PP1-1-1  Facial and lower cranial nerve preservation in jugular schwannoma surgery

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Objective: The purpose of this study was to discuss surgical preservation of the facial and lower cranial nerve function in jugular schwannomas surgery.

Methods: 74 jugular schwannomas were operated by the same surgical team.

Results: 37 tumors were intra- and extracranial, 17 were intracranial and 20 were extracranial. According to the tumor region, infratemporal fossa type A approach, petrous occipital transsigmoid approach and transcervical approach were selected for tumor removal. Gross-total resection was achieved in 70 patients. Adjunctive radiosurgery was used in the management of residual tumor in 2 patients: tumor control was ultimately obtained in all cases. During follow-up period, good facial function was obtained in 71 patients (95.5%) and complete compensation of lower cranial nerve function was achieved in all patients.

Conclusions: Facial nerve and lower cranial nerve function can be preserved in maximal degree by proper surgical approaches and careful operative manipulation.

[Key words] jugular schwannoma; facial nerve; lower cranial nerve; surgical management; classification

PP1-1-2  Function-preserving multi-modal treatment for jugular foramen meningiomas

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Objective: Spite of being pathologically benign, jugular foramen meningiomas (JFMs) may be locally aggressive and spread in three compartments. Because of the complex anatomic location, radical removal of JFMs usually causes the serious morbidity of lower cranial nerve (LCN) deficits. To accomplish the long-standing tumor control with good functional outcome, we report the function-preserving multi-modal treatment (FMT) for JFMs: the combination of intradural tumor removal with preserving the LCN function and stereotactic radiosurgery (RS) for the residual tumor.

Material: This paper comprises six JFM patients (5 women and 1 man). Preoperatively, five of them showed no LCN sign.

Results: All patients underwent the function-preserving retrosigmoid intradural tumor removal: no patient developed new LCN deficit. Three patients underwent RS for the residual tumor at 8-12 months of surgery. After RS, all three tumors were controlled. No patients showed tumor recurrence or new LCN deficits in the follow-up period (2 months - 7 years).

Conclusions: Function-preserving multi-modal treatment for JFMs can accomplish the long-standing tumor control with excellent functional outcome.

PP1-1-3  Long-term functional and recurrence outcomes of jugular foramen schwannomas

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Objective: This study aimed to investigate the outcomes of jugular foramen schwannoma (JFS).

Methods: Between 1993 and 2013, 133 patients with JFS were surgically treated. Clinical charts were reviewed.

Results: The classifications of the JFSs were as follows: 65 cases of A type, 15 of B type, 5 of C type, and 48 of D type. Gross total resection was achieved in 107 (80.5%) patients. Transient and permanent CNs IX-X morbidities were 19.8% and 11.5%, respectively. After a mean follow-up duration of 108.0 months, 13 patients (9.9%) suffered recurrence. The presence of a solid tumor, non-total resection, and pathological mitoses were independent risk factors for tumor recurrence. Decreased preoperative KPS per 10 points, a less soft tumor consistency, and a solid tumor were risk factors for recent poor outcomes.

Conclusion: Quality of life and preservation of neurological function are the goals. Favorable long-term surgical outcomes for JFSs can be achieved, the morbidity rate of CNs IX-X is stressed, and patients with non-total resection or pathological mitosis should be closely followed-up.

PP1-1-4  Minimally invasive lateral approach and its extension for the craniocervical region

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Objective: A wide variety of craniocervical pathology traditionally has been treated from a midline posterior approach. however, it carries a risk of vascular problems and postoperative complications including CSF leakage, and spinal
We describe concepts of minimally invasive lateral approach. **Methods:** The location of the tumor and involvement of any vascular structures are noted and included in the decisionmaking process. **Results:** 5 high cervical neurinoma, 3 foramen magnum meningioma, 3 high position Carotid artery endoarterectomy via Retromastoid approach, 3 vertebral artery aneurysm (endoscopic assist trapping) were treated. Intradural Juglar tuberclectomy is useful to remove the anterior part of bony eminence after the transcondylar fossa approach. The exposure was straightforward and provided relatively narrow but shallow operative field. Endoscopic assistance increased the anatomic exposure. **Conclusions:** The selected cranio-cervical pathologies can be safely and effectively treated with minimally invasive techniques. Safe management of the vertebral artery and tailored surgical corridors after intrafascial muscle dissection are key considerations.

**PP1-1-5**  
**Muscular stage dissection during far lateral approach and its transcondylar extention**  
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**Purpose:** The far lateral approach includes exposure of the C1 transverse process, the vertebral artery, the posterior arch of the atlas, and the occipital condyle. We designed our method of quick muscular stage dissection and present our experience for this approach. **Operative methods:** We used a horseshoe scalp flap that was reflected downward and medially. The lateral muscle layers were separated layer to layer to expose suboccipital triangle. The medial muscle layers were separated in the midline and reflected in a single layer. At this stage the midline of C1 process and the foramen magnum was identified. C1 transverse process and the vertebral artery were identified by reflection of the superior oblique muscle. The rectus capitis posterior major muscle was reflected to expose the posterior arch of the atlas. The occipital condyle was separated accordingly. **Results:** We recently used this method of muscular dissection in 8 of 14 patients (foramen magnum meningioma 9, hypoglossal schwannoma 3, others 2). It was easy and quick to identify anatomical landmarks for this approach. **Conclusion:** Our muscular stage dissection could contribute to safe and effective tumor removal.

**PP1-1-6**  
**Vertebral artery transposition for cranio-cervical junction tumors**  
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Vertebral artery (VA) transposition can minimize the manipulation of the low cranial nerves and the brainstem. VA transposition was performed in 16 patients for anterior foramen magnum meningioma and 12 patients for cranio-cervical junction (CCJ) tumors. Tumor resection was done via extreme-lateral approach with partial condelectomy to expose the anterior portion of the brainstem. For intradural tumors, the VA was mobilized caudo-medially after circumferential dural incision around the VA. For extradural tumors involving the CCJ, VA was transposed medially from the transverse foramen of C1.

Gross total resection was achieved in 26 of 28 patients (92.9%) with VA transposition. The origin of the tumors was foramen magnum (67.1%), C1 nerve root (17.9%), clivus (10.7%), jugular foramen (7.1%), posterior skull base (3.6%) and hypoglossal canal (3.6%). VA transposition was done intradurally in 19 patients (67.9%) and extradurally in 9 patients (32.1%). The mean follow-up duration after surgery was 4.2 years. VA transposition can provide a wide surgical window for anterior foramen magnum meningioma or CCJ tumors with the least manipulation of the neuraxis.

**PP1-2-1**  
**The usefulness of the musculo – pericranial flap in reconstruction of the skull base**  
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**Object:** We have reconstructed the skull base with using musculo-pericranial flaps. In this paper, we present our methods and consider its effectiveness and problems. **Method:** We verified the postoperative course for 82 cases of skull base surgery performed from 1984 to 2015. A temporal musculo-pericranial flap was mainly used for the repair of the dura mater and a frontal musculo-pericranial flap was mainly used for isolating the cranial cavity from the nasal cavity. **Results:** Among the 82 cases, 70 cases (85%) recovered with no problems. Postoperative complications were observed in 12 cases (15%). The breakdown of these is 10 cases of localized infection, 1 case of aspiration pneumonia and 1 case with rupture of internal carotid artery. The localized infection cases were all treated by procedures such as drainage and debridement. **Conclusion:** It was very effective for the local infection to reconstruct the dura mater.
using with the temporal musculocranial flap which has blood circulation. Because the flap became a strong barrier against the spread of infection within the dura and the fetal complications were avoided.

**PP1-2-2** Complications after the reconstruction of the anterior skull base with RAM

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**Object:** It is safe to cover the dural defect with TMP and intercept between the cranial and nasal cavity with FMP. For the extended defect, it is necessary to use RAM.

**Methods:** 2 cases had the defect from the anterior skull base to the maxillary sinus. One side TMP was used for the dural repair and RAM was used for the defect.

**Results:** The first case had the herniation because of swelling RAM. After the partial reduction of RAM, the consciousness was recovered. In the second case, the liquorrhea occurred from the sphenoid sinus. In spite of grafting the fascia and the mucosal flap, it didn't stop. The other TMP was used for covering the fistula from the intradural and it stopped.

**Conclusion:** In the first case, RAM occupied the space between the frontal bone and the cerebral. The flap should not be used for occupying this space because of the cerebral expansion. In the second case, TMP didn't contact with the residual dura sufficiently. Bilateral TMP should be used for covering the dural defect.

**PP1-2-3** Experience and adaptation of skull base reconstruction using free muscle flap

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We summarized our initial series of the skull base surgery using free muscle flap for the reconstruction. **Method:** Since 2013, we operated on 7 skull base tumor cases using free muscle flap reconstruction in one stage: 2 recurrent meningiomas, 1 recurrent chordoma, 1 glomus tumor, 1 endolymphatic sac tumor, 1 melanoma, and 1 basal cell adenocarcinoma. Three men and 4 women, ranging in age 14-70 (median 66). Five rectus abdominis (RA) muscle flap, and 2 latissimus dorsi (LD) muscle flap were used depending on dead space volume and area. All graft survived: 1 RA flap for melanoma needed reanastomosis at day 3 after surgery. Minor debridement was needed in all cases, but their clinical courses are good. Although excluded from this series, 1 recurrent cavernous meningioma case turned into epidural abscess after removal of the huge tumor, and then free RA flap was placed to control the infection. But the patient died after 3 weeks due to encephalitis. **Conclusion:** When massive infection once occurs, it is very difficult to overcome even by the muscle flap at next surgery. Free muscle flap reconstruction is an essential method to separate intracranial space from nasal/paranasal space.

**PP1-2-4** Our experience in skull base reconstruction with free flap transfer

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**Introduction:** For safe and reliable skull base reconstruction, the dead space around the repaired dura should be filled with a flap of sufficient volume. We obtained good results using rectus abdominis flaps for skull base reconstructions.

**Patients and Methods:** This is a review of 13 cases with tumors involving the skull base, treated by tumor resections and immediate reconstructions with free flap transfer from 2007 to 2014. The most common origin of tumors was maxillary sinuses (69%) followed by external auditory canals (15%). 11 cases underwent preoperative radiotherapy and 5 cases underwent neoadjuvant chemotherapy. All cases were reconstructed with rectus abdominis flaps.

**Results:** Flap survival rate was 100%. Complications occurred in 4 cases including cerebrospinal fluid leaks, which were treated conservatively. In one case, we had to remove a calvarial bone flap. Eight cases are alive and remain free of disease, three cases died because of recurrent carcinoma during the follow-up periods (from 2 months to 8 year 5 months).

**Conclusions:** The rectus abdominis flap is an excellent flap for skull base reconstruction because well-vascularized voluminous muscle reduces...
PP1-2-5  **Indication of reconstructive surgery for middle skull base defects**

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Introduction: Reconstructive surgery is not always needed in cases of middle cranial fossa defects because of the anatomical location, whereas it is necessary in most cases of anterior cranial fossa defects. The operative indication for reconstruction will be reported in this presentation.

