial 3 cases but neurological function did not deteriorate in all cases.

Conclusions: Skull base tumors within the presented skull base circle can be safely and radically removed via EEA

MS1-2-4 Complications of nasoseptal flap reconstruction
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Object: We reviewed our experience with the nasoseptal flap (NSF) to describe complications and nasal morbidity associated with the use of this flap.

Methods: A retrospective review of endoscopic endonasal surgeries (EES) was performed to identify the incidence and risk factors for NSF necrosis and postoperative nasal deformities.

Results: Of 601 patients undergoing EES with NSF reconstruction, 1.2% of patients had NSF necrosis; only 3 of 8 patients had a CSF leak. Necrotic NSF were less likely to enhance on postoperative imaging (p<0.001) and these patients were more...
likely to develop meningitis (p=0.001). Risk factors for necrotic NSF included prior EES. 5.8% of 328 patients undergoing EES developed nasal dorsum collapse postoperatively and were only observed in patients with NSF reconstruction (p=0.0001).

Conclusions: The NSF is a reliable and effective method of reconstruction during EES of the skull base. The risk of NSF necrosis is low. Patients who develop meningitis with a non-enhancing flap on MRI should be evaluated for NSF necrosis. Nasal dorsum collapse following EES is associated with NSF reconstruction. The mechanism is not known.

MS1-2-5 Extended endoscopic transsphenoidal approach infrachiasmatic corridor (including tuberculum sella meningiomas, craniopharyngioma and other pathologies)

Savas Ceylan
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Infrachiasmatic corridor (IC) which is made up by Liliequist’s Membrane and with it’s leaves Diencephalic and Mesencephalic leaf. Inferior approach using IC, allows access to the lesions through the tumor growth that is favorable. We performed extended endoscopic transsphenoidal approach using IC for 73 cases. The infrachiasmatic approaches were performed for tuberculum sella meningiomas (n=35), craniopharyngiomas (n=23), suprasellar Rathke cleft cyst (n=6), pituitary adenoma (n=3), fibrous dysplasia (n=1), granular cell tumor (n=2), and epidermoid tumor (n=3). Total resection was achieved in 29 of 35 (%83) with tuberculum sella meningiomas. 31 patients presented with visual disorders and 23 of them improved. 23 patients were operated on by infrachiasmatic approach for craniopharyngiomas, 15 patients presented with visual disorders and it was found to have improved in 9 of them. Complete tumor resection was performed in 18 of 23 cases, cyst aspiration in 3 cases. IC provides an easier and safer inferior route for the removal of middle midline skull base lesions in selected cases.

MS1-2-6 Endoscopic endonasal surgery for meningiomas: Advances and limitations

Paul A. Gardner
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MS1-3-1 Infratemporal fossa approach

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MS1-3-2 Management of the infratemporal fossa for malignancy

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There has been a considerable evolution in the management of patients with advanced sinonasal malignancy extending to the skull base, as well as the rare primary malignancy arising in the infratemporal fossa. The presenter will focus on the diagnostic evaluation of this patient population stressing both the radiographic and histologic parameters, which will impact upon treatment selection. Surgical strategies in terms of access to the tumor, extent of surgical resection, and an appropriate reconstruction will all be detailed. Deployment of endoscopic approaches, transfacial approaches and transcranial access will all be detailed. Utilization of appropriate multidisciplinary care incorporating the medical and radiation oncologist will also be stressed. Strategies for overall reduction of the morbidity associated with treatment will be discussed. Upon completion of this presentation, the attendee should understand the nuances in terms of management of both advanced carcinomas of the maxillary sinus invading the infratemporal fossa and primary lesions arising within this site.

MS1-3-3 Pure endoscopic and combined approaches to the petrous apex tumors

Giovanni Danesi
ENT Department and Microsurgery of Skull Base, Ospedali Riuniti, Italy
MS1-3-4  The role of endoscopy for surgical management of infratemporal fossa tumors

James K. Liu
Department of Otolaryngology – Head and Neck Surgery, Rutgers New Jersey Medical School, USA

MS1-3-5  Endoscopic transsphenoidal anterior petrosal approach for petroclival tumors

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Department of Neurosurgery, The University of Tokyo, Japan

Object: To present experience with endoscopic transsphenoidal “anterior petrosal” approach (ETAP) through the retrocarotid space (RCS) for tumors in petroclival (PCL).

Methods: We performed ETAP for the 27 tumors (16 chondrosarcomas, 9 chordomas, 2 meningiomas), in which 12 extensively occupying internal auditory canal or jugular fossa. After wide anterior sphenoidotomy, tumors were approached with antero-medial petrosectomy through RCS, defined by the cavernous and vertical segments of internal carotid artery, and the petro-occipital fissure. Surgical procedure was mainly performed under 30° and 70° scopes.

Results: Gross total/subtotal resection was achieved in 20/4 tumors, respectively. All patients with abducens nerve palsy preoperatively showed improvement within 6 months. In a patient with hearing loss with facial palsy, facial palsy completely resolved, but hearing loss remained. As complications, 5 showed mild and transient abducens nerve palsy. CSF rhinorrhea requiring surgical repair was observed in 1.

Conclusions: ETAP can reach more extensive areas in the extradural regions than transcranial approach, offering a simple, less-invasive option for PCL tumors.

MS1-3-6  Distinct endoscopic endonasal approaches to paraclival skull base lesions

Masaaki Taniguchi, Hidehito Kimura, Eiji Kohmura
Department of Neurosurgery, Kobe University Graduate School of Medicine, Japan

The endoscopic endonasal removal of paraclival lesions was retrospectively analyzed for the access route used. The upper paraclival lesions at the petrous apex were approached from medial to lateral direction circumventing the paraclival carotid artery using various malleable and steerable instruments (Retrocarotid approach, Acta Neurochirurgica, 2012) up to the trigeminal impression and abducens nerve. The middle paraclival lesions at the lower petrous apex were approached through the space between the petrous carotid artery and the Eustachian tube (trans-lacerum approach, J Neurosurg, 2015) up to the internal auditory canal and jugular foramen. The lower paraclival lesions at the level of hypoglossal canal and occipital condyle were approached by reflecting the Rosenmüller fossa mucosa and partially resecting the torus tubarius (trans-Rosenmüller fossa approach) reaching up to the medial parapharyngeal space.

Approach to paraclival lesions can be categorized into three. Selecting the distinct approaching route appropriate for each lesion helps surgeon to understand the necessary minimum resection of paranasal and skull base structures, and the range of access thus being created.

MS1-4-1  Posterolateral access to the foramen magnum - All problems solved?

