

## P1-Intradural Neurolysis for the Intractable Pain of Adhesive Arachnoiditis after Spinal Surgery

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**Objective:** Although the clinical and radiological features of the intradural adhesive cauda equinas lesion after spinal surgeries have been established for sometime, less attention has been paid to the previous neurolysis compared to the recent neuromodulation. We would like to review the clinical impact of intradural neurolysis and literatures around the adhesive arachnoiditis.

**Methods:** A 43 and 41-year-old males presented with chronic pain in perianal area and leg after spinal fusion. The pain was burning, shocklike nature with simultaneously felt some paresthesia over the buttocks and left leg, extremely aggravated during defecation and urination but motor of lower extremities was intact. An electromyography represented the lumbosacral radiculopathy. Digital Infrared Thermal Imaging showed low temperature around the left S1-3 dermatome. On radiologic examination, the rootlets of cauda equina were conglomerated posteriorly to the dural sac at the level of L2-L3. The first patient had seven procedures including intradural neurolysis and colostomy and the another patient had just only the intradural neurolysis with removal of some epidural artificial bone materials.

**Results:** The calcified adhesion of rootlets were completely dissected but the another patient had incomplete neurolysis. The high peaks of anal pain and leg pain in the first case show marginal improvement and relieved in the second case.

**Conclusion:** The adhesive arachnoiditis with various pain modalities from FBSS should be defined as early as possible because it seems to be the less effective by multimodal procedures.

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## P2-Meige Syndrome Satisfactory Controlled with Unilateral Pallidal DBS: A Case Report

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Bilateral pallidal DBS is the surgical procedure of choice in patients with axial or bilateral dystonia. However, there have been different degrees of improvement in axial dystonic symptoms with unilateral pallidal DBS. We describe a case report of meige syndrome who was satisfactory treated with unilateral stimulation of the left internal globus pallidus after the removal of the right sided generator due to infection. Our case an example of a succesful unilateral treatment. Although bilateral DBS is the procedure of choice, staged DBS may point towards cases that show significant benefit from unilateral procedures.

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## P3-Subthalamic Region Deep Brain Stimulation for Isolated Head Tremor with Laterocollis: Clinical Outcome in 5 Cases

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**Objective:** Head tremor has shown inconsistent or unpredictable improvement with thalamic deep brain stimulation (DBS). Several reports indicate that stimulation in subthalamic region may be particularly effective for axial and proximal tremor. The optimal site within subthalamic region for stimulation is the subject of ongoing debate. However, experience with subthalamic region DBS in head tremor with head tilt is limited. The optimal site within subthalamic region for stimulation is the subject of ongoing debate. The aim of the study was to assess the efficacy of bilateral subthalamic region DBS for medication-refractory disabling head tremor without appendicular tremor with laterocollis and to examine trajectory planning for the suitable subthalamic target.

**Methods:** All five patients (3 females and 2 males) had failed extensive medical treatment. The mean duration of the disease was  $4.5 \pm 2.5$  years. The mean age at time of surgery was  $63.8 \pm 7.2$  years. The mean follow-up period was  $3.4 \pm 1.6$  years. Patients were assessed pre and postoperatively using the head tremor rating scale used by Fahn-Tolosa-Marin and laterocollis severity scale of Toronto Western Spasmodic Torticollis Rating Scale and subjective assessment by patient. DBS electrodes (DBS-3389; Medtronic) were implanted bilaterally into the subthalamic region using microelectrode recording and stimulation guidance. The final mean target of 4 cases was  $12.1 \pm 0.3$  mm lateral,  $2.0 \pm 0.4$  mm posterior, and  $2.0 \pm 0$  mm inferior to the midcommissural point for a rostral zona incerta-subthalamic target in the junction of the rostral zona incerta and the dorsal subthalamic nucleus. The other final target was 14 mm lateral, 5.8 mm (the right) or 3.8 mm (the left) posterior, and 2.0 mm inferior to the midcommissural point for the caudal zona incerta. After mean 2.2 days of a trial test, the stimulation device was implanted subcutaneously.