Patients and Methods: We examined the medical records of middle skull base reconstructive cases between 2008 and 2015 in our institution. Sixty-two patients (42 males and 20 females) were included. The age of the patients ranged from 8 to 72 years old (mean age 36 years). Primary diseases were 34 benign tumors, 25 malignant tumors, and 3 non-neoplastic lesions.

Results: Indications were as follows (multiple selections):
- **Separation** between the cranial and other (nasal or oral) cavities in 41 cases.
- **Reconstruction** of facial skin in 15 cases and facial nerves in 15 cases.
- **Augmentation** of soft tissues in 16 cases and bony dead spaces in 10 cases.
- **Coverage** of dural patches in 3 cases, infection sites in 2 cases, implanted bone in 1 case, and artificial material in 1 case.

Discussion: Many reconstructive indications other than cranial cavity blockages need to be considered for middle skull base defect cases.

PP1-2-6  **Primary and secondary reconstruction of temporal muscle defect**

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The temporal myofascial flap is an option for the reconstruction of skull base defects. The cosmetic dissatisfaction led to several proposed methods of muscle preservation or reconstruction.

The authors analyze a group of 42 muscle reconstructions using microporous polyethylene implants operated from 2006 to 2015. Primary reconstruction, due to use of muscle flap for defect reconstruction or dynamic reanimation of mimic muscles was indicated in 20 cases. A secondary augmentation for cosmetic deformity was performed in 21 cases. There was no severe morbidity or mortality related to the implantation procedure. The mean followup of the whole group was 47.8 months. An early correction of the implant position was performed in one case. In another case the implant had to be removed 6 years after implantation due to local infection after cosmetic eyelid procedure with uncomplicated reinsertion of the new one after successful management of the local infection. The cosmetic result was perceived by all patients as good or excellent.

In conclusion the use of polyethylene implants for the reconstruction is an easy procedure with an excellent cosmetic outcome and minimal long-term risks.

PP1-2-7  **Advantage of extended craniofacial resection for advanced malignant tumors of the nasal cavity and paranasal sinuses: Long-term outcome and surgical management**

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Objective: Craniofacial resection (CFR) for advanced sinonasal malignant tumors (SNMT) is mandatory for radical resection, and surgeons must be aware of perioperative complications and long-term outcome. Methods: Thirty-eight consecutive surgical patients with advanced SNMT of T4 stage or Kadish stage C treated by CFR in the past 28 years were followed up for 59.4 months. In cases of unilateral orbital extension, en-bloc resection was achieved using several neurosurgical techniques (extended CFR) from 2005 onwards. Results: Squamous cell carcinoma was the most common histological type observed (65.8%), followed by esthesioneuroblastoma (15.8%). Using a combination of adjuvant radiation therapy, the 5-year overall survival and the 5-year disease specific survival rates were 55.5% and 59.4%, respectively. The 5-year disease specific survival rate was 48.9% in earlier stage and improved to 82.1% in recent stage (P = 0.037), which was related to improvement in local control rate. Conclusions: CFR and postoperative radiotherapy are safe and effective for treating advanced SNMT. Extended CFR, which includes radical orbital exenteration, may contribute to good long-term outcome.
**PP1-3-1** "MeAV Anatomie" a 3D display system for surgical simulation in cadaver study

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**Objectives:** Knowledge of 3D surgical anatomy is important for preoperative simulation. We developed a 3D display system of cadavers, in cooperation with Panasonic®. We report the performance of our 3D display system in a study of cadaveric heads and its potential in neurosurgery. **Methods:** The head region was dissected into several layers. In each layer, we obtained images from multiple viewpoints corresponding to 5-degree increments of latitude and longitude. For surgical simulation, we performed several neurosurgical approaches, such as the pterional, orbitozygomatic, and petrosal approaches. **Results:** Three-dimensional images with accurate depth information were generated by our system. We could change the magnification, viewpoint and depth of dissection freely. This 3D display system was effective tool to assist cadaver dissection and as self-study material especially for young neurosurgeons. We also developed a new service, "MeAV Anatomie". This is a self-learning tool using iPad or Windows PC. **Conclusion:** This novel 3D display system allows young neurosurgeons to learn neurosurgical microanatomy and to obtain important information for surgical simulation.

**PP1-3-2** A combined three-dimensional bone and soft-tissue model for skull base surgery

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**Object:** Preoperative surgical simulations, using 3-dimensional (3D) virtual imaging, have enabled a more accurate understanding of the complex anatomy of the skull base and has been applied for all skull base surgeries at our institution. Moreover, to minimize complications and achieve accurate resection, "a combined 3D bone and soft-tissue model" has been developed at our institution and has been used particularly for simulation of difficult cases. **Methods:** We present the case of a 52-year-old man, who was diagnosed with ethmoidal sinus carcinoma, squamous cell carcinoma, T4bN0M0. We approached the tumor craniofacially. Because of the invasion to the frontal sinus, access to the deep portion of the skull base region was a concern. We developed a combined 3D model with brain and vessels and simulated the surgery in the operation room before the actual surgery. **Results:** We could understand how the brain was retracted by the brain spatula and could plan the surgery more easily. **Conclusion:** A combined 3D bone and soft-tissue model is very effective. Future studies should look into cost reduction and duplication of the surrounding soft tissues.

**PP1-3-3** Autostereoscopic 3D neuronavigation to the sella

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**Introduction:** A drawback of conventional neuronavigation is the necessity of focusing on 2D-images in 3 planes at the same time to determine one's position in the OP-field. A solution would be to merge the images into a single 3D-image that mirrors the actual anatomy. Glassless 3D-monitors paved the way to 3D-navigation. We present our experience with 3D-neuronavigation to the sella. **Methods:** The operative planning in pituitary tumor cases was conducted with a navigation system (BrainLab). The image-datasets were processed by the 3D-system (Setred), enabling realtime-navigation in 3D. The operations were conducted through an endoscopic transnasal-transphenoidal approach. **Results:** We found 3D-navigation intuitive, simple and safe. The rendered images reflected the anatomical configuration and spatial depth of the OP-field. We report a short learning-curve. **Conclusions:** 3D-navigation is a beneficial supplement to conventional navigation, especially in objects with complex spatial depth and configuration. This is particularly advantageous in recurrent pituitary surgery.
PP1-3-4  Usefulness of preoperative 3D simulation for skull base surgery
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Objective: The purpose of this paper is to report on our presurgical simulation technique using a 3D models for skull base surgery.

Methods: We performed simulation prior to surgery in patients with skull base tumors. The 3D computer graphical models for simulation were composed of brain, cranial nerves, vessels, tumor and skull individually created by the image analysis, including segmentation and fusion of CT and MR images. Virtual simulation was performed by computer aided design software to imitate the surgical procedures. The findings were compared with intraoperative findings.

Results: Surgical planning and simulation of all cases were performed as well. The real operations of all patients were conducted according to the simulation with well outcomes.

Conclusion: According to the presurgical virtual simulation, neurosurgeons could get more anatomic information about skull base tumors and surrounding structures and choose the best approach for tumor resection, which would lead to better prognosis for patients.

PP1-3-5  3D simulation and neuronavigation for the surgery of paraclinoid aneurysm might contribute to the safe direct surgery and preserve the visual function
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Objective: For paraclinoid aneurysm, endovascular surgery is now recommended. However, its recurrence rate is high. Direct surgery with removal of anterior clinoid process (ACP) is useful in broad neck and symptomatic cases, but difficult because of its rarity and danger for vision. We reviewed our cases and assessed whether 3D simulation and navigation might contribute to safe surgery and visual preservation. Method: 14 paraclinoid aneurysm cases since December 2012 are assessed. Result: 5 and 9 received endovascular and direct surgery. 6 were clipped with ACP removal, however, 1 of 6 showed visual impairment after surgery. Compression and contraction of optic nerve by incomplete cutting of falcifalm fold might harm vision. Assessment by 3D simulation and navigation were useful to understand location around aneurysm and identify drilling area, resulting safe drilling and sufficient cutting. No visual impairment has been observed thereafter. Conclusion: 3D simulation and navigation could facilitate to mobilize optic nerve and preserve vision by ACP removal, dural ring and falcifalm fold cutting. Those image technologies can be beneficial to improve skills and perform safe surgery.

PP1-3-6  An innovative skull base surgical simulation using computer graphics by multimodal fusion imaging integrated time, space, and real
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Object: We report an innovative virtual reality skull base surgical simulation using computer graphics with a high spatial resolution integrated time, space, and real. Subjects: 100 patients with skull base tumor or vascular disease. Method: All the imaging data required for preoperative examination such as CT, MRI, flow dynamics study, and intraoperative photo were fused for each case. All the images were automatically fused by normalized mutual information. The visualization of CG is used hybrid rendering method combined with surface rendering and volume rendering method. Surface rendering is performed to the same tissue using multiple thresholds. Intraoperative photo such as cortical surface was textured to the CG by thin-plate spline method. Our proposed CGs were simulated pre- and intra-operatively on workstation interactively. Results: Our proposed method CG contributed to the spatial understanding of the pathological condition and was useful in the planning of skull base surgical strategy. We found that there were many findings that could not be understood in conventional imaging. Conclusion: Our proposed method was extremely useful in skull base surgical planning.
PP1-3-7  Skull base training by using a colored temporal bone model created by three-dimensional printing technology
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Background: We created a synthetic whole-skull model from powder material by selective laser sintering in 2010. The aim of this study was to establish a more suitable mastoidectomy training model focused on overcoming the limitations of the previous model. Methods: The temporal bone model was created in 2 pieces cut into a "W" shape. After the separated temporal bone model was cleaned, a dye was placed into these canals, and each piece was merged with glue. This colored temporal bone model was drilled using a high-speed drill. Results: The appearance of the temporal bone precisely resembled real bone. The semicircular canals and the fallopian canal were easily identified during mastoidectomy because of the dye. A minimal amount of the powder material was observed inside the mastoid air cells. Conclusions: This colored temporal bone model will pave the way to a "new era" in skull base training using a high-speed drill.

PP1-4-1  Withdrawn

PP1-4-2  Short term subjective and objective analysis of functional outcome of modified endoscopic Lothrop’s procedure – our experience
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Object: To study the short-term functional outcomes of the endoscopic modified Lothrop procedure with well defined subjective and objective criteria.
Methods: It's a retrospective cohort study of 31 patients with chronic frontal sinusitis who underwent endoscopic modified Lothrop procedure with uncinate preservation during the period Jan 2011- 2014. Minimum followup period was 6 months. Assessment was done based on subjective severity score and Kennedy's 5 point endoscopic criteria.
Results: Subjective improvement was seen in all symptoms whereas statistically significant improvement was found for headache (P<0.025), nose block (P<0.03) and rhinorrhea (P<0.05). Post-op endoscopy revealed no mucosal disease in all patients. No complications were noted.
Conclusion: The study illustrates the benefit obtained from endoscopic modified Lothrop surgery in chronic frontal sinusitis refractory to medical treatment and conventional endoscopic sinus surgery.