Helmut Bertalanffy
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[Background] Surgery for jugular foramen tumors is very difficult to obtain good surgical results. Selecting an appropriate approach and strict intraoperative nerve monitorings are mandatory for excellent surgical results. [Patients] The author surgically treated 107 patients with jugular foramen tumors, including 48 jugular foramen schwannomas, 11 hypoglossal schwannomas, 24 meningiomas, 18 glomus jugulare tumors and 6 others. Intraoperative continuous vagus nerve monitoring by direct electrical stimulation of vagus nerve was used in surgery for these tumors. [Results] Vagus nerve function after surgery was generally good and hearing improvement was observed in 53% of patients with jugular foramen schwannomas. In glomus jugulare tumor, total or nearly total removal was achieved in most cases, however, five patients required additional radiation therapy for tumor recurrence. [Conclusions] Using intraoperative continuous vagus nerve monitoring is useful in surgery for jugular foramen tumors. Postoperative hearing improvement was frequently observed in patients with jugular foramen schwannomas.
MS1-4-4  Foramen magnum meningiomas: Choosing the best approach
Jose Alberto Landeiro1,2, Edson Rocha Constantino1,2
1Department of Neurosurgery, Universidade Federal Fluminense. 2Department of Neurosurgery, Hospital Universitário Antônio Pedro, Brazil

Surgical limitations must be given in designing an approach to the lesions placed in the foramen magnum. The approaches depend on the position of the tumor in relation to the brain stem, vertebral arteries and the shape of the foramen. The presentation reviews the indications of these approaches after treating 49 patients with ventral and lateral craniocervical lesions. There were 20 meningiomas, 12 neurinomas and 17 chordomas. The majority of patients presented with headache, oculomotor nerves deficits, visual deficit, neck pain, mielopathy, lack of motor coordination, numbness and incapacity to walk. The most used approach was the far lateral posterolateral approach with partial or not resection of the occipital condyle and the C1 facet. Radical resections were obtained in the majority of the patients. There was a late postoperative death. Six required tracheotomy and gastrostomy after surgery, five transitory. New cranial nerves deficits accommodated 11 patients, most transitory. CSF leak occurred in three and was clinically treated. The far lateral approach provides direct access to the pathologies placed on the ventrolateral aspects of the clivus and the craniovertebral junction.

MS1-4-5  Foramen magnum meningiomas: Surgical results and risks predicting poor outcomes
Zhen Wu, Jun-Ting Zhang, Da Li
Department of Neurosurgery, Beijing Tiantan Hospital, Capital Medical University, China

Object: The study aimed to evaluate neurological function and recurrent outcome of foramen magnum meningioma (FMM).

Methods: This study included 185 consecutive cases of FMMs. Type A (n=49), the dural attachment of the lesion grew below the vertebral artery (VA); Type B (n=39), the dural attachment of the lesion grew above the VA; Type C1 (n=84), the VA coursed across the lesion with or without VA encasement; and Type C2 (n=13), Type C1 plus partial/total encasement of VA and extradural growth.

Results: Type C2 lesions inherently harbored larger size (p=0.001), higher percentage of ventrolateral location (p=0.009), and VA encasement (p<0.001), lower GTR rate (p<0.001), more time-consumption (p=0.015), higher morbidity (38.5%), higher P/R rate (30.8%, p=0.009), and poorer recent KPS (mean 66.2) compared to other types. Type C2, non-total resection, and pathological mitosis were adverse predictors for tumor recurrence. Non-total resection and pathological mitosis were risks for poor outcome.

Conclusion: The classification helped to predict surgical outcome and recurrence. Preoperative radiologic films and neurological function should be reviewed carefully to improve long-term outcome.

MS1-4-6  Endoscopic endonasal odontoidectomy and posterior stabilization: Preliminary experience with a single-step surgical procedure
Filippo F. Angileri¹, Felice Esposito¹, Fabio Cacciola¹, Stefano Priola¹, Luigi M. Cavallo², Paolo Cappabianca², Francesco Tomasello¹
1Department of Biomedical and Dental Sciences and Morphofunctional Imaging, University of Messina, Italy. 2Department of Neurosciences and Odontostomatological and Reproductive Sciences, Università degli Studi di Napoli Federico II, Naples, Italy

Object: The transoral route is still considered the gold standard midline approach to anterior craniocervical junction. The development of endoscopic procedures has made possible to perform odontoidectomy via a minimally invasive endoscopic endonasal approach.

Methods: 3 patients, mean age 70 yrs, with irreducible anterior medullo-cervical compression, underwent surgical endoscopic odontoidectomy, using rigid endoscopes (0° and 30°), followed by occipito-cervical fusion with Vertex® system in the same procedure. All patients had a spastic tetraparesis.

Results: Complete odontoid resection with adequate anterior decompression and fixation was successfully obtained in all patients. No CSF leak or others surgical complications occurred. At 6 months follow up, the neurological condition was improved in all patients.

Conclusion: The endoscopic odontoidectomy via the transoral route is still considered the gold standard midline approach to anterior craniocervical junction. The development of endoscopic procedures has made possible to perform odontoidectomy via a minimally invasive endoscopic endonasal approach.

MS1-5-1  Endoscopic management of giant angiofibromas
Carl H. Snyderman¹, Paul A. Gardner²
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Juvenile nasopharyngeal angiofibromas (JNA) with skull base involvement are challenging tumors to
treat due to vascular contributions from the internal carotid artery (ICA). Excessive bleeding impairs visualization, increases the risk of complications, limits the ability to achieve a complete resection, and may result in blood transfusion. The UPMC staging system provides superior staging of JNA based on the extent of the tumor and residual vascularity following sacrifice of the contribution from the external carotid artery (ECA). In most cases, complete excision of giant JNA can be achieved using endoscopic techniques via an endonasal and transmaxillary approach. The surgical strategy includes preoperative embolization of the ECA contributions using Onyx, team surgery, supplementation of an endoscopic endonasal approach with an endoscopic tranmaxillary approach, the use of hemostatic materials and devices, segmenting the tumor into vascular territories with early control of ICA contributions, and staging of surgery as needed. Residual tumor can be observed until there is evidence of significant growth: most recurrences can be managed with additional endoscopic surgery.

**Objective:** To assess the usefulness of skull base surgery for large juvenile nasopharyngeal angiofibromas (JNA) showing lateral extension to the infratemporal fossa.

**Material and methods:** Eleven cases were enrolled for this study. The range of extension of tumor, surgical approach and treatment outcome were estimated.