**Results:** Preoperatively, head tremor was all marked amplitude (1-2 cm). Constant laterocollis or head tilt was all mild type within 15 degrees. Lead placement was achieved easily by passing micro-electrodes to the calculated target area of a rostral zona incerta-subthalamic target which identified characteristic neural firing pattern of the zona incerta and the STN. But the caudal zona incerta target, microelectrode recording method did not help. Postoperatively, excellent improvement in their head position occurred soon after surgery, and head tremor was markedly improved in the first 3 months in all patients and maintained long-term benefit. Reversible mild dysarthria was observed in 2 patients who had a rostral zona incerta-subthalamic target.

**Conclusion:** Our findings provide evidence that bilateral subthalamic region DBS is an effective treatment of isolated head tremor with mild type of laterocollis without significant adverse effects. A rostral zona incerta-subthalamic area may be a valuable target for treatment of them, based on microelectrode recording. More cases and studies will be required to confirm it.

## P4-GKS for Neurofibromatosis Type 2

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**Objective:** The goal of radiosurgery is to arrest tumor growth while preserving neurological function. Patients with vestibular schwannomas associated with neurofibromatosis type 2 represent a special challenge because of the risk of complete deafness. To evaluate the result of stereotactic radiosurgery treating vestibular schwannomas secondary to type 2 neurofibromatosis.

**Methods:** 10 patients underwent Gamma knife radiosurgery. 9 patients underwent one stage radiosurgery, one patient performed two stage radiosurgery. The mean tumor volume at radiosurgery was 13.3 ml, the mean marginal dose was 10.8 Gy (range 10-12 Gy).

**Result:** During the mean follow-up period of 54.7 months, 5 tumors (50%) regressed, 2 tumor (20%) remained unchanged, and One patient (10%) grew.

New tumor was developed, and repeated radiosurgery was performed in two patients (20%) after radiosurgery. Useful hearing was preserved in 8 (80%) of the patients. Facial nerve function was preserved in the all patients.

**Conclusion:** Radiosurgery is a valuable minimally invasive treatment for vestibular schwannomas secondary to type 2 neurofibromatosis.

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## P5-Neuronal Loss in the Medial cholinergic Pathway from the Nucleus Basalis of Meynert in Patients with Traumatic Axonal Injury: a Preliminary Diffusion Tensor Imaging Study

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**Objectives:** The recent development of diffusion tensor imaging allows visualization and estimation of the medial cholinergic pathway(MCP), which originates from the nucleus basalis of Meynert and provides cortical cholinergic innervation to the cerebral cortex. We investigated injury of the MCP in patients with traumatic axonal injury (TAI), using DTI.

**Method:** Fourteen patients with chronic TAI and 14 age and sex-matched normal control subjects were recruited. Using the FMRIB software Library, diffusion tensor images were acquired using a sensitivity-encoding head coil at 1.5 T DTIs. Fractional anisotropy (FA), mean diffusivity (MD), and tract volume of the MCP were measured.

**Result:** FA value and tract volume in the TAI group were significantly decreased compared with those of the control group ( $p < 0.05$ ); in contrast, there was no difference in the MD value between the two groups ( $p > 0.05$ ).

**Conclusion:** Changes in DTI parameters of the TAI group appear to be ascribed to neuronal loss of the MCP. We believe that DTI would be useful for evaluation of the MCP in patients with TAI.

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## P6-A Painful Tic-convulsif Due to Arteriovenous Malformation

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**Objectives:** Trigeminal neuralgia (TN) and hemifacial spasm (HFS) are due to compression by the blood vessels at root exit zone of the appropriate cranial nerve. The coexistence of the paroxysmal pain in the distribution of the trigeminal nerve and ipsilateral contraction of the facial muscles are described as “painful tic convulsif”. Tic convulsif caused by arterial loops of the cerebellar arteries and tortuous vertebrobasilar system was sporadically reported in the literature. We describe a rare case of tic convulsive caused by a posterior fossa arteriovenous malformation (AVM).