PP1-4-3  Surgical anatomy for endoscopic endonasal approach to the ventrolateral skull base lesions
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Background: Although it is not so difficult to get access to lesions in the midline via endoscopic endonasal approach (EEA), it is a bit troublesome to reach lesions in the lateral skull base due to some complicated anatomy.
Objective: To show surgical anatomy for EEA to the ventrolateral skull base lesions.
Method: Cadaveric heads were dissected using the endoscope. Surgical techniques were applied to clinical cases.
Results: To get access to the upper lateral skull base (cavernous sinus, orbit), simple opening of ethmoid sinus via uninostril approach provide sufficient exposure of this area. To reach the inferior lateral skull base (petrous apex, parapharyngeal space, condyle), transpterygoid approach is the key procedure providing wide exposure of this area. To get to the infratemporal fossa, endoscopic Denker's approach, followed by dissection around the lateral pterygoid plate is a feasible technique for accurate opening of this area.
Conclusion: Understanding of surgical anatomy is mandatory for treating the ventrolateral skull base lesions via EEA. Less invasive and appropriate approach should be applied depending on the size, location and type of the lesion.
**PP1-4-4** Management of large and giant pituitary adenomas with suprasellar extensions  
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**Object:** Pituitary adenomas with dumbbell shaped configurations, fibrous consistency are difficult to remove. We evaluated the characteristics and therapeutic problems of large and giant pituitary adenomas with suprasellar extensions.

**Methods:** We retrospectively analyzed 39 cases of large or giant pituitary adenomas surgically treated.

**Results:** 39 cases 43 approaches were transsphenoidal, 2 approaches were transcranial. The most frequent preoperative symptoms were visual impairment and visual field defect (75.6%), and improvement of visual function after surgery was observed in 87%. 11 cases of functioning adenomas showed improvement of endocrinological examination in 10 cases, and normalization of the hormonal examination and complete remission was seen in 80%.

**Conclusions:** Transsphenoidal approach is safe and effective procedure even in large or giant pituitary adenomas. In establishing endoscopic approaches for pituitary adenomas, classic contraindications for transsphenoidal approaches are being questioned. Transcranial approaches were indicated only in eccentric extensions that could not be reached through the transsphenoidal route.

**PP1-4-5** Otolaryngologist’s review of transnasal endoscopic skull base procedures  
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In our institute we did 17 endoscopic transnasal pituitary surgeries in collaboration with neurosurgery department. We also did 7 endoscopic lacrimal sac surgeries in collaboration with department of Ophthalmology. As endoscopic otolaryngologists we help the neurosurgeons and eye surgeons in these procedures. We also took post-operative care for these patients and dealt with rhinological complications. Here we share our experiences in these procedures from Otolaryngologist’s point of view.

**PP1-4-6** Comparaison of endoscopic third ventriculostomy alone and combined with choroid plexus coagulation in infants younger than 1 year of age  
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**Introduction:** The aim of this study is to determine whether and in which patients, the outcome of choroid plexus cauterization (CPC) combined with endoscopic third ventriculostomy (ETV) is superior than ETV alone.

**Methods:** A retrospective study was performed in our department from May 2005 to May 2015. 1828 ETV were performed as primary treatment of hydrocephalus including 296 children with communicating hydrocephalus.

**Results:** 136 ETV–CPC and 160 ETV alone were performed. Overall, the success rate of ETV–CPC was superior than ETV alone (82% VS 63%). The success rate of ETV–CPC, compared to ETV alone was superior in infants with a myelomeningocele (68% VS 38.7%) and those with idiopathic hydrocephalus (73.6% VS 35.2%). Although the difference wasn’t significant for postinfectious hydrocephalus (67% VS 62%). VP shunts were placed after 2 endoscopic failures (1% ETV-CPC VS 7% ETV alone). Overall mortality was 1.8%.

**Conclusion:** ETV–CPC is an effective primary treatment for hydrocephalus in infants younger than 1 year of age. Our algorithm is to perform an ETV (+/- CPC) as a primary treatment of hydrocephalus whatever etiology and age. VP shunts are placed only after failure of 2 or 3 ETV.

**PP1-4-7** Development of a nasal corridor protection device  
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**Objective:** During endoscopic skull base surgery (ESBS), mucosal trauma from blind passage of instruments results in bleeding and contributes to postoperative nasal morbidity. The purpose of this project was to develop and test a nasal corridor protection device (PD).

**Methods:** The design of the nasal corridor PD was perfected using cadaveric models. Structured questionnaires were employed to assess the attributes of the PD. Outcome measures included the ability to perform ESBS on cadavers with full instrument mobility, minimal friction, and complete target visualization, without
displacement of the PD.

**Results:** Study of CT scans and cadaver measurements were used to calculate probable dimensions for the intranasal PD. Prototypes were developed with variations in key parameters, and these were then trialed in cadaver procedures modelling ESBS. A pilot study to assess the performance of the PD is in progress.

**Conclusions:** We developed a pathway PD for use in ESBS. The PD appears to allow performance of transnasal pituitary surgery with diminished mucosal trauma and without loss of surgical access or interference with passage of instruments.

**PP1-5-1 Preservation of middle cerebral vein during the anterior transpetrosal approach**

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**Object:** The objective of this study is to show the surgical modifications to the anterior transpetrosal approach (ATPA) that are necessary for preservation of the superficial middle cerebral vein (SMCV).

**Methods:** This study included 48 patients treated via ATPA in whom the SMCV was examined using three-dimensional computed tomographic venography (3DCTV). The drainage patterns of the SMCV were classified into 3 types: cavernous/absent (Type1), sphenobasal (Type2), and sphenopetrosal type (Type3). Type2 was subdivided into medial (Type2a) and lateral (Type2b), and Type3 into vein (Type3a), vein/sinus (Type3b), and sinus (Type3c). Standard ATPA can be performed with Type1, Type2a, and Type3a drainage. With Type2b drainage, an epidural anterior petrosectomy with subdural SBV visualization is appropriate. The dural incision should be modified in Type3b. With Type3c a subdural ATPA is required.

**Results:** The frequency of each type was 68.7% in Type1, 8.3% in Type2a, 4.2% in Type2b, 14.6% in Type3a, 2.1% in Type3b, and 2.1% in Type3c. No venous complications were found.

**Conclusions:** We proposed a SMCV modified classification based on ATPA modifications required for venous preservation.

**PP1-5-2 Preoperative evaluation of enlarged occipital and marginal sinuses**

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**Objective:** Bleeding from the dural venous sinuses could cause fatal complications in suboccipital craniotomy. The dural sinuses are not always readily distinguishable intraoperatively. The aim of this study was to evaluate enlarged occipital and marginal sinuses by 3D cerebral MR venography.

**Methods:** The 3D cerebral MR venography at 3T obtained in 145 cases with hemifacial spasm or trigeminal neuralgia were reviewed retrospectively to determine the presence of enlarged occipital and marginal sinuses. **Results:** Enlarged occipital and marginal sinuses were present in 117 (7.6%) of patients. In 8 patients only one side was enlarged. The marginal sinus communicated with the sigmoid sinus in all cases. There was a single case with no marginal sinus by 3D cerebral MR venography, but bleeding from the sinus intraoperatively confirmed clinical presence.

**Conclusions:** Preoperative understanding of the presence of enlarged occipital and marginal sinuses is important for safe suboccipital craniotomy. Even if the marginal sinus is not visualized but an enlarged occipital sinus is seen, it is possible to encounter a clinically relevant marginal sinus.

**PP1-5-3 Evaluation of bony structure around the petrous apex by 3D-CTA**

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**Objective:** Cadaveric or radiological studies around the petrous apex structure have been reported. We assessed bony ridge over the Meckel's cave by 3D-CTA and MRI (CISS). Fifty seven cases (male 18, female 39, mean age 57.8 years old) were evaluated basically on their normal side. These include 29 meningiomas, 21 schwanommas, 7 others. We classified in 4 types about bony structure over the Meckel's cave: No ridge (none type) in 56%, partial continuous ridge (partial type) in 24%, uncontinuous ridge (free type) in 7%, bony Meckel's cave (canal type) in 11%. We should know that bony structure surrounds the
Results: In all patients with tumors, gross total removals achieved. TCFA provided shorter access to the lower cranial nerve and lower clival region. Full exposure of the sigmoid sinus eliminated the bony overhanging of the mastoid bone and also provided more direct access to the ventral brain stem using dural tack-up suture. Cerebrospinal fluid leak occurred in 2 patients (14%).

Conclusions: Lateral and inferior extension of the retrosigmoid approach was simple and useful method to treat large CPA tumors.

PP1-5-6 Retrosigmoid suprajugular approach to jugular foramen neuromas
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Object: The removal of jugular foramen (JF) neuroma is technically challenging and contains risks of postoperative morbidities such as lower cranial nerve (LCN) injury. The retrosigmoid suprajugular approach through the osseous roof of the JF has been recently proposed for removal of the intraforaminal component. This study presents our surgical experiences with this approach and examines the utility of the real-time continuous vagus nerve monitoring.

Methods: Ten of 48 surgeries for JF neuromas in which this approach was used these 10 years.

Results: The gross- or near-total resection was achieved in all but the first case. Extubation just after surgery and oral feeding within few days was possible in all patients. Real-time continuous vagus nerve monitoring was performed in 8 cases and no LCN complications occurred except in 1 patient with postoperative sternocleidomastoid muscle weakness.

Conclusions: The retrosigmoid suprajugular approach is effective for removal of tumor extending into the JF without sacrifice of the sigmoid–jugular venous system. The real-time continuous vagus nerve monitoring is useful to avoid postoperative LCN complications in such surgeries.
PP1-6-1  Volumetric change of vestibular schwannomas after gamma knife radiosurgery
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Object: The authors prospectively analyzed volume changes in vestibular schwannomas (VSs) after gamma knife radiosurgery (GKS).

Methods: Among 164 VSs treated with GKS between 1998 and 2007, 123 consecutively treated unilateral VSs observed on follow-up MR imaging for at least 7 years were analyzed. The Gd-enhanced volume of each lesion was measured serially every 6 months. The frequency and degree of volume shrinkage were documented and prognostic factors were analyzed.

Results: The mean tumor volume was 2.7 cm³. The lesions were irradiated by directing a median dose of 12.0 Gy to the tumor margin. The mean follow-up period was 10.7 years. Peak tumor volume expansion was most frequently observed at 6 months after GKS and the median rate was 40%. Seven years after GKS, the mean reduction in tumor volume was 46%, and 11 tumors still remained larger than their initial volumes. Tumors that homogeneously enhanced on MR images displayed less shrinkage than other tumors.

Conclusions: Most VSs exhibit shrinkage 7 years after GKS. The mean volume reduction rate in this series was 46%. Careful serial follow-up is necessary for harbor tumors that display homogeneous enhancement on MR images.

PP1-6-2  Treatment failure following SRS for VS; surgery or repeat SRS?
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Objectives: We report a series of patients who have undergone surgery for treatment failure following SRS.

Patients & Methods: A retrospective review identified 21 patients [median age 49yrs (r=23-84yrs)] who underwent surgical excision between 2000-2015 following treatment failure with GK SRS. Five patients had neurofibromatosis type 2 (NF2). The median tumour size at SRS was 2.5cm (r=0.8-4cm). The median interval from radiotherapy to surgery was 37 months (r=4-228 months). The median size of tumour at surgery was 3cm (range 2-5cm). 8 (38%) had total macroscopic excision, 9 (43%) near total and 4 (19%) subtotal excision.