**Results:** From the image study, extensions to the middle cranial fossa (8), orbit (4), anterior cranial fossa (1) and cavernous sinus (1) were also observed. Coronal skin incision (1) and a facial dismasking flap (9) were used, and a wide lateral skin incision with temporary incision of the facial nerve was applied in one case. The orbitozygomatic approach and its modification were applied to all cases. Pronto-lateral craniotomy was applied in four cases and lateral craniotomy was applied in seven cases. Total resection was achieved in 10 cases, and subtotal resection was achieved in one.

**Conclusions:** Coupled with craniotomy, tumor removal was successfully carried out in these patients with JNAs showing large lateral extension. Our surgical strategy is a safe and effective approach for the removal of JNAs with the infratemporal fossa extension.

**MS1-5-3 Multidisciplinary surgical approach for advanced juvenile nasopharyngeal angiofibroma with skull base and cavernous sinus extension**

Yoshihisa Kawano, Masaru Aoyagi, Taketoshi Maehara, Takahiro Asakage, Seiji Kishimoto

1Department of Neurosurgery, Tokyo Medical and Dental University, Tokyo, Japan
2Department of Neurosurgery, Shioda Memorial Hospital, Chiba, Japan
3Department of Head and Neck Surgery, Tokyo Medical and Dental University, Tokyo, Japan
4Department of Plastic Surgery, Tokyo Medical and Dental University, Japan
5Department of Neurosurgery, Shioda Memorial Hospital, Chiba, Japan

**Objective** Surgical removal of juvenile nasopharyngeal angiofibromas (JNA) with skull base and cavernous sinus (CS) extension is challenging. We present our surgical strategy for these complex lesions.

**Methods** Fifteen patients with JNA with skull base extension underwent surgical removal by multidisciplinary surgical team between 2007 and 2015. Seven tumors were classified as Radkowski’s stage IIIB and the other eight as IIIB.

**Results** Surgical removal via cranial and maxillofacial routes primarily using facial dismasking was performed. In 8 cases, we transected the second and/or third branches of trigeminal nerve (TN) to explore IC C4-6 and dissect upper margin of the tumors from CS and orbit. Gross total resection was archived in 11 cases and subtotal resection in 4. Although mild facial numbness was observed in 3 cases, there was no sequelae by transection of the trigeminal branches that causes in a reduction of quality of life.

**Conclusions** JNA at stage IIIB with invasion to the medial side of CS can be successfully removed by transection of TN branches that enables to broaden the operative corridor from the root of pterygoid plate and infratemporal fossa up to the medial side of CS.

**MS1-5-4 Endoscopic surgery for dealing with juvenile angiofibroma**

Bing Zhou, Qian Huang, Jingying Ma, Shunju Cui, Yunchuan Li, Demin Han

Department of Otolaryngology – Head and Neck Surgery, Beijing Tongren Hospital, Capital Medical University, China

The transnasal endoscopic surgery has been considered the ideal treatment for juvenile
Juvenile Nasopharyngeal Angiofibroma (JNA) are benign tumors that affect almost exclusively male patients and typically presenting during the teenage years. Though benign, JNA are often very locally invasive extending along and up through the cranial base, including potential involvement of the clivus, parapharyngeal space/infratemporal fossa, and cavernous sinus. Historically, JNA resection was performed via an open approach and could have significant blood loss during the surgery due to the significant vascular nature of these lesions. Advances in endoscopic techniques and equipment along with preoperative embolization have added less invasive approaches for JNA resection. There is a spectrum of approaches now available to surgeons from totally endoscopic and endoscopic-assisted to a range of open approaches. Computer-assisted stereotactic image guidance has also improved preoperative planning and intraoperative management of JNA's. Typical disease presentation: preoperative evaluation, staging and use of embolization in preparation for surgery; and various approaches and technologies for resection will be presented.

### MS1-5-5 Management of juvenile nasopharyngeal angiofibroma

Ken Kazahaya\(^1,2\)

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Juvenile Nasopharyngeal Angiofibroma (JNA) are benign tumors that affect almost exclusively male patients and typically presenting during the teenage years. Though benign, JNA are often very locally invasive extending along and up through the cranial base, including potential involvement of the clivus, parapharyngeal space/infratemporal fossa, and cavernous sinus. Historically, JNA resection was performed via an open approach and could have significant blood loss during the surgery due to the significant vascular nature of these lesions. Advances in endoscopic techniques and equipment along with preoperative embolization have added less invasive approaches for JNA resection. There is a spectrum of approaches now available to surgeons from totally endoscopic and endoscopic-assisted to a range of open approaches. Computer-assisted stereotactic image guidance has also improved preoperative planning and intraoperative management of JNA's. Typical disease presentation: preoperative evaluation, staging and use of embolization in preparation for surgery; and various approaches and technologies for resection will be presented.

### MS1-5-6 Surgical principles for the treatment of intracranially extending juvenile angiofibroma

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Intracranially extending JNA though almost always extradural, poses significant surgical difficulties due to its vascularity, involvement of the cavernous sinus and proximity to the internal carotid artery. Three distinct variants are identified: a) medial to the cavernous sinus and extending by erosion of the sphenoid lateral wall, b) extension via the superior orbital fissure with its expansion, c) extension from inferiorly with erosion of the basisphenoid with tumor invasion of the cancellous bone.

Surgical approach varies as per the extensions but mainly hinges on two main approaches: Facial Translocation (maxillary swing) and the Preauricular subtemporal-infratemporal approach. Pre-surgical optimization is by 1) flutamide anti-androgen treatment to effect tumor shrinkage & 2) embolization. The surgical principles to minimize recurrences are 1) appropriate surgical approach for adequate tumor exposure, 2) vascular control, 3) lateral to medial dissection, & 4) attention to vidian canal and pterygoid base.

### MS1-5-7 Endoscopic endonasal surgery for juvenile nasopharyngeal angiofibroma -key points for smooth tumor resection-

Nobuyoshi Otori, Jiro Iimura, Daiya Asaka.

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Endoscopic endonasal surgery (EES) for juvenile nasopharyngeal angiofibroma (JNA) is less invasive method compared with conventional extranasal approaches. EES enables surgeon excise the tumor with less hemorrhage, lower risk of complications and less hospitalization. For smooth and safe removal of JNA, following matters pre-operatively and intra-operatively are indicated as key points,

1. Angiography and coil embolus for not only main feeder but also the collateral artery and the inflowing vessels in the pterygopateline fossa, should be done on the morning of the day of the surgery. It provides better control of hemorrhage when the feeding vessel is properly treated and makes it possible to excise the tumor more safely than in the cases without preoperative embolization.
2. Surgeon have to image tumor three-dimensionally.
3. Modified medial maxillectomy with preservation of inferior turbinate and nasolacrimal duct,
Endoscopic skull base surgery: State of the art

Fred Gentili
Department of Neurosurgery, University of Toronto, Canada

The aim of this study is to discuss the current indications to the endoscopic skull base surgery and to try to delineate its future perspectives.