**Method:** A 44 year-old male presented a paroxysmal lancinating pain in his right V2 and V3 dermatome for 3 months. He has been suffered for involuntary hemifacial spasm in his right face for 20 years. His HFS did not responded to conventional medical treatment, however, he did not seek further deailed studies or treatment for the cause of HFS. TN was that of a typical of idiopathic trigeminal neuralgia in his right V2 and V3 dermatome. Finally TN pain develops, he find medical treatment and checked MRI scan. On neurologic examination, there was a minimal hypesthesia to light touch. Otherwise, there was no neurologic abnormality detected. On MRI, there were multiple, huge signal voids along the right cerebellopontine angle and right posterior fossa. With the impression of posterior fossa AVM causing tic convulsif, a cerebral angiography was performed.

**Result:** About 4.5 cm-sized AVM was found in right posterior fossa (Spetzler-Martin grade 3). The arterial feeder came from the fetal type PCA and SCA from right ICA, AICA and bilateral PICAs supplied the AVM. The drainage was done through precentral cerebral vein and right transverse sinus. A large venous aneurysm was detected in the vein of galen dye to high-flow in the venous drainage.

The patient refused the operation due to the risks associated with AVM removal. TN responded favorably with carbamazepine (200 mg tid) but it was not completely relieved (BNI grade 2). Botulinum toxin injection was also denied by the patient and he is in good condition with medical treatment alone.

**Conclusion:** The most common cause of painful tic convulsive can be caused by compression of aberrant, ecstatic intracranial vessels, mostly vertebral and posterior inferior cerebellar arteries. Tic convulsive has also been reported to be associated with tumors of posterior fossa (meningioma, epidermoid) and AVM. Though AVM has been reported to cause tic convulsive, the report of tic convulsif from AVM is extremely rare. we add our case of AVM causing tic convulsif in the literature.

## P7-An Epidural Blood Patch Method and Spontaneous Intracranial Hypotension Syndrome

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**Objectives:** The spontaneous intracranial hypotension (SIH) presents with orthostatic headache, low CSF pressure and volume, and magnetic resonance (MR) abnormalities, including diffuse pachymeningeal enhancement, subdural fluid collection, and downward displacement of the brainstem and tonsils. Among several treatment options, epidural blood patch (EBP) has been regarded as the most efficient means for SIH. The current mechanism of EBP in SIH involves sealing of a tear by coagulating injected blood, or the initiation of inflammatory reactions that promote dural tear healing. Therefore, EBP is directed to the leaking points specifically determined with imaging studies including MR or CT-myelography. Recently, a novel EBP technique at the level of L1-2 for SIH has been proposed in line with new hypothesis upon pathophysiology of SIH that the purpose of EBP is designed to provoke a marked rise in epidural pressure to reverse the CSF-hemodynamic gradient, thus removing the epidural hypotension maintained by the epidural venous drainage through the inferior vena cava system. We present our application of new pathophysiological treatment of EBP on L1-2 in a case with bilateral subdural collection from the SIH.

**Method:** A 37 year-old male presented a severe headache of 2 months duration. His headache developed spontaneously without a history of head trauma, and had a occipital and suboccipital distribution. There was no abnormality in routine laboratory examination. The headache was not relieved with over-the-counter medication against migraine, and conventional medications including acetaminophen, propranolol, tryptans. Finally he visited outpatient clinic and checked the magnetic resonance imaging (MRI). The MRI showed bilateral subdural collection (subdural hematoma), and effacement of cortical sulci markings, and diffuse pachymeningeal enhancement. Medical treatment including opioids (IR-codon, tramadol) was ineffective. A CT-myelography (CTM) was performed under the impression of SIH and CTM showed diffuse, bilateral leaking of the contrast from the level of T12 to L5.