Results: Of the 17 patients with pre-operative HB grade 1 facial function, 53% of patients had HB grade 1-2 postoperatively and 30% had HB grade 3. During the follow-up period 2 patients, both with NF2 had enlarging residuum. There was no evidence of tumour recurrence in patients who had complete tumour excision. All non-NF2 patients with subtotal & near total tumour excision had a stable residuum.

Conclusion: Surgery for VS following treatment failure with SRS provides good tumour growth control but with higher rates of poor facial nerve outcomes.

PP1-6-3  Delayed vestibular schwannoma growth following stereotactic radiosurgery
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Object: Stereotactic Radio-Surgery (SRS) is a well-recognised treatment for Vestibular Schwannomas (VS); long-term outcomes however still remain under-investigated. The aim of this study was to examine for any patients with a VS treated with SRS with initial response to treatment (shrinking) and delayed further growth.

Methods: A retrospective analysis of all patients with sporadic VS managed in a tertiary referral centre was performed. The size of the tumour was measured on axial contrast-T1-weighted Magnetic Resonance Imaging. Significant change in size was deemed as a change of greater than 1.5 mm.

Results: In a 10-year period 495 patients with VS were identified. A total of 83 patients with VS received SRS. Two patients were found to have initial regression of their medium sized tumour (regression >3 mm following SRS) with delayed re-growth after 3.5 and 2.5 years, respectively.

Conclusion: Our results show a trend for a decrease in tumour size in long term follow up for most patients receiving SRS, however on rare occasions tumours that did regress can start growing again. This study highlights the need to keep patients under long-term review with serial imaging post SRS.
**PP1-6-4** Head and neck paragangliomas radiosurgery: Long-term experience

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**Objective:** The aim of this study is to evaluate the long-term local tumor control and safety of radiosurgery for the head and neck paragangliomas.

**Patients and methods:** In the period between August 2004 and May 2014, 27 patients underwent radiosurgery due to a paraganglioma. Twenty-one out of these 27 patients have a minimum clinical and radiological (MRI) follow up of 12 months and they have been included in the present analysis.

All patients were clinically and radiologically evaluated before and after the treatment.

**Results:** Seven lesions underwent a single-session radiosurgery with a mean dose of 12.2 Gy (range 11-13 Gy). Fourteen lesions had a multisession radiosurgery with a mean dose of 24.7 Gy (range 20-30 Gy) delivered in 3 to 5 fractions. The mean tumor volume for sRS was 4cc (range 1.4-9.2). The mean volume for mRS was 19cc (range 1.3-50.9).

The mean follow-up is 46 months (range 11-111). After this period all lesions are radiologically stable or show a partial response. Neurological conditions are generally maintained or improved.

**Conclusions:** Both single and multisession radiosurgery have been confirmed as a safe and effective treatment modality for paragangliomas.

**PP1-6-5** Linac frameless radiosurgery for trigeminal neuralgia

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From 2010 to 2016, 35 patients (15 male, 20 female, median age 71 years) were treated with Linac frameless SRS for trigeminal neuralgia. Treatment started with molding a personalized thermoplastic mask, followed by elaborate CT and MRI imaging. For treatment planning, target was a single isocenter to the retrogasserian cisternal portion of the fifth cranial nerve. A single fraction dose of 90 Gy was delivered to the isocenter through a conical collimator with a diameter of 4-5 mm by seven non-coplanar arcs, limiting critical dose to brainstem and temporal lobe.

The median time of an entire treatment session was 55 min. None of the patients who received treatment suffered from acute toxicity. After a median follow-up of 40 months (range 2-60 months), 20 patients were pain-free without medications, 10 patients were pain-free with more than 50% reduction of medication doses, 5 patients failed. The 6-month follow-up MRI data confirmed the treatment accuracy by highlighting the treatment isocenter as a radiation-induced lesion exactly located at the planned target. Linac frameless radiosurgery is found to be a safe and effective treatment option for trigeminal neuralgia.

**PP1-6-6** Proton beam therapy for pediatric skull base tumors

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**Background:** Proton beam therapy (PBT) is a promising treatment option which may take the place of conventional photon radiotherapy. Especially for pediatric patients, PBT can significantly reduce the risk of late toxicity and secondary cancer by sparing healthy organs. Here, we evaluate the merits of PBT for pediatric skull base tumors.

**Patients:** From 1984 to 2014, 202 pediatric patients were treated with PBT in our institute. There were 104 males and 98 females, and the median age of all patients was 7 years old (range: 0-19). There were 45 rhabdomyosarcomas, 39 brain tumors, 29 neuroblastomas, 18 Ewing sarcomas, 13 head and neck tumors, 7 skull base chordomas, and 51 other tumors. Two-thirds of the patients received PBT for head and neck or brain tumors.

**Results:** In 7 patients with pediatric skull base chordomas, we minimized the volume of healthy brain tissue exposed to radiation and limited the maximum dose for the optic chiasm and brain stem to 50 GyE. Consequently, the median PBT dose was 70 GyE (Range 60-78). At the time of analysis, 5 patients were alive and 2 patients were dead: the median follow up period for survivors was 43 months. Acute treatment-related toxicities were generally mild, with acute dermatitis and/or otitis of grade 1 and 2, respectively. Treatment-related late toxicity of grade 3 or more was not observed.
but one patient demonstrated pituitary adenoma which was located within the irradiated field. We will also present other types of pediatric tumors located at the skull base which were treated with PBT.

**Conclusion:** We demonstrated 0 cases of pediatric skull base tumors treated with PBT. Although further long term follow-up is needed to prove the actual superiority of PBT, the outcome so far is favorable.

**PP1-7-1 Postoperative complications in skull base surgery for nasal and paranasal malignant tumors involving skull base**

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**Objectives:** To evaluate the postoperative complications in the patients undergoing skull base surgery for the treatment of nasal and paranasal malignant tumors involving the skull base.

**Methods:** Forty-seven patients underwent 48 skull base surgeries for tumors involving the skull base between 1993 and 2015. Thirty patients had the following treatment prior to the skull base surgery: radiotherapy or chemoradiotherapy in 20 patients, particle radiotherapy in 4 patients, chemotherapy in 5 patients, and surgery alone in 3 patients.

**Results:** Major postoperative complications were observed in 14 surgical procedures (29%): 2 cerebral herniation, 3 CSF leakage, 3 meningitis, 1 hydrocephalus, 6 epidural abscess, 2 local infections, and 2 partial flap necrosis. Two or more complications were encountered in 4 patients. Eleven out of 22 patients (50%) with radiotherapy or particle radiotherapy had complications.

**Conclusions:** Patients who had radiotherapy or particle radiotherapy were significantly at high risk of postoperative severe complications. Meticulous care should be taken for the patients treated by radiotherapy and particle therapy in the skull base surgery.

**PP1-7-2 Functional nerve preservation in parapharyngeal tumor surgery**

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**Object:** The complex anatomy and proximity of vital neurovascular structures within the parapharyngeal space (PPS) structure makes surgical treatment difficult. Avoiding damage to the cranial nerve is a primary concern for the surgical removal of PPS tumors.

**Method:** We performed function preservation surgery for benign PPS tumors. The cranial nerve monitoring technique and surgical approach for the PPS tumors were chosen according to the location or histopathological findings.

**Results:** A total of 30 patients with a PPS tumor were enrolled. An EMG was used to monitor the facial nerve for all of the PA tumor surgeries. In schwannoma cases, the motor nerve schwannoma was then enucleated by incision along tumor fibers mapped using EMG stimulation. This study also monitored several lower cranial nerves that were discovered to be the origin and the adjacent nerve to the tumor.

**Conclusion:** In this study, we demonstrated a method of diagnosis and nerve preservation surgery for extracranial schwannomas. Nerve functionality was preserved in all vagus schwannoma cases. However, preservation of nerve function in sympathetic schwannoma cases remains problematic and needs further investigation.

**PP1-7-3 Spectrum analysis of parapharyngeal space tumors**

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Parapharyngeal space is a triangular space in the neck having its base in the skull base and the apex is in the level of hyoid bone. 0.6% of all head and neck tumors are from parapharyngeal spaces which can originate either from pre-styloid compartment or from post-styloid compartment. Important structures like the neurovascular bundle of the neck are closely related to the tumor arising from the post styloid compartment. Both benign and malignant tumors can arise from this space however neurogenic & salivary gland tumors outnumbers it in the benign group. Investigative procedures include ultrasound neck, CT scan, MRI scan, Angiography, FNAC, Ultrasound-guided or CT guided FNAC. Various surgical approaches include cervical, cervico-submaxillary or the cervico-parotid, trans-cervical trans-mandibular
trans-labial approach. We present our experience in 61 cases of parapharyngeal tumors of varied histopathological character managed during the period from 1992 to 2015 with different surgical approaches highlighting the use of CT scan, MRI, angiography, ultrasound, simple FNAC and ultrasound guided FNAC as a diagnostic tool.

PP1-7-4  Significance of surgery for head and neck sarcoma with skull base invasion

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Objective: To reveal a role of surgery for sarcoma with skull base invasion.

Methods: We retrospectively reviewed 22 sarcoma (14 rhabdomyosarcomas, 3 Ewing’s sarcomas, and 5 others). The tumors invaded the anterior skull base in 13, infratemporal fossa in 4, and middle cranial fossa in 5.

Induction chemotherapy (IC) followed by surgery and postoperative radiotherapy (PORT) and adjuvant chemotherapy was performed in 18 chemo-sensitive sarcoma and surgery with PORT in 4 chemoresistant sarcoma. We analyzed the local control rate (LCR) and overall survival (OS).

Results: Conservative resection (partial maxillectomy) was performed in 9 cases exhibiting good response to IC. Radical resection (skull base surgery) was performed in 9 cases exhibiting poor response to IC and in 4 chemoresistant sarcomas. 55% of cases underwent a complete resection. The 3-year LCR of cases exhibiting good response to IC, poor response to IC, and chemoresistant sarcoma were 100%, 58%, and 54%, respectively. The response to IC was significantly associated with LCR (P < 0.04). The 3-year OS of all cases was 70%.

Conclusion: Multidisciplinary treatment is important. Poor response to IC is a risk for local recurrence.

PP1-7-5  Should "parotidectomy" be done with the surgery of external auditory canal cancer?

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Until now, little was known about the mode of parotid involvement in external auditory canal (EAC) cancer. The understanding of mode parotid gland spread is very important to decide whether to perform parotidectomy or not when EAC cancer surgery.

The incidence of parotid node metastasis and direct parotid invasion was examined in patients with EAC carcinoma. Among 37 patients, 22 patients revealed squamous cell carcinomas (SCCa) and 15 patients were confirmed as adenoid cystic carcinomas (ACC). Direct parotid gland invasion were noted. Direct parotid invasion occurred 7/22 patients SCC, especially in advanced stages. However, direct invasion occur 8/15 in all stage of ACC. Parotid node metastasis was noted in 4 cases of advanced staged SCC.

The elective posterior resection of parotid gland to secure adequate safety margin is mandatory for advanced SCC and all cases of ACC. But, total parotidectomy for control of occult parotid node metastasis is necessary only in advanced stage SCC carcinoma.