Since 1998 to December 2015, 1756 endoscopic endonasal procedures have been performed. The vast majority of cases has been represented by pituitary adenomas, which accounted for 1395 cases. In 79 cases of cavernous sinus invasion we adopted an extended ethmoido-pterygo-sphenoidal approach to remove the endocavernous portion of the tumor medially and/or laterally to the carotid artery. In these years the indications to the endoscopic endonasal approach have been progressively extended to the suprasellar area, for selected cases of pituitary adenomas, for suprasellar meningiomas, and for craniopharyngiomas. Recently we adopted this route also for 6 hypothalamic gliomas. Extending the transsphenoidal approach to the clival region, we performed 84 procedures for clival chordomas. This approach has allowed to remove also portions of these tumors invading the cranial-vertebral junction, the paramedian regions of skull base and to resect the odontoid process for cases of basilar invagination.

Endoscopic endonasal approach for retrochiasmatic craniopharyngiomas: Technical pearls and limitations

James K. Liu
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Endoscopic skull base surgery

Diego Mazzatenta, Ernesto Pasquini, Matteo Zoli, Laura Milanese, Giorgio Frank
Department of Neurosurgery, Institute of Neurological Sciences of Bologna, Italy

The aim of this study is to discuss the current indications to the endoscopic skull base surgery and to try to delineate its future perspectives.

Since 1998 to December 2015, 1756 endoscopic endonasal procedures have been performed. The vast majority of cases has been represented by pituitary adenomas, which accounted for 1395 cases. In 79 cases of cavernous sinus invasion we adopted an extended ethmoido-pterygo-sphenoidal approach to remove the endocavernous portion of the tumor medially and/or laterally to the carotid artery. In these years the indications to the endoscopic endonasal approach have been progressively extended to the suprasellar area, for selected cases of pituitary adenomas, for suprasellar meningiomas, and for craniopharyngiomas. Recently we adopted this route also for 6 hypothalamic gliomas. Extending the transsphenoidal approach to the clival region, we performed 84 procedures for clival chordomas. This approach has allowed to remove also portions of these tumors invading the cranial-vertebral junction, the paramedian regions of skull base and to resect the odontoid process for cases of basilar invagination.

Cavernous sinus endoscopic pituitary surgery for pituitary adenomas: is it still justified?

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Even if its superiority compared to microscope is still under debate, no one question the improvement of visualization brought by the endoscope. This allows pushing further the surgery under direct visual control. For decades, the cavernous sinus (CS) was considered as a no man's land regarding pituitary adenomas (PA). Recent articles advocate again for aggressive surgery of the lateral extension of PA. Authors throughout their experience of more than 1000 pituitary surgery and literature review summarize the data on the topic.

Among their database considering only grade III-IV Knosp’s PA and PUBMED search, the results (control of hypersecretion and GTR for Non Functioning PA) and morbidity of a CS surgery were collected. Articles were considered only when the authors attempted to remove tumors inside the CS. Visual and vascular morbidity is low in experienced hands but more frequent when operating lateral to the carotid. Knosp's Grade IV PA are not cured by surgery alone and aggressive surgery in such circumstances is questionable except in resistant tumors. A significant percentage of grade III close to 70% is amenable to MR GTR or short term remission of hypersecretion.

Meningiomas - chondrosarcomas - skull base techniques

Sebastien Froelich
Department of Neurosurgery, Lariboisière Hospital, France
MS2-1-6  Endoscopic endonasal chordoma resection: The new standard of care

Paul A. Gardner¹, Georgios A. Zenonos¹, Eric W. Wang², Elizabeth C. Tyler-Kabara¹, Juan C. Fernandez-Miranda¹, Carl H. Snyderman²
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Object: To study our experience with endoscopic endonasal surgery (EES) for clival chordomas.

Methods: We retrospectively reviewed 151 EES performed on 106 patients with clival chordomas from April 2003-January 2015.

Results: The overall gross total resection (GTR) rate was 58% (75% for primary tumors vs. 45% for recurrent tumors, p=0.016). Factors associated with decreased rates of GTRs were: multiple (>1) prior surgeries, involvement of the craniocervical junction or the lower third of the clivus, and lateral extension of the tumor. Clinical improvement was observed in 40%, whereas 8.7% deteriorated. Cerebrospinal fluid (CSF) leaks were the main source of morbidity with an overall incidence of 22%. The years of experience significantly correlated with the rates of GTRs (r=0.199, p=0.034), and the correlation was stronger when evaluating only recurrent tumors (r=0.414, p=0.003).

Conclusion: EES affords high rates of complete resections in clival chordomas. Surgical limitations include the craniocervical junction and significant lateral extension. CSF leaks remain a main cause of morbidity.

MS2-2-2  Fororable facial never function hearing pressrvation in vestibular schwannoma surgery

Shin Jung
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We present our remarkable surgical outcomes, focusing on preservation of facial nerve function and hearing after microsurgical VS removal. We also discuss the technical aspects for higher success rates.

From 1993 and 2015, 228 patients with VS underwent microsurgical resection at our institution. We put a lot of work to keep the following key techniques. First, we used the intra-operative monitoring. Second, we tried to keep the intervening arachnoid plane all the time. Third, the labyrinthine structures should be protected from thermal or mechanical injuries during drilling of the IAC. In case of that facial nerves were severely adhered by the tumor, the tiny island of tumor on facial nerve was left in order to preserve facial nerve. For hearing preservation, the tumor was dissected from cochlear nerves in a medial-to-lateral direction.

At 1 year after surgery, excellent facial nerve function (H-B grade I or II) was present in 73.5% (155 of 211 patients). Overall hearing preservation rate was 53.3% (49 of 45 patients).

If we follow those microsurgical resection techniques mentioned above, preservation of good facial nerve function and hearing can be accomplished in VS surgery.

MS2-2-3  Surgery for small vestibular schwannomas

Amir R. Dehdashti
Department of Neurosurgery, Northshore University Hospital, USA
MS2-2-4 Microsurgical management of vestibular schwannomas

Martin Sames, Petr Vachata, Jiri Cee, Tomas Radovnicky
Department of Neurosurgery, University J.E.Purkinje, Masaryk Hospital, Usti nad Labem, Czech Republic

Introduction: The aim of this study is to evaluate the development of the results of surgical resection of acoustic neuroma in our department.

Material and methods: The authors assess the results of surgical management in Neurosurgical Department, Masaryk Hospital in Usti nad Labem from 1969 to 2015. Facial nerve function was assessed using the House-Brackmann scale, hearing by the AAO-HNS criteria.