**Result:** An EBP was performed at the level of L1/2 with autologous blood (20 ml) mixed with contrast (5 ml) under the fluoroscopic guidance. Immediately after the procedure, his headache disappeared completely and there was a mild discomfort on the lumbar epidural puncture site. The patient discharged in an improved condition. With 3 months follow-up MRI scan showed disappearance of bilateral subdural collection and disappearance of diffuse pachymeningeal enhancement. He returned to his usual life without any medication.

**Conclusion:** This case gives us the instruction that the so-called SIH syndrome, the dural leak, even in those cases in which it can be clearly identified on neuroradiological examinations, is not the cause of the disease but the effect of the epidural hypotension maintained by the inferior vena cava outflow to the heart. The goal of our EBP procedure is not to seal CSF leaks, but instead to help in reversing the CSF-blood gradient within the epidural space along the entire cord.

## P8-Medically Intractable Seizure after Stereotactic Radiosurgery on Previously Ruptured Arteriovenous Malformation: A Case Report

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**Objectives:** The aim of this paper is to report a case of medically intractable seizure occurred on the patient with ruptured arteriovenous malformation (AVM) which was treated by stereotactic radiosurgery (SRS).

**Case:** A 24 year old male visited our institute with recurrent generalized tonic-clonic seizure. He was diagnosed on 2006 as intracerebral hemorrhage due to ruptured AVM when he was 19 year old. Two years after the diagnosis, he underwent SRS when he was 21 year old. He has been experiencing repeated seizure about once a year. The seizure is usually generalized tonic-clonic type that lasts for about 3 minutes. Brain MRI and transfemoral carotid angiography (TFCA) were performed to evaluate the previously treated lesion.

**Results:** The Spetzler-Martin grade of the AVM was 1 with right angular artery as the feeding artery and draining to cortical vein. The nidus was situated in right deep parietooccipital area. TFCA performed on May, 2011 confirmed complete obliteration of the AVM. The patient's follow up brain MRI on May, 2011 showed about  $2 \times 2 \times 1.5$  cm multilobulated enhancing mass at the AVM site with severe perilesional edema. The lesion shown on the MRI was diagnosed as radiation necrosis. The patient was taking antiepileptic drugs (AED) such as sodium valproate, lamotrigine and levetiracetam. But EEG showed no definite epileptiform discharge. He was followed at outpatient department with repeated serum antiepileptic drug level measurement. The patient last visited our institute on Feb. 29, 2012, 15 days after raising the drug dose on Feb. 14, 2012 for seizure recurrence.

**Conclusion:** We experienced a case of intractable seizure after SRS on previously ruptured AVM. In AVM patients, surgical treatment can eliminate the risk of rebleeding immediately and seizure control improves but its invasive nature and surgical risks hesitates us to choose surgery as the first treatment. Long term follow up with continuous AED administration, brain imaging studies and serum drug level monitoring is required in patient with AVM treated with radiosurgery. If seizure repeatedly recurs, surgical treatment can also be considered. The patient must be fully educated about the disease as well as the expected complications.

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## P9-Unusual Variation in the Course of the Lateral Femoral Cutaneous Nerve (LFCN) in Meralgia Paresthetica

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**Objectives:** Compression or entrapment of the lateral femoral cutaneous nerve (LFCN) results in a condition known as Meralgia paresthetica (MP), causing paresthesia, tingling, and/or burning along the anterolateral thigh. The LFCN conveys fibers from the dorsal branches of the ventral rami of L2, L3 spinal nerves. The traditional surgical assumption identifies the LFCN running under the inguinal ligament two finger-breadth (3.5 cm) medial to the anterior superior iliac spine (ASIS). However, on the basis of the increasing incidence of MP from laparoscopic procedures, the anatomical variation in the course of LFCN has been stressed recently. We report unusual course of the LFCN which lies over the ASIS, an extremely lateral location in a patient with MP and reviewed the anatomical variation of the LFCN.