PP1-7-6  Treatment strategy of intracranial hemangiopericytoma

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Recent studies suggest grossly total resection (GTR) with adjuvant radiotherapy (RT) as a treatment of choice for intracranial hemangiopericytoma (HPC). In the present study, we reviewed the relevant cases from our experience focused on the clinical efficacy of surgical grading of resection, and analyzed the optimal treatment strategies as well.

From January 1995 through December 2014, 17 patients treated for intracranial HPC were included in this study. We analyzed clinical presentation, pathologic diagnosis, extent of resection, and follow-up outcomes.

A total of 26 operations were performed including 9 recurrent intracranial HPCs. GTR was performed in 16 cases, partial resection in 8 cases, and an endoscopic biopsy in 2 patients. In Simpson grading system, grade 1 was done in 2 patients, grade 2 in 11 patients and grade 3 in 3 patients.
Postoperative RT was delivered in 16 patients, total amount of 50-60 Gy in 30-40 fractions. The extent of resection and adjuvant RT were significantly associated with recurrence-free survival.

Surgical resection of intracranial HPC, in an attempt to reach Simpson grade 1 removal, is necessary for better outcome, along with adjuvant RT.

**PP1-8-1** Facial nerve reconstruction in vestibular schwannoma and lateral skull base surgery

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**Introduction:** The aim of the work is to show all methods of reconstruction of facial nerve (CN VII) and to distinguish between direct and cross anastomosis. **Methods:** During the vestibular schwannoma and skull base surgery, we used 1) direct CN VII to CN VII using proximal stump (with or without autologous nerve graft): end-to-end in cerebellopontine angle (CPA), intracranial-intratemporal anastomosis, intratemporal-intracranial-extratemporal anastomosis (N.Dott,1958): 2) cross-anastomosis using proximal stump from CN XII with end-to-side technique. **Results:** Follow-up was 1-23 years. Clinical monitoring and EMG. In direct reconstruction, good reinnervation was achieved (House-Brackmann/HB stages 1-2). Only signs of intraneural aberrant regeneration lead to HB stage 3. N.Dott intracranial-extratemporal anastomosis of CN VII brings the same results as other direct anastomosis. The method is valuable and should not be forgotten. **Conclusion:** The direct anastomosis with the use of proximal stump of CN VII, regardless of the method used, brings the best results. Only in cases of absence of proximal stump of CN VII, the cross-anastomosis using CN XII are indicated.

**PP1-8-2** Descending hypoglossal-facial anastomosis for facial reanimation: Results in 18 patients

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**Objective:** Hypoglossal–facial nerve anastomosis (HFA) has been widely used for severe facial palsy. The major drawbacks of the classic HFA technique are hemiglossal dysfunction. To reduce this morbidity, a modified technique with descending hypoglossal-facial nerve anastomosis (DHFA) has been used.

**Methods:** A retrospective study was performed in 18 patients who underwent facial reanimation by DHFA technique between October 2010 and December 2014. Facial outcome was evaluated with House–Brackmann (HB) grading system.

**Results:** The average age was 45.9 years (range 26-72 years). The mean interval between facial palsy and ACHFA was 3.8 months (range 0-21months). The median follow-up period was 25.3 months (range 6-53 months) in 16 patients (88.9%). The last follow-up HB grade was II in 4 patients (25%), III in 5 patients (31.3%), IV in 6 patients (37.5%) and V in 1 patient (6.2%). Only 1 patient (5.6%) suffered hemitongue atrophy post-operation.

**Conclusion:** DHFA is simple, effective and time-saving for facial reanimation, and it has a much lower morbidity related to tongue function. It may be one of the choice for surgical treatment of facial paralysis.

**PP1-8-3** Different pathogenesis makes different aspects of facial movement in chronic facial paralysis

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**Objective:** In chronic facial paralysis patient, there has been observed different aspects of facial movement according to their pathogenesis.

**Methods:** Four pathogenesis types of facial paralysis could be found in our office. 1) patients with resection and anastomosis (n=15) 2) patients with chronic nerve compressive injury (n=13) 3) patients with severe Bell’s palsy (n=68) 4) patients with total resection without reanimation surgery. (n=8). All of them (n=104) were investigated their severity of synkinesis, regression of muscular volume, latency and amplitude in EMG and facial movement by HB grade system.

**Result:** First group had severe synkinesis without regression of muscular volume, HB grade 3.7±0.76. Second group had mild synkinesis with minimal regression of muscular volume, HB grade 3.7±0.44. Third group had moderate to severe synkinesis with moderate regression of muscular volume, HB grade 3.4±0.96. Fourth group had no synkinesis with profound regression of muscular volume, HB grade 5.7±0.34.

**Conclusion:** Clinical configuration of facial movement including severity of synkinesis, muscular regression and facial weakness can be reflected by pathogenesis of facial nerve injury.
PP1-8-4  Timing & recovery of delayed facial palsy after vestibular schwannoma resection

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Object: Delayed facial palsy (DFP) is described as noticeable worsening of facial nerve function after an initially normal post-operative result. Our institution’s series of VS resections were reviewed to evaluate the timing of DFP onset and recovery.

Methods: 403 consecutive cases of VS resection between Nov 2001 and Jun 2015 were retrospectively reviewed. Patients who developed significant facial palsy (House-Brackmann (HB) grade ≥ 3) post-op were categorized into three groups based on the timing of onset: immediate facial palsy (IFP), early-onset DFP (on post-op day 2 or prior), and late-onset DFP (on post-op day 3 or later) and compared.

Results: 6.8% developed minor IFP, 4.9% major IFP, 2.6% early-onset DFP, and 5.7% late-onset DFP. Late-onset DFP group demonstrated the quickest recovery (3.0 weeks), followed by minor IFP group (8.5 weeks), then early-onset DFP group (40.8 weeks), and with major IFP group exhibiting the poorest recovery with only 21% of patients recovering to HB grade 1 or 2 within 1 year.

Conclusion: The time-course of recovery in different facial palsy subgroups suggests different pathophysiological mechanisms and prevention are proposed.

PP1-8-5  Botulinum toxin injection of both sides of the face to treat post-paralytic facial synkinesis

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Objective: To produce a new ‘balance’ in facial dynamics between paralyzed and non-paralyzed face by concomitant injection of botulinum toxin A (BTX-A) on both sides in patients with long-lasting facial sequelae.

Methods: 42 patients who recovered partially from facial nerve paralysis were enrolled. The dosage of injection site of the paralyzed side with synkinesis varied from 1.5 to 2.5 U per site, and the total dosage used per patient was 17.12±5.3 U. That of the non-paralyzed side with muscular hypertrophy varied from 2.5 to 5 U, and the total dose was 52.6±9.7 U. All patients had been evaluated by the Sunnybrook (SB) facial nerve grading systems and developed dynamic facial asymmetry ratio.

Results: After injection of BTX-A, relief of facial synkinesis and enhancement of facial symmetry were observed. Before the injection, the patients showed an 38.8±10.68 score and after the injection, changes of synkinesis and symmetry score were 7.9±1.81 and 8.4±3.25, respectively, resulting in a 58.4±12.46 score at last evaluation. Before the administration, the value of dynamic facial asymmetry was 0.83±0.06 and it was increased to 0.90±0.05 one month after administration.

PP1-8-6  Thread lifting for drooping face as a new approach for chronic facial paralysis

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Object: To correct in static paralyzed face by reduction of synkinesis and concomitant non-paralyzed face injection of Botox® in patients with long lasting facial sequelae.

Methods: 22 partial recovered facial nerve paralysis patients were enrolled. The Length of insertion varied from 60–410mm by the site. 22-23G needles were used and the total number of used threads per patient was 20–30. Botox unit of non-paralyzed side varied from 3–5U, and the total dosage of botox used per patient was 40–70U (mean 55.4±5.5U) Sunnybrook (SB) facial nerve grading systems and developed dynamic facial asymmetry ratio were used to evaluation.

Results: The patients showed 37.6±10.55 SB score. After the procedure, change of synkinesis and symmetry score were 7.9±1.81 and 8.4±3.25 respectively, and total SB score was 58.4±12.46 at last evaluation. Before the procedure, the dynamic facial asymmetry score was 0.83±0.06 and it was increased significantly to 0.90±0.05 one month after administration.

Conclusion: Facial lifting & Botox injection suppressed synkinesis and improved facial symmetry with better quality of life, social interaction, personal appearance and food intake without complication.

PP1-9-1  Endoscopic transpterygoid approach – an excellent surgical corridor

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Objective: To describe the endoscopic transpterygoid approach for surgery in anterior skull base pathologies and to compare this approach with other infra temporal fossa approaches.

Methods: This is a retrospective study of 25
patients who underwent surgery for diverse pathologies via the transpterygoid approach. The patients were followed up clinically and with postoperative imaging to find the efficacy of treatment.

**Results:** The 9 lateral sphenoid CSF leak patients underwent successful closure of the CSF leak. Among the patients with juvenile nasopharyngeal angiofibroma, 3 patients who presented in the early stage underwent complete excision whereas 6 patients in the late stage had near total excision. 5 trigeminal schwannoma patients had near total excision done and 2 adenoid cystic carcinoma patients underwent palliative surgery.

**Conclusion:** The endoscopic transpterygoid corridor offers adequate access for the excision of diverse pathologies located in infra temporal fossa and upper parapharyngeal space. In selected cases it is an ideal approach and gives satisfactory results with probable lesser morbidity that is associated with the open approaches.

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**PP1-9-2 Endoscopic endonasal transpterygoid approach for non-vestibular schwannomas**

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**Background:** Although endoscopic endonasal transmaxillary-pterygoid approach (ETMPA) has been used for resection of laterally extending skull base lesions, the role of EES for schwannomas is not well evaluated.

**Method:** By searching our prospectively collected database of 345 cases underwent EES in our hospital, 4 cases of non-vestibular schwannoma underwent ETMPA was found.

**Results:** Of 4 patients, 2 had tumor in the cavernous sinus, 1 in the pterygopalatine fossa, and 1 adjacent to the foramen lacerum. In no case, tumor extended to the posterior fossa. All the patients were primary case and underwent 1 staged ETMPA. Gross total resection was achieved 3 and subtotal in 1. Preoperative trigeminal deficit was improved in 1 case and new deficit did not occur. Preoperative abducens nerve palsy was improved in 1 case, however, transient worsening of abducens nerve palsy was encountered in 1. New postoperative disturbance of emotional tearing was found in 1 case. No postoperative CSF leakage occurred.

**Conclusion:** ETMPA is safe and effective for well selected cases of non-vestibular schwannoma without extension in the posterior fossa.

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**PP1-9-3 The impact of vidian nerve anatomy on endoscopic middle fossa exposure**

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**Object:** Iatrogenic injury to the vidian nerve is sometimes necessary but its sacrifice requires consideration. Previous authors assessed the vidian in the coronal plane; however, this view fails to capture the entire route and its obstruction of the transpterygoid approach. We examined the vidian in the sagittal plane; if the nerve courses below the level of V2, we hypothesize it will likely require sacrifice in order to provide a full transpterygoid working channel.

**Methods:** Fifty patients, ages 22-80 years, had CT scans reviewed on a Stealth workstation. The distance between foramen rotundum (FR) and the vidian canal (VC) was measured along the entirety of their respective courses. The level of sphenoid sinus aeration was recorded for each side.