Results: 134 patients were treated surgically in the studied period. The facial nerve function HB grade I-III were achieved in 19% of cases within the years 1969-1985, in 27% cases in the years 1986-2000 and 90% patients (61/68) achieved HB grades I-III between years 2001-2015.

Conclusions: Improved surgical technique, modern imaging methods (HRCT/MRI) and electrophysiological monitoring (motor evoked potentials, intraoperative online EMG monitoring of the facial nerve, BAEP) are the main factors that lead to improved results of surgical treatment and preservation of the facial and auditory nerve.

MS2-2-5 Our strategy and surgical experiences in management of vestibular schwannoma

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2 Department of Otolaryngology Head and Neck Surgery, Xinhua Hospital, Shanghai Jiaotong University School of Medicine, China

Object: To evaluate the treatment strategy and surgical outcomes of vestibular schwannoma in a single treatment team.

Methods: Retrospective study of 941 vestibular schwannomas treated in Xinhua hospital from 2001 to 2014, clinical features, managements and outcomes were discussed.

Results: Among 941 patients, 733 were received surgical intervention, 52 were introduced to radiosurgery, and 156 for wait and scan. During follow up, 73 cases were received surgical or radiosurgical intervention because of tumor enlargement or worsen clinical symptoms. Totally, 779 patients received surgical removal. Among them, 545 (69.8%) via translabyrinthine approach, 31 (3.9%) via transotic approach, 111 (14.3%) via retrosigmoid approach, and 92 (12.0%) via middle fossa approach. Long-term good FN function rate was 82.1%. Among the preserving hearing cases, the useful hearing preservation rate was 62.3%.

Conclusion: Surgical removal is still the main option for vestibular schwannoma. Wait and scan policy can be used for non-life threaten cases. Tumor control and postoperative cranial nerve function preservation can be achieved by proper treatment strategy and surgical techniques.

MS2-2-6 Vestibular schwannoma: Personal experience, preferable treatment

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Introduction. Is there a difference between primary total removal of vestibular schwannoma/VS and totally removed tumors after previous subtotal/partial resection and stero radiosurgery/SRS? Method. We compared 2 groups treated: primary radical removal (407) and radical removal following partial surgery and/or gamma knife SRS failure (11). Results. 90% of treated VS were Gr.III and IV. Retrosigmoid-transmeatal approach was used for removal. In group of primary microsurgery 99% were removed radically. Only 3 recurrences present. Primary microsurgery achieved anatomical preservation of CN VII in 96% with House-Brackmann I-III function in 87%. Useful hearing spared in 12%. Majority of patients returned to previous activity. Surgery after partial resection and SRS failure was difficult in achieving radical removal. Satisfactory function of CN VII was achieved in 9% only without chance of hearing preservation. Viable and proliferating tumor cells were proven histologically in all tumors after SRS.

Conclusion. Growing VS is to be treated by primary radical microsurgery. SRS did not prove to be effective alternative to microsurgery in patients in whom the initial microsurgical removal failed.

MS2-3-1 Multimodal management outcome of malignancies of the skull base

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Optimal outcomes of management of skull base malignancy are only achieved through a collaborative environment that leverages the knowledge and experience of multiple medical, surgical, pathological and radiotherapeutic specialists. The senior authors experience over the past 20 years will be presented and current advancements and persistent limitations will be addressed.
MS2-3-2 Quality of life of patients undergoing skull base operations
Dan M. Fliss
Department of Otolaryngology, Head and Neck Surgery and Maxillofacial Surgery, Tel Aviv Sourasky Medical Center, Israel

MS2-3-3 Management of temporal bone cancer
Jong W. Chung, Woo S. Kang, Sang H. Lee, Chan J. Yang
Department of Otorhinolaryngology-Head & Neck Surgery, University of Ulsan College of Medicine, Asan Medical Center, Korea

Primary squamous carcinoma of the temporal bone is very rare disease with an incidence of 1 per million individuals. Results vary according to T stage, with overall 5-year survival rates of 85-100% in patients with early stage (T1, T2) disease and 15-41% in patients with advanced stage disease (T3, T4). Primary treatment consists of complete resection with negative surgical margins, and extensive bony involvement has been correlated with poor prognosis. The rate of recurrence is about 40%, with over 90% being local recurrence, whereas distant metastasis is very rare. Surgical resection procedures that can be performed include limited, lateral, subtotal and total temporal bone resection. Adjunctive procedures are parotidectomy, neck dissection and craniotomy. Radiation therapy is usually performed alone or addition to surgical resection. Procedures related in surgical procedures will be discussed.

MS2-3-4 Extended orbital exenteration for sinonasal malignancy with orbital apex extension
Takashi Sugawara, Masaru Aoyagi, Masashi Tamaki, Yano Tomoyuki, Atsunobu Tsunoda, Kikuho Ohno, Taketoshi Maehara, Seiji Kishimoto
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Object: Sinonasal malignancies generally have a poor prognosis and surgical extirpation still remains the mainstay for treatment. In cases of sinonasal malignancy with orbital apex extension (SMOAE), gross total tumor resection requires orbital exenteration including skull base bone resection around the orbital apex (EOE) in order to provide sufficient margins. Methods: 15 patients of SMOAE underwent craniofacial tumor resection with EOE between Feb. 2001 and Aug. 2012 at our institutes. We present the surgical technique of EOE with video step by step and outcome of the 15 patients. Results: The mean age of patients was 47.7 (14-79) years. The mean postoperative follow up was 4.0 (0.67-11.3) years. Two patients experienced recurrences at 1, 5 months and died at 5, 10 months after surgery. Overall 5-year RFS and OS were 86.7% and 86.2%. There was no perioperative mortality, and complications except for five graft infections. Conclusions: Our technique provided sufficient margins for total resection of SMOAE. The 5-year OS and RFS rates were high, and the perioperative complication rate was acceptably low, demonstrating the safety and efficacy of this technique.

MS2-3-5 New insights into perineural spread of cancer
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PNS of malignancy is a unique method of tumour metastasis presenting with a neurological deficit and positive MRI findings. It needs to be distinguished from incidental perineural infiltration which is a pathological diagnosis that provides prognostic information. In order to provide meaningful treatment guidelines homogenous disease processes need to be studied. We have over 200 cases of cutaneous malignancy. SCC makes up the majority, 120 consecutive are reviewed. The vast majority of cases present months to years after the primary cancer has been treated (median time 16 mths). In assessing index lesions 21.7% are unassessable (Tx) and 22.5% were T0. The delay in diagnosis was 6 mths. The current NCCN staging system is inappropriate and is unique in incorporating a method of metastasis into a primary (T) classification. The zonal system describing the spread along the nerve to the brainstem serves better as a prognostic indicator. DSS at 5 years for 120 cases is zone 1 84%, zone 2 63% and zone 3 16% (p<0.0001). Patients able to have surgical resection with p/o radiotherapy do best. A clear/close margin is better than an involved margin, 5yr DSS 72% v 46% p=0.04.
**MS2-3-6** Apparent diffusion coefficient and diffusion-weighted MR imaging are useful for the diagnosis of head and neck malignancies with skull base invasion

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5Department of Neurosurgery, Tohoku University Graduate School of Medicine, Japan.