**Results:** The distance between FR and VC ranged from 2.6-13mm, averaging 6.1mm. 35 patients displayed previdian, 40 had prerotundum and 25 had postrotundum sphenoid aeration. There were increasing distances with increasing aeration.

**Conclusion:** Viewing the vidian nerve in the sagittal plane provides a superior understanding of its relationship with the transpterygoid middle fossa corridor and its need for sacrifice.

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**PP1-9-4 Transcanal endoscopic lateral skull base surgery: Initial experiences**

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**Objectives:** Surgical approaches to the lateral skull base, internal auditory canal (IAC) and petrous bone are widely known and have been extensively recorded. The aim of present report is to describe our initial experiences with minimally invasive endoscopic approaches to the lateral skull base.

**Methods:** Patients affected by lesions involving suprageniculate fossa/petrous apex and IAC who underwent transpromontorial and suprageniculate endoscopic approaches were included in the study.

**Results:** From November 2011 to January 2016, 35 patients underwent endoscopic transcanal lateral skull base surgery at Verona and Modena.
University Hospital. The pathology was successfully removed in all cases with no important postoperative complications and reasonable facial nerve outcomes.

**Conclusions:** The transcranial endoscopic approaches to the lateral skull base allow to reach the IAC, petrous apex and suprageniculate using a minimally invasive surgical route, compared to traditional surgical procedures. Even if these are initial results, transcanacl endoscopic procedures seem to obtain good results in terms of facial nerve outcome and low morbidity, avoiding manipulation of the brain.

**PP1-9-5 Endoscopic triportal approach for extracranial trigeminal schwannomas**

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**Object:** We have applied endoscopic triportal approach for extracranial trigeminal schwannomas by an interdisciplinary ENT and neurosurgeon team.

**Methods:** This approach comprises three surgical routes: a modified medial maxillectomy from one nostril, transseptal route from the contralateral side, and sublabial transmaxillary route through the canine fossa.

**Results:** This approach was performed in 4 patients with schwannomas in the pterygopalatine fossa. The meticulous and comfortable manipulation of an endoscope and instruments was achieved. The hemostasis for arterial bleeding was effectively performed using a variety of instruments and materials. Gross total resection of the tumor was done in all patients. Empty nose syndrome did not occurred postoperatively with sparing of the inferior turbinates in all patients.

**Conclusion:** This endoscopic combined binostril and sublabial transmaxillary approach through three surgical corridors may be useful for selected patients with lateral skull base lesions, especially when performed using a team approach with skilled endoscopic rhinologists and neurosurgeons.

**PP1-9-6 Endoscopic endonasal approach to orbital lesions - our experience**

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**Objectives:** To assess the efficacy of the endoscopic endonasal surgical approach in the management of orbital lesions in terms of surgical time, number of days of hospitalization, cure rate, complications, morbidity and mortality.

**Methods:** This is a prospective study of 23 cases with orbital lesions managed by endoscopic endonasal surgical approach at our tertiary care hospital between the years 2006-2015. The minimum follow-up period was 3 months.

**Results:** Seven patients had inflammatory orbital conditions, six benign tumors, five traumatic conditions and five miscellaneous conditions. The average surgical time was 70 minutes, no patients required nasal packing, average duration of hospitalization was 3 days, and cure rate was 100% in inflammatory conditions and benign tumors and 60% in traumatic conditions. There was no significant morbidity and complications in any case.

**Conclusion:** The endoscopic endonasal surgical approach is an effective and safe option in managing orbital lesions.

**PP2-1-1 Staged surgical strategy with far medial endoscopic endonasal approach and endoscopy-assisted far lateral transcranial approach for chordoma of the craniovertebral junction and upper cervical spine**

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**Introduction:** Chordomas often involves a skull base regions including the clivus, craniovertebral junction (CVJ), and the upper cervical spine (UCS).

**Case presentation:** A large CVJ chordoma extended into the CVJ and the UCS. Firstly, the paramedian lesion through an endonasal approach (EEA) and following resection with a transcranial lateral approach (far lateral approach, FLA), with/without endoscopic assistance (EA). 85% of resection was achieved with the EEA. The additional FLA, transposition of the vertebral artery allowed exposure of the tumor residue left in the ipsilateral C1 lateral mass. During FLA, EA was decisive in visualization of deeper targets. Near-total
PP2-1-2  Endoscopic endonasal surgery for chordomas and chondrosarcomas

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Object: Endoscopic endonasal surgery (EES) is widely applied for chordomas and chondrosarcomas. However, it remains difficult to achieve gross total resection (GTR) and prevent recurrence. We analysed outcome of EES in our consecutive case series.

Methods: Eighteen cases of chordoma and 2 of chondrosarcoma underwent EES from 2010 to 2015. The patient’s ages ranged from 4 to 79 years (median 57.5 years), 5 of the 20 are recurrent cases. We applied transmaxillary-pterigoid approach for 10 cases of inferolateral tumor extension, transodontoid approach and combined with endonasal-transoral approach for each case of inferior tumor extension.

Results: GTR was achieved in 11, subtotal removal in 8, partial removal in 1 case. Location of residual tumors were cavernous sinus in 1 cases, hypoglossal canal in 1, Meckel’s cave in 2 and subarachnoid space in 5 cases (adhering with the brain stem in 4). Rate of GTR was 67% in primary cases, whereas 20% in recurrent cases.

Conclusion: EES is effective for the treatment of chordomas and chondrosarcomas. However, gross total resection is still challenging especially in recurrent cases and tumors with brain stem adhesion.

PP2-1-3  Endoscopic surgery for cranial chordoma and chondrosarcoma compressing brainstem

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Object: To delineate the outcomes of endoscopic transnasal surgery (ETS) for skull base chordoma (Cho) and chondrosarcoma (ChS) penetrating the dura matter and markedly compressing brainstem (Bst).

Methods: Since 2011, 13 tumors (7 Chos and 6 ChSs) were treated with ETS. Pons was the most common site of compression, found in 8, 3 in medulla, and 1 in midbrain. In 1 case, both pons and medulla were extensively compressed.

Results: Relief of Bet compression was achieved in all the cases. Gross total resection (GTR) was performed in 10 (77%) without disabling complications. In 2, tumors were strongly adherent to Bst and GTR was abandoned. They were treated with Gamma Knife. In 1 case, a small residual tumor was observed in the tumor margin and second operation was planned because of multiple radiotherapies in the previous hospital. Postoperatively, cerebrospinal fluid leakage was observed in 2, of which 1 required a surgical repair. Both of them had previous history of radiotherapy and postoperative administration of intensive steroid therapy.

Conclusion: ETS was safe and effective for Cho and ChS with Bet compression. Maximum but judicious resection will warrant good surgical outcomes.

PP2-1-4  Temporal bone chondrosarcomas (CSAs): Site specific surgical strategies

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Object: To identify factors affecting resection of temporal bone CSAs. Methods: From 1994–2015, 31 tumors were resected at MD Anderson. Patient, tumor and surgical factors were analyzed using chi² analysis. Histological subtypes included conventional (84%), mesenchymal (13%) and dedifferentiated (3%). Most common origin sites were petroclival synchondrosis (syn.) (71%), sphenopetrosal syn. (6.5%), glenoid fossa (6.5%), and indeterminate (9.6%). Tumors varied by subcranial, bony and cavernous sinus invasion. Gross total resection (GTR) was achieved in 48%. New neurologic deficits occurred in 6.5%. Results: Histology did not predict extent of resection (p>.05). Origin sites associated with GTR were: petroclival (neg relation, p<.05), sphenopetrosal (pos relation, p<.05). For all sites, jugular tubercle, clivus, nasopharynx, cavernous sinus invasion were linked with subtotal resection (p<.05). For petroclival syn. lesions, infrapetrous extension was linked with STR (p<.05). A staged or endonasal transpterygoid approach was linked with GTR (p<.05) for petroclival lesions. Conclusions: Temporal bone CSA resection strategies should be tailored to site of origin and extension.
were RS (2 cases), transpetrosal (3) and high cervical (1). Surgical strategies used to increase exposure included VA transposition (2), Jugular tubercle resection (3), infralabyrinthine and condylar resection (2). Other blind spots better visualized with the endoscope were the contralateral occipital condyle, lateral C1 mass and odontoid region. Near-total resection was achieved.

**Conclusion:** Use of the EA may increase the TC corridor allow for more radial resection of these tumors safely.

**PP2-1-7 Skull base chordomas and chondrosarcomas: Outcomes of multi-disciplinary management**


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**Objectives:** To analyse treatment outcomes for patients with skull base chordomas and chondrosarcomas.

**Methods:** From 1992 to 2011, we treated 24 patients with skull base chordoma using aggressive surgical removal as a principal strategy. Skull base approaches were selected according to tumor extension to remove the tumor and surrounding bone as completely as possible. After surgery, all patients were closely observed with MRI to find small and localized recurrent tumors, which were treated with gamma-knife radiosurgery or surgical resection. The mean postoperative follow-up duration was 10.2 years (range, 1-17.2 years).

**Results:** The 5-, 10-, and 15-year overall survival rates were 86%, 72%, and 72%, respectively. The 5- and 10-year progression-free survival rates were 47% and 35%, respectively. Tumor extension to the brainstem and partial tumor removal were the factors related to poor survival.

**Conclusions:** Our results suggest that aggressive surgical removal improves the long-term outcome of patients with skull base chordoma. We would like to emphasize that skull base chordomas should be aggressively removed using various skull base approaches.

**PP2-1-6 Increasing the surgical corridor in deep-seated lesions: The value of the endoscopic assistance**

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**Objective:** Although most SB lesions are benign tumors, a gross total resection is preferred; including in clival chordomas, chondrosarcomas, and jugular foramen (JF) tumors.

**Methods:** We reviewed our recent experience with surgical treatment of clival chordomas and JF schwannomas operated on through transcranial (TC) approaches during which there was a need for endoscopic assistance (EA). **Results:** During 2015, 6 patients underwent TC approaches for resection of complex lesions with EA. The main approach used were RS (2 cases), transpetrosal (3) and high cervical (1). Surgical strategies used to increase exposure included VA transposition (2), Jugular tubercle resection (3), infralabyrinthine and condylar resection (2). Other blind spots better visualized with the endoscope were the contralateral occipital condyle, lateral C1 mass and odontoid region. Near-total resection was achieved.

**Conclusion:** Use of the EA may increase the TC corridor allow for more radial resection of these tumors safely.
PP2-2-1  Trans-eyelid approach in treating meningioma of anterior and middle cranial base
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Aim: Transeyelid approach is a modified trans-orbital access to the anterior cranial fossa. We describe our study from cadaveric anatomy to clinical operations with some revisions and new experience.

Methods: After studying cadavers, assisted by an experienced ophthalmologist for incisions, we treated 3 patients of sphenoidal wing meningioma via this approach.

Results: There were some differences of exposure between trans-orbital and transeyelid approaches. All tumors were totally resected with Simpson Grade I. Complications included orbital apex syndrome because of tumor invasion. No cerebrospinal fluid leakage. Excellent cosmetic outcome was accomplished.