Objectives: Advanced MRI techniques, such as diffusion-weighted MR imaging (DWI) and apparent diffusion coefficient (ADC), are promising tools for tumor diagnosis including those of the head and neck. To elucidate the role of advanced MRI techniques for diagnosis of head and neck malignancies with skull base invasion, we retrospectively analyzed MR imaging from a number of patients.

Materials and Methods: A total of 20 patients with head and neck tumors with skull base invasion undergoing skull base surgery were enrolled in this study. MRI imaging including DWI and ADC, CT, and FDG-PET/CT of all patients were examined. Pathological findings were also investigated.

Results: All patients were successfully analyzed by the above methods. Bone defects were detected by CT in 16 of 20 patients (80%). However, the pathological finding revealed that no tumor infiltration was detected in the region of the bone defects in 7 of 16 patients. Advanced MRI analysis of these 7 patients revealed a high ADC and low DWI in the region of the bone defects.

Conclusion: The results of this study suggest that advanced MRI imaging is useful for diagnosis of head and neck malignancies with skull base invasion.

**MS2-4-1** Paragangliomas and jugular foramen tumors: Recent management

Michael Gleeson
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**MS2-4-2** Surgical management of giant glomus jugular tumors

Luis A. B. Borba
Department of Neurosurgery, Federal University of Parana, Brazil

Personal experience of cavernous sinus tumor surgery during the past 20 years was reviewed to determine the role of surgery for cavernous sinus tumors. Results of surgery was analyzed focused on clinical outcome in terms of functional status of the patients, recurrence free survival and recurrence rate of the tumor. Our results confirmed that (1) Meningiomas: outcome of the radical surgery for meningioma involving the cavernous sinus is worse than the conservative surgery with or without additional radiosurgery, or radiosurgery alone. (2) Schwannomas: outcome of radiosurgery shows inferior result to my surgery series in terms of tumor control rate and progression free survival. Therefore, radiosurgery should not be used as a front line treatment of trigeminal schwannomas involving cavernous sinus. (3) Regardless of tumor type, surgical removal should be attempted first for those tumors larger than 3cm in diameter. (4) Aim of treatment should be tailored for each patient according to the tumor type, size and location.

**MS2-4-3** New trends in management of temporal bone paragangliomas

Giovanni Danesi
ENT Department University of Kocaeli, Italy

Our aim is to present our experience with endoscopic transnasal surgery (ETS) to the cavernous sinus (CS) and evaluate the efficacy of this approach.

Patients undergoing ETS for CS invading adenomas were selected from a database of 1153 patients. We included 226 patients in the study. CS invasion expands through 2 ways, medial corridor (MC) & lateral corridor (LC). We classified these lesions as Type I (MC Involvement), Type II (LC Involvement), Type III (Total Encasement).

The tumors are divided in to the groups as: nonsecretory adenomas in 113 (50%), GH adenomas in 66 (29%), prolactinomas in 34 (16%), ACTH adenomas in 13 cases (5%). Considering the invasion classification, there were 101 Type I, 32 Type II and 93 Type III cases. Total tumor removal was performed in 136 patients (%60). The remission rates were 35% for GH adenomas, 30% for prolactinomas and 55% for ACTH adenomas.

ETS provides a contribution to the differentiation of invasion and extension. ETS enables removal of the adenoma from the medial CS wall. It also increases the resection and remission rates.
Chordoma in 16, chondroma in 6, hemangiopericytoma in 2, and myxoma in 3, bone giant cell tumor in 2, and epidermoid cyst in 1. Preoperatively, hearing dysfunction occurred in 86 patients, dizziness in 32, dysphagia in 43, diplopia in 56, tongue paresis in 23, hoarseness in 35. Postoperatively, lower cranial nerve deficits newly developed or worsened in total of 110 patients immediately after surgery. 3 patients died postoperatively. A total of 24 patients were found with regrowth of tumor and applied re-operation or radiosurgery. Conclusion: NGTJF achieved significant favorable outcomes, the neurological deficits remain challenging.

MS2-5-1 Supermicrosurgery for aesthetic craniofacial repairs

Isao Koshiba
Plastic and Reconstructive Surgery Department, The University of Tokyo, Japan

Since perforator flap was started from 1989, new less invasive reconstructive surgery has been developed. Conjunction with perforator concepts, supermicrosurgery, and aesthetic surgery developed a new aesthetic reconstruction. So far we developed follows: Facial contour reconstruction with free thoracodorsal artery perforator (TAP) or superficial circumflex iliac artery perforator (SCIP) flaps after massive resection of craniofacial cancer, irradiated deformity, and scleroderma etc., 3D contour plasty using intraoral adiposal flap transfer perforator-on-perforator flaps, and full thickness skin flaps under small incision. Aesthetic repair for facial palsy with nerve flap and muscle flap transfers, multi-fascia suspension, and aesthetic techniques. For early stage of palsy, less invasive (prophylactic) cross-face nerve flap is indicated. Nerve gaps could be repaired with fascicular turnover method rather than nerve graft. Vascularized adiposal flaps (possible under local anesthesia) are indicated for severe facial and extremity depression. One-stage Chimera and multi-stage Hub combined flap transfers using these techniques for 3D aesthetic reconstruction of larger defects.
MS2-5-3  Comprehension of surgical anatomy for high flow bypass

Rokuya Tanikawa
Department of Neurosurgery, Sapporo Teishinkai Hospital, Japan

In this presentation the author will present his experience in the management of 87 patients with giant glomus jugular tumor. The surgical technique, results and complications will be addressed.

MS2-5-4  Our techniques of microsurgery in free flap reconstruction for skull base

Yuzuru Kamei, Keisuke Takanari
Department of Plastic Surgery, Nagoya University Graduate School of Medicine, Japan

Recent advancement in microsurgical free flap transfer has expanded the surgical possibility in the skull base surgery. In our institution, we use rectus abdominis myocutaneous flap for large defect of skull base, while omental flap is used for narrow, deep and/or complex skull base defect. In this presentation, we describe our technique for safe and sure microvascular surgery. To perform safe microvascular reconstruction, there are several points to be regarded in each stage of the operation.