Conclusion: We found that transeyelid approach is more suitable for lesions situated around sphenoidal wings within 2cm range, especially lesions invading cranio-orbital communicating region, anterior and lateral to the internal carotid artery. Comparing to trans-orbital frontal mini-craniotomy, this approach may expose the lesion more lateral to the temporal lobe. We suggested that this approach be named as transeyelid pterional approach. This is a safe and minimally invasive approach, with excellent cosmetic results.

PP2-2-2  Middle infratemporal fossa keyhole approach for the parapharyngeal tumors
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The infratemporal fossa (ITF) is an inferior lateral cranial base space. Surgery of ITF and parapharyngeal area still presents a formidable challenge to the neurosurgeon, neurootologist and head & neck surgeon due to its rarity, anatomical complexity and limited access. Conventional surgical approaches to these regions were often too invasive and necessitate sacrifice of normal function and anatomy.

We propose the preauricular transzygomatic “Middle infratemporal fossa approach (ITFA)”, which is indicated for surgery of lesions located at the medial mandibular condylar area, posterolmedial to the trigeminal third branch (V3) or anterior to the internal carotid artery vertical segment (C7) in the parapharyngeal region. This less invasive keyhole exposure through a small space between the V3 and the TMJ is feasible with anterior translocation of the V3 with skeletonization of the foramen ovale and modest bone removal around the mandibular condyle.

PP2-2-3  Effect of fibrin glue injection into the cavernous sinus on the venous drainage
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Object: The present study investigated changes in the venous draining pattern after trans-cavernous surgery with and without fibrin glue injection into the cavernous sinus.

Methods: A total of 82 patients treated by the trans-cavernous approach were retrospectively divided into two groups based on the hemostasis methods. Both pre- and post-operative angiography and/or three-dimensional computed tomography venography were available in 24 patients in the cotton packing group and 12 patients in the fibrin glue group.

Results: Postoperative change in the venous draining pattern was observed in 5 of the 24 patients in the cotton packing group and 3 of the 12 patients in the fibrin glue group. One of the 82 patients showed postoperative brain swelling due to occlusion of the sphenoparietal sinus. Volume of injected fibrin glue ranged from 0.5 to 2.5 mL but none of the patients had brain swelling.

Conclusion: Fibrin glue direct injection into the opened cavernous sinus is relatively safe but change in the venous draining pattern occurs in 25% of patients. The study indicates the potential danger of change in venous draining pattern and recommends limiting the injection volume of fibrin glue.

PP2-2-4  Anatomical and clinical findings of modified orbitozygomatic craniotomy
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Object: Orbitozygomatic (OZ) approach is an excellent procedure for skull base lesions originally reported by Pellerin and Hakuba. A technique of
OZ craniotomy reported by Zabramski facilitates wide exposure, easy orbital reconstruction, and a satisfactory postsurgical esthetic outcome. The authors introduce an easier technique of OZ craniotomy, and present the anatomical and clinical findings.

**Methods:** OZ craniotomy was performed on 18 sides of 10 cadavers, in which the cut between the inferior orbital fissure (IOF) and superior orbital fissure (SOF) was simplified, and the shortest distance between them was measured. This technique was applied to 11 clinical cases, and craniotomy-associated complications were evaluated.

**Results:** The average of the shortest distance from IOF to SOF was 21.1 mm on cadavers. In the clinical cases, atrophy around the temple was noted in one patient, cerebrospinal fluid leak in two, and transient facial pain in one. Other craniotomy-associated complications including enophthalmos were not found.

**Conclusion:** Modified OZ craniotomy facilitated a wide surgical field and favorable postsurgical esthetic and functional outcomes with a simpler procedure.

**PP2-2-5 Trans-SOF approach for paraclinoid lesions: Operative tips and cadaveric study**

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**Objective:** Trans-SOF approach can provide extensive exposure of the anterior clinoid process and early exposure, and decompression of the optic nerve and internal carotid artery. The present study investigated the usefulness of this technique and discusses the operative nuances. **Methods:** We retrospectively reviewed 80 consecutive patients with neoplastic (21 patients) and vascular lesions (59 patients) underwent the trans-SOF approach. We also investigated the histological characteristics of the lateral cavernous sinus using adult cadaveric specimens. **Results:** Preoperative visual acuity worsened in 4 (5.0%), and worsening of visual field function occurred in 10 patients (12.5%). Postoperative outcome was GR in 71, MD in 6, SD in 2, and death in one (due to re-ruptured aneurysm). Histological examination showed invagination of the dura propria and periosteal dura into the SOF. **Conclusion:** Extradural anterior clinoidectomy via the trans-SOF approach is safe and recommended for surgical treatment of deeply located aneurysms and skull base tumors to reduce the risk of intraoperative optic neurovascular injury.

**PP2-2-6 Evaluation of variation in the course of the facial nerve in acoustic neuromas**

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**Objective:** To investigate the variation in the course of the facial nerve (FN) in patients undergoing acoustic neuroma (AN) surgery, its adhesion to tumors, and the relationship between such adhesions and postoperative facial palsy. **Methods:** The subjects were 356 patients who underwent AN surgery in whom the course of the FN could be confirmed. Patients were classified into six groups: ventro-central surface of the tumor (VCe); ventro-rostral (VR); ventro-caudal (VCa); rostral (R); caudal (C); and dorsal (D). **Results:** The FN course was VCe in 185 cases, VR in 137, VCa in 19, R in 10, C in 4, and D in one. For tumors < 1.5 cm, the VCe was most common. For tumors ≥ 1.5 cm, the proportion of VR increased. No significant difference was observed between course patterns of the FN in terms of postoperative FN function, but for tumors > 3 cm, there was an increasing tendency for the FN to adhere strongly to the tumor capsule, and postoperative facial palsy was more severe in patients with stronger adhesions. **Conclusions:** The VCe pattern was most common for small tumors. Strong or less strong adhesion to the tumor capsule was most strongly associated with postoperative FN palsy.

**PP2-2-7 Radical resection of craniopharyngioma via the extradural temporopolar approach**

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**Objective:** Authors describe results of their surgical case series and the technical importance of EDTPA for the craniopharyngioma. **Methods:** 7 cases of surgically treated craniopharyngiomas are included. **Results:** Surgical approach were EDTPA with zygomatic osteotomy in 4, combined interhemispheric translaminaterminalis approach and anterior temporal approach (ATA) in 2 and interhemispheric translaminaterminalis approach in 1. All 7 cases were achieved total removal of tumors and showed no recurrence during follow up period. Transient morbidities were oculomotor nerve palsy in 2 and meningitis and hydrocephalus
in 1. Permanent morbidity was 1 case of hydrocephalus and 1 case of blindness of operative side. Visual acuity and visual field were improved in 4 cases, 2 were no change and 1 was worsening. Though pituitary stalk was preserved in 2 cases, all 7 cases needs total hormone replacement therapy. Conclusion: EDTPA can be acquired enough movability of the ICA, well lateral and looking- up operative view. Hence, this is effective to radical resection of craniopharyngioma via from the optico-carotid space and retro-carotid space.

PP2-3-1 Application of transpetrosal approach in combined simultaneous surgery
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Large skull base tumors are challenging lesions. Due to anatomical complexity, a combination of surgical approaches is often required. Staged surgery is one of the surgical strategies, but is not always validated. To achieve safe and aggressive resection in a single stage, we recommend a combined simultaneous approach. Since 2011, transpetrosal approach was applied in 6 simultaneous combined surgeries for the resection of petroclival tumors: anterior petrosal approach + endoscopic endonasal approach in 4, posterior petrosal approach + endoscopic endonasal approach in 1, and posterior petrosal approach + infratemporal approach in 1. Out of 6 surgeries, 3 had gross total removal, 1 had subtotal removal, and 2 had planned partial removal. Based on postoperative outcomes, 2 severe complications were observed (brain stem infarction and infection). Simultaneous surgery makes tumor bulk reduction easier, improves visualization of critical neurovascular structures, and improves safety and resectability. We present our case series using transpetrosal approach in combined surgery, and provide some technical points and a discussion relating its advantages and limitations.

PP2-3-2 Intradural anterior transpetrosal approach for petroclival lesions
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The standard anterior transpetrosal approach (ATPA) for petroclival lesions is fundamentally an epidural approach and has been practiced for many decades quite successfully. However, this approach has some disadvantages, such as the limited space and difficult orientation in the epidural space and the risk of postoperative cerebrospinal fluid (CSF) leak. We describe here our experience with a modified technique for anterior petrosectomy via an intradural approach. Five patients with petroclival lesions underwent surgery via the intradural ATPA. The intraoperative hallmarks are detailed and surgical results are reported. Total removal of the lesions was achieved in two patients with petroclival meningioma and two patients with pontine cavernoma, whereas subtotal removal was achieved in one patient with petroclival meningioma, without significant morbidity. The intradural approach allowed to tailor the extent of anterior petrosectomy to the individually required exposure and the surgical procedure appeared to be more straightforward than via the epidural route. Intradural ATPA allows to tailor and optimize the surgical procedure and minimize the risk of CSF leak.

PP2-3-3 Navigation-guided drilling technique for the skull base surgery in the middle and posterior fossae
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Objective: The navigation system is not commonly applied in middle or posterior fossae skull base surgeries because incomplete registration often occurs in the lateral or prone position. Surface matching of registration on the skull called “bony surface registration” was developed and it enabled highly precise navigation in the middle and posterior fossae skull base surgeries. We introduced navigation-guided drilling technique with bony surface registration for skull base surgery. Methods: 9 cases with skull base tumors which needed drilling of the skull bone were included. Navigation was used for drilling of the skull base as follows: 1) some labyrinthine structures were marked by color in the source image and it was superimposed with the navigation image in the work station, 2) registration was achieved with a 3D skull reconstruction model, 3) drilling of the petrosal bone under navigation guidance with confirmation of color-marked labyrinthine structures. Results: Navigation-guided drilling technique provided adequate drilling of the petrous bone without risk of labyrinthine perforation in all cases. Conclusion: This new technique is useful for the skull base surgery.
PP2-3-4 Withdrawn

PP2-3-5 Three subtypes of trigeminal schwannoma in relation with meninges pattern
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Trigeminal schwannomas are rare tumors that comprise of 0.2% of all intracranial tumors. To clarify the pattern of trigeminal schwannomas in relation with meninges for surgical considerations. 3 adults head cadaver specimens were used for surgical simulation and taken for immunohistochemical staining to observe the meninges pattern and applied in surgical technique. In our study we found that the dura wrapped the trigeminal nerve from the beginning of gasserian ganglion which change into interdural space. It becomes periosteal dura after passing through the foramen, we call it extracranial part. The arachnoid clearly covers the nerve bundle from entering Meckel cave and becoming perineurium in the interdural space.
At the extracranial part it is only covered by periosteal dura or similar to epineurium structures.
Conclusion for surgical method, that we did surgery sub arachnoidal dissection in posterior fossa, submeningoperisoteal dura dissection in middle fossa, subperiosteal dissection in infra temporal fossa.