1) When dissecting recipient vessels, small branches of vessels are ligated under microscope and make sure the blood flow is not disturbed in the ligated site. Head and neck should be returned to normal position before anastomosis and the anastomosed site has to be set straight after operation.

2) Just before the anastomosis, adventitia of the vessel is carefully removed. The intimas of vessels are smoothly fit with manipulation. To achieve this, manipulation of anastomosis has to be carefully considered according to caliber discrepancy, thickness of intima and media, and configuration of intima.

3) Drain insertion and wound closure are done carefully not to disturb the anastomosed site.

MS2-5-5  "Awake" highflow bypass for giant aneurysms

Saleem I. Abduralrauf
Department of Neurological Surgery, Saint Louis University Center for Cerebrovascular and Skull Base Surgery, USA

MS2-6-1  Anterior skull base closing by polyethylene implants

Claude F. Litre, Jean C. Kleiber, Christophe Eap
Department of Neurosurgery, University Reims, France

We report our experience about closing anterior skull base by polyethylene implants. The most common postoperative complications are cerebrospinal fluid (CSF) leak with secondary meningitis. We use multi layer closing to optimize the waterproofness. We developed a closing technique with 2 layers by polyethylene implants. From 2012 to 2016, 30 patients underwent anterior skull base surgery closing by polyethylene implants (10 orbital tumors, 10 olfactory groove meningiomas, 5 esthesioblastomas, 5 epidermoid carcinomas).

The aim of this technique is to provide better management of complications and shorten the surgery. Polyethylene implants can be resized and the biocompatibility is excellent. At the end of the follow up (median 29 months) only one patient had CSF leak 10 days after the surgery. Polyethylene implants are easy, safe for the closing of anterior skull base tumor surgery with an excellent biocompatibility.

MS2-6-2  Multilayer resection of olfactory neuroblastoma using endoscopic endonasal approach

Takayuki Nakagawa, Satoru Kodama, Tetuji Sanuki, Masayoshi Kobayashi
Department of Otolaryngology, Kyoto University, Japan

Background Curative treatment for large or giant aneurysms is difficult, even if a newly developing device like a flow-diverter was applied. The revascularization techniques for recurrent complicated giant aneurysms as a safe treatment will be explained in this lecture.

Selection of graft Trapping or proximal ligation will be prepared for clipping difficult aneurysm, with revascularization using appropriate size of graft vessel which has equivalent size of diameter. If the CBF ratio between pre- and post-op was more than 0.8, no ischemic symptom appeared in our consecutive 70 cases.

Surgical Anatomy and Technique The graft route medial to mandibular bone should be understood accurately, which the space between temporal muscle and lateral pterygoid muscle at skull base and the space between medial pterygoid muscle and digastric muscle at the neck are important to place the graft in EC-M2 high flow bypass. The fish mouse trimming is necessary to make the temporary occlusion time short and to make the
orrifice of the bypass wider.

**MS2-6-3 A randomized trial of lumbar drainage after endoscopic skull base surgery**

Paul A. Gardner  
Department of Neurosurgery, University of Pittsburgh Medical Center, USA

**Object:** We evaluated the benefits of postoperative lumbar drainage in a prospective, randomized control study.  
**Methods:** Inclusion criteria included at least one of the following: 1) extensive arachnoid dissection, 2) dissection into a ventricle or cistern, or 3) dural defect greater than 1 cm². 186 consecutive patients were randomized to either lumbar drainage for 72 hours or no drain.  
**Results:** The trial was stopped early (170 patients) due to a significant difference in CSF leak rate between the drain and no drain groups. The most significant variable for postoperative leak was not having a drain (p<0.011). During subgroup analysis, we found a significant (p<0.021) difference between location of the tumor (anterior, posterior, suprasellar) and CSF leak rate. In 108 patients, the average defect in the no leak group was 2.78 cm² whereas the mean size of the defect in the leak group was 6.86 cm² (p<0.076).  
**Conclusions:** For patients undergoing endoscopic endonasal skull base surgery, prophylactic lumbar drain placement lowers the rate of postoperative CSF leak. The impact seems to be greatest in patients with large anterior or posterior cranial base defects.

**MS2-6-4 The supraorbital approach for anterior skull base, sallar and paraseller tumors**

Sung J. Cho  
Department of Neurosurgery, Soonchunhyang University Seoul Hospital, Korea

**Object:** We report our recent experience with supraorbital(SO) approach for anterior skull base neoplastic pathology.  
**Methods:** Between March 2010 and September December 2015, thirteen patients with neoplastic lesions underwent surgery by the SO approach. The clinical presentations, neuroradiological findings, microsurgical techniques, and outcome at discharge were analyzed.  
**Results:** The mean maximum tumor diameter was 2.5cm and seven patients had preoperative optic apparatus involvement with visual problem. Four patientshad preoperative pituitary insufficiency. Total tumor removal was achieved in 9 patients; There was no surgical mortality. One patient had temporary cerebrospinal fluid leakage. Two patient had new visual deficit. Remnant tumor occurred in two pituitary adenoma and two craniopharyngoma.  
**Conclusion:** Compare with traditional pterional approach, the SO approach is a safe and effective keyhole method to remove both extraaxial and intraaxial skull base tumors, particularly lesions of the orbitofrontal region and parasellar area allowing for minimal disruption of normal brain parenchyma and promoting a rapid recovery and short hospital stay.

**MS2-6-5 Surgery of esthesioneuroblastoma**

Rungsak Siwanuwath  
Department of Neurosurgery, Chulalongkorn University, Thailand

A meningioma is a benign tumor, and radical cure is provided by total resection by the operation. But in case of invading venous system, the treatment becomes very difficult. If the patient is asymptomatic, waiting the operation until the venous sinus is completely occluded and the collateral pathway is developed is best option. Or the partial extraction that let a tumor around the venous sinus remain is often chosen. However, the patient has symptom due to the venous perfusion disorder or if the tumor is malignant, it is necessary to perform resection combined with reconstruction of the venous sinus. The reconstruction of the venous sinus itself is very difficult, but a method to make graft between bridging vein (VV bridge bypass) is few risks, and effective. We describe these surgical procedures with a video presentation.