PP2-3-6 Treatment decision-making for petrous apex and petroclival meningiomas
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Treatment of petrous apex and petroclival meningiomas requires advanced surgical technique and extensive experience. In particular, in cases with strong adhesions to surrounding structures, the conflict between "functional preservation" and "resection rate" becomes a problem. However, because meningiomas in these areas are also pathologically benign, the ideal treatment is to perform maximum resection without any complications, suppress the recurrence rate, and maintain the patient's quality of life (QOL) over a long period of time. Not only improvements in surgical techniques, but also the overall ability to judge specific aspects of treatment, including follow-up, multi-staged surgeries, and radiation therapy, and a well-balanced treatment approach are demanded. In addition the latest advancements in diagnostic imaging techniques have been remarkable, and not only the spatial relationships with surrounding structures, the degree of adhesion, the tumor blood flow and the stiffness, but also the growth and recurrence rates of the tumor are becoming increasingly predictable.

PP2-3-7 Reoperation for posterior fossa lesion
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Background: Reoperation is sometimes difficult and requires time for attainment of operative field, arachnoidal dissection and understanding surgical orientation.
Methods: For 2 years from 2014, 1105 cases were surgically treated. Total 74 cases were treated using a microscope for posterior fossa lesion. 46 tumor removal, 18 MVD, 9 FMD with or without tonsillectomy, and 1 arachnoidal dissection were performed. We reviewed the cases of reoperation for posterior fossa lesion, regardless of the institute where the previous surgery had been performed.
Results: We performed 13 reoperations for posterior fossa lesions, including 8 tumor removal, 4 FMD with partial tonsillectomy and 1 microvascular decompression. Total removal was achieved for hemangioblastomas, subtotal removal for other tumors, except for 1 case with partial resection for meningioma. For recurrent cases of Chiari malformation, partial tonsillectomy is useful for symptomatic relief and syrinx reduction.
Discussion and Conclusions: Surgical planning by preoperative CT and MR images is essential. At reoperation, sufficient working space and meticulous dissection is needed for safe and effective surgery.

PP2-4-1 Mapping of cranial nerves in endoscopic endonasal surgery of skull base tumors
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Materials and Methods: Nine patients were operated on by endoscopic endonasal approach within 2 year period: large skull base chordomas (6 cases) and
trigeminal neurinomas located in cavernous sinus (3 cases). During the surgeries the identification of cranial nerves was carried out using t-EMG with bipolar method (except one case of chordoma). The assessment of functional activity of cranial nerves was made both before and after tumor removal.

Results: In 7 cases the tumor removal was estimated as total, and in 2 case as subtotal (chordomas). Third (4 patients), fifth (2 patients), and sixth (7 patients) cranial nerves were identified intraoperatively. There were no cases of postoperative functional impairment of these cranial nerves. In one case we were unable to get the response of fourth cranial nerve during surgery, and observed its postoperative plegia (the nerve function was normal before surgery).

Conclusion: T-EMG is a promising method of intraoperative neuromonitoring which needs further investigation.
PP2-4-5  Pure single nostril Endoscopic Endonasal Transsphenoidal Hypophysectomy surgery: Clinical series of 50 cases

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Objectives: This study evaluates a series of consecutive Endoscopic Endonasal Transsphenoidal Hypophysectomy (EETH) performed since 2012 in our center. The aim of the study was to analyze the outcome and the surgical technique to enlighten advantages and limitations of this procedure.

Methods: All patients underwent a pre- and postoperative evaluation of neurological status, hormonal investigations and magnetic resonance imaging. Surgical time, post-surgical complications, post operative diabetes insipidus, and post operative length of stay (LOS) were considered, based on medical records.

Result: EETH was done in 50 cases of pituitary adenoma. Bleedings during the surgery were minimal. Post-operative LOS of most patients was 7 – 14 days and 9 patients can be discharged within 7 days. Re-operation was done in 6 patients. Those was due to post operative hemorrhage and profuse cerebrospinal fluid leakage in 4 and 2 cases respectively.

Conclusion: EETH procedure resulted in a safe, effective, and well-tolerated procedure. From our experience, complications can be further reduced after achieving the learning curve, good understanding of limitations with proper patient selection.

PP2-4-6  Endoscopic transoral transclival approach to jugular foramen and hypoglossal canal: Anatomy study and clinical implications

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Object: We have developed endoscopic transoral transclival approach (ETTA) to remove schwannomas involving jugular foramen (JF) and hypoglossal canal (HC). This study was to detail its anatomy and discuss its surgical implications.

Methods: Eight cadaver heads were dissected under endoscope. With pharyngeal incision, the clivus and parapharyngeal space (PPS) were exposed. By drilling the clivus, HC and JF were opened in turn.

Key procedures and anatomic landmarks were investigated, relevant measurements were performed. In addition, three JF or HC schwannoma cases were presented for better understanding.

Results: In ETTA, limited drilling of clivus provides wide exposure and direct trajectory to JF, HC, PPS and cerebellopontine angle. Main landmarks in this approach include pharyngeal tubercle, tubercle of atlas, occipital condyle and petroclival fissure. The jugular vein, carotid artery and caudal cranial nerves are in close relationship with JF and HC. ETTA has been successfully used in 18 cases of JF and HC schwannomas without major complications.

Conclusions: ETTA provides a direct, simple and safe anteromedial corridor to remove schwannomas mainly located in JF, HC and PPS.

PP2-4-7  Withdrawn

PP2-5-1  Neuronavigation and ICG angiography for the posterior transpetrosal approach

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Objective: The posterior transpetrosal approach is used to expose the petroclival or brainstem region. Neuronavigation and indocyanine green (ICG) angiography are necessary for neurosurgical procedure. This study investigated the advantages of intraoperative navigation and ICG angiography for the posterior transpetrosal approach.

Methods: Thirty tumors were meningioma (12 cases), vestibular schwannoma (9 cases), middle ear cancer (2 cases), and others (e.g., chordoma, solitary fibrous tumor). Navigation was useful for identifying the drilling area for temporal bone, incision of the dura, and tumor location. ICG angiography was helpful for vessel preservation in dural opening and tumor resection.

Results: Thirty tumors were meningioma (12 cases), vestibular schwannoma (9 cases), middle ear cancer (2 cases), and others (e.g., chordoma, solitary fibrous tumor). Navigation was useful for identifying the drilling area for temporal bone, incision of the dura, and tumor location. ICG angiography was helpful for vessel preservation in dural opening and tumor resection.

Conclusion: Neuronavigation and ICG angiography contributed to safety of the operation and resection of the tumor for the posterior transpetrosal approach.
PP2-5-2  A novel method for imaging white matter pathways in distorted brain anatomies that combines MRI tractography with visual evoked potentials

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Introduction: Conventional MRI does not fully describe the optic radiations and other white matter pathways. Diffusion tensor imaging (DTI) identifies white matter, but differentiating between the many white matter complex pathways in close proximity is difficult. We have developed a novel imaging method that combines DTI tractography and Visual Evoked Potentials (VEPs), which are widely-available in the clinical environment, to localise the primary visual cortex and identify the optic radiations.

Methods: We recruited 13 healthy adults and 2 children with distorted anatomies from congenital hydrocephalus. MRI echo-planar diffusion-weighted images were acquired along 60 non-collinear gradient directions at \( b=1000 \text{ s mm}^{-2} \), with 2.5 mm voxels. The DTI images and VEPs were merged to produce tractography maps of the optic radiations.

Results and Conclusions: The novel method produced superior maps of the optic radiations in the controls. We also were able to fully identify the optic radiations in the 2 patients with distorted anatomies. The maps can be added to a Neuronavigator for surgical interventions, meaning that the method could reduce complications from skull base surgery in the future.

PP2-5-3  Image-guided skull base surgery, from surgical simulation toward navigation

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Skull base surgery for malignant tumors, especially an en-bloc resection of those, needs a lot of experience and longer period necessary to raise a good surgeon. This is mainly due to anatomical complexity of skull base, different tumor extension in each case, difficulty in understanding the 3D anatomy. We developed an advanced 3D simulation software, the 3D-Virtual Surgescpe (3DVS), to support preoperative navigation and simulation during surgery. The 3DVS is equipped with many efficient tools, such as a 3D segmentation tool, virtual translucent view, and drilling simulation capability, enhancing comprehension of the 3D Surgical anatomy. Next, we have further improved the 3DVS as a 3D navigation system during surgery. It provides 3D view of the surgical field during surgery, visualizing important anatomical structures, even hidden underneath the bone. The navigation is also capable of interaction between the virtual and real space (the interactive navigaion). Resection during surgery is reflected to the 3D virtual navigation image so that 3D image is updated as surgery goes. Image-guided surgery with 3D technology could help future skull base surgery.

PP2-5-4  Capturing skull and brain surface by kinect v2 for brain-shift simulated by GPU

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In this study, we firstly capture and represent cerebral elements (nerve, blood vessels, tumor, and aneurysm, etc.) of a patient by MRI as DICOM before and after a surgical operation. Secondly during the operation extracting the tumor or aneurysm whose time is about 2-3 hours, we capture skull bone and brain surface by the depth/RGB/IR camera Kinect v2 with 1-2 cm distance errors in the video rate (30Hz). The camera is directly mounted beside the surgical bed. Therefore, the relative position and orientation between patient head and the camera is always fixed. Also, a doctor sometimes likes to put aside the camera for microsurgery. For this purpose, our mechanism has a vertical slide in order to open upper space of surgical area for the microscope. Then using both image information of DICOM and Kinect, we model a brain-shift in 3D digitalized space with a huge of voxels based on DICOM data. In the 3D digitalized space, we consider and calibrate elastic, viscous, and prastic materials by the trial and error search. Finally, we visualize the brain-shift in real-time by GPU (Graphics Processing Unit).

PP2-5-5  Withdrawn
**PP2-5-6**  **A training model for ICA in endoscopic endonasal surgery**

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**Introduction:** As the indications for endoscopic endonasal approach (EEA) have increased, an increasing number of devastating complications due to internal carotid artery (ICA) injury have been reported. Our objective was to develop an artificial ICA injury training model for EEA.

**Methods:** Based on CT-DICOM data of a human head, we constructed an artificial model by a selective laser sintering technique. This model is made of polyamide, nylon, and glass beads and is connected to a pulsatile pump. The pump can maintain a pressure, monitored by a pressure sensor, and a heart rate.

**Results:** Devastating extravasation mimicked real ICA injury. Trainee improved psychomotor skills and self-confidence required to achieve the hemostasis using the suction and cottons.

**Conclusion:** This ICA injury model is portable, reproducible and avoids ethical, biohazard, religious, and legal problems associated with animal and cadaveric models. A synthetic ICA injury model for EEA allows recurring training that may improve the surgeon's ability to maintain endoscopic visualization; control catastrophic bleeding; decrease psychomotor stress; and develop effective team strategies to achieve hemostasis.

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**PP2-5-7**  **Sylvian aesthetics in skull base**

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In this lecture, according to the personal experiences of Ismail Hakkı AYDIN, MD (the Author), it was aesthetically analyzed the intraoperative anatomical findings of the Sylvian vein and fissure, lenticulostriatal artery, olfactory nerve, and recurrent artery of Heubner and showed the surgical pitfalls and steps in 700 patients with different diagnoses that were operated on with the pterional approach in Yaşargil Higway. All patient were operated on by the Author. The findings were recorded during surgical interventions and through the slides and videotapes of the operations. Also, we have stressed the preservation of the frontotemporal branch of the facial nerve, the delicate retraction of frontal lobe, the cottonoid retraction in temporal lobe and the preservation of olfactory nerve functions.