**MS2-6-6 Treatment outcome and strategy for olfactory neuroblastoma**

Hiroaki Motegi  
Hokkaido University Graduate School of Medicine, Department of Neurosurgery, Japan

**Background:** Olfactory neuroblastoma (ONB) is such a rare malignant tumor that no consensus has been reached on its management. We retrospectively compared the therapeutic outcome in various combinations of surgery (SG), radiotherapy (RT) and chemotherapy (CT) and present our strategy.**Methods:** Twenty six patients with ONB treated between1980 and 2013 were included. Three patients were Kadish stage B and 23 were C.  
**Results:** The median observation time was 98 months. As for the combination of treatment, 2 cases were SG only, 6 were SG+RT, 9 were...
SG+RT+CT, 3 were RT only, 6 were RT+CT. The 5-year OS of the patient treated including SG was 93% and excluding SG was 44% (P=0.02). In the combined modality (SG+RT+CT), no patient was dead in 81 months. In the other arm, 9 patients were dead. The combined modality arm has significantly higher survival rate (p=0.042).

Conclusion: Surgery occupied an important role for the initial treatment of ONB. Longtime survival could be expected by combined modality treatment. In consideration of sensitivity to CT of ONB, we take the initial treatment strategy for Kadish C as follows. After biopsy, neoadjuvant CT including cisplatin followed by SG and RT.

MS2-7-1 Education and training in skull base surgery - AO neuro delivering opportunities
Christian Matula
Neurosurgical Department, Medical University of Vienna, Austria

The AO foundation is the world’s leading educational and research organization and represent one of the most important networks in medicine. AONeuro is an initiative of the AO Foundation to expand its activities into neurosurgery. The mission is to improve patient care by high quality education. International reviewed Curricula in Skull Base Surgery has been developed to offer a comprehensive framework for education, training and science. These curricula are designed to address the patient problems and the needs of the special target audiences at all stages of the career: from training, early years in practice, to when someone become an expert. It integrates the latest science of education for designing, implementing and evaluating high quality education. AONeuro has proven to be one of the most promising opportunities for education, training and science for all interested in neuroscience activities. It has become one of the world’s leading global “Neuro” communities, where information flows freely not only from the organization, but also among peers to affect and improve clinical practices through the sharing of knowledge.

MS2-7-2 Educating future skull base surgeons: Simulation and competency
Ian J. Witterick
University of Toronto, Department of Otolaryngology-Head & Neck Surgery, Canada

The vast majority of skull base surgeons are well trained, conscientious and provide excellent care. Is there anything wrong with the apprentice model that so many surgeons have been trained by? This talk will explore traditional training pathways and introduce newer training models for skull base surgeons including simulation and methods to measure competency.

MS2-7-3 Surgical simulation of brainstem lesions with 3D-fusion images
Hiroyumi Nakatomi, Taichi Kin, Seiji Nomura, Naoyuki Shono, Nobuhiro Sato
Department of Neurosurgery, University of Tokyo Hospital, Japan

Objective: To show advanced surgical simulation for difficult brainstem cases with 3D-fusion images.

Methods: To visualize all information in an image, we have recently developed a new method to create a 3D-fusion image from various neuro-imaging modalities for simulation. The fusion image was created using visualization software, AVIZO®. Shapes of brain and cranial nerves are created from heavily T2-weighted magnetic resonance (MR) images. Arteries are form MR-angiography and/or 3D-digital subtraction angiography (DSA). Veins are from TRICKS (time resolved imaging of contrast kinetics) and/or 3D-DSA.

Results: The fusion image enabled us to make surgical strategies more precisely. With the fusion images, it has become possible to simulate approaches to deep-seated lesions or brainstem lesions, resulting in minimizing the size of craniotomies. Identification of cranial nerves, feeders and drainers of vascular rich tumors has also become much easier.

Conclusions: Surgical simulation with 3D-fusion images is useful. Cases with pontine glioma, hemangioblastoma and cavernous malformation are presented.

MS2-7-4 Simulation based skills training in skull base surgery
Ashish Suri
Department of Neurosurgery, All India Institute of Medical Sciences, India

The vast majority of skull base surgeons are well trained, conscientious and provide excellent care. Is there anything wrong with the apprentice model that so many surgeons have been trained by? This talk will explore traditional training pathways and introduce newer training models for skull base surgeons including simulation and methods to measure competency.
MS2-7-5  Preoperative simulation for skull base approach  
- Usefulness and limitation -
Fusao Ikawa¹, Takafumi Mitsuhara², Toshikazu Hidaka², Tatsuya Mizoue², Masaaki Takeda¹, Satoshi Yamaguchi¹, Kaoru Kurisu¹
¹Department of Neurosurgery, Graduate School of Biomedical and Health Sciences, Hiroshima University, Japan, ²Shimane Prefectural Central Hospital, Izumo, Japan

Nowadays, development of information technology is remarkable especially in imaging diagnosis modality. So, we investigated the usefulness and limitation of preoperative simulation for skull base approach by 3D-MDCT, 3D-DSA and 3T MRI as the substitutional tool.

Subjects, Methods and Results:
From 2008 to 2015, we experienced totally 212 surgical clipping and 32 skull base tumor with preoperative simulation by CTA, DSA and MRI. By using CISS image, we can find the cranial nerve identification and fusion image with CTA or DSA was useful. In case of hypervascular tumor like large hemangioblastoma, fusion image CTA with 3D-DSA was useful for surgical strategy. Some small vessels were not able to visible due to increased ICP or other reasons.

Conclusions:
We have evolved a strategy of surgery for skull base approach, however, we should pay attention to several pitfalls and remained problems.

MS2-7-6  Image-guided deep seated glioma surgery
Kazuya Motomura, Toshihiko Wakabayashi
Department of Neurosurgery, Nagoya University Graduate School of Medicine, Japan

The ideal treatment for both lower-grade and high-grade gliomas has been reported to be maximal tumor resection as the initial therapeutic option. Maximum extent of resection for lower-grade and high-grade gliomas increased survival of patients. However, these infiltrative gliomas are often observed near or within deep-seated regions such as insula, thalamus, hippocampus, parahippocampal gyrus and midbrain. Based on the latest surgical navigation system, we have performed image-guided neurosurgery for deep seated gliomas to accurately project preoperative magnetic resonance imaging (MRI) data into the operative field for defining anatomical landmarks and tumor margins. Furthermore, we performed intraoperative MRI (iMRI) using a 0.4-T vertical field MR scanner. If remaining resectable tumor was found, we performed additional tumor removal and iMRI investigation was repeated in order to achieve the surgical goal based on the preoperative plans. Therefore, the combination of surgical navigation system with iMRI was associated with a favorable surgical outcome for glioma patients in deep anatomical structures while avoiding neurological complications.
MS2-8-3  Skull base approaches to intrinsic brainstem lesions
Helmut Bertalanffy
Department of Neurosurgery, International Neuroscience Institute, Germany

MS2-8-4  Interdisciplinary treatment of skull base lesions
William Couldwell
Department of Neurosurgery, University of Utah, USA