**Method:** A 54 year-old male patient presented chronic dysesthetic pain in his lateral thigh for 2 years. On physical examination, hypesthesia to light touch and minimal allodynia was noted with paresthesia in his lateral thigh. Conventional medical treatment including NSAIDs and gabapentin, antidepressant was ineffective and physical therapy gave only temporary relief for 2 days. Sensory nerve conduction was not elicited in left LFCN. Diagnostic block of the LFCN relieved his paresthesia for 3 hours. Under the diagnosis of MP, neurolysis was performed.

**Results:** After making incision 2 cm along the inguinal skin fold, fine dissection was performed pursuing the branches of LFCN. The LFCN took an extreme lateral position. It was over the ventral surface of the ASIS. The maximal compression was found at the level of tentinous arc from the iliac fascia and compression was relieved. After neurolysis, the paresthesia and hypesthesia in the lateral thigh was relieved completely.

**Conclusion:** According to current anatomical researches, the LFCN is located more medially than previous knowledge. The LFCN was observed to cross the inguinal ligament  $1.4 \pm 0.4$  cm medial to the ASIS. The current finding of the LFCN over the ASIS adds the knowledge in the anatomical variation in the course of the LFCN.

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## S10-Decompression of Greater Occipital Nerve and Dorsal Root of C2 for Intractable, Bilateral Occipital Neuralgia

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Occipital neuralgia is defined as a paroxysmal, sharp pain in the distribution of the lesser or greater occipital nerve with associated paresthesia or dysesthesia in the same region. There is usually tenderness over the affected nerve with persistent aching between the paroxysms and temporary relief of the condition by local anesthetic block. Although most cases of occipital neuralgia are idiopathic, they may be related to specific causes such as trauma, prior skull base surgery, rheumatoid arthritis, nerve entrapment by hypertrophied atlantoepistrophe (C1-c2) ligament, compression by an anomalous ectatic vertebral artery or lower-lying posterior inferior cerebellar artery, or degenerative C1-C2 arthrosis. A wide variety of treatment have been tried, including cervical collars, transcutaneous nerve stimulations, analgesics and antimigraine drugs, occipital nerve block with or without glucocorticoid injection, chemical or radiofrequency occipital nerve ablation, atlantoaxial arthrodesis, and dorsal cervical rhizotomy, decompression of C2 root and dorsal root ganglion, neurolysis of the greater occipital nerve and sectioning of the inferior oblique muscle, all with variable degrees of success. A unique case is presented that demonstrates that entrapment of GON in its piercing the semispinalis capitis and C1-C2 ligament. Decompression of bilateral GON and C2 root relieved bilateral occipital neuralgia promptly.

A 67-year-old, right-handed female without a history of drug abuse and trauma presented with a 3-month history of bilateral occipital neuralgic headache. The pain originated at the occipito-cranial junction and radiated to the vertex. It was a sharp and lancinating that had typical nature of paroxysmal occipital neuralgia. The pain was much more severe at left side. Mild hypesthesia and dysesthesia was present along the distribution of C2,3. Allodynia was present bilaterally and the hypersensitivity was more prominent in left side. The tender point was detected in the left suboccipital region with characteristic radiating pain to the vertex. Her neuralgic pain was not exacerbated with neck motion such as flexion and rotation of the neck. The pain was not relieved with maximal medical treatment including acetaminophen, propranolol, indomethacin, ultracet, muscle relaxants, etc. anticonvulsant including gabapentin and carbamazepine was not effective. Opioid (IR-codon, tramadol) was not effective also. Only intramuscular injection of diclofenac sodium was effective for about 2 hours. Her NRS (numeric rating scale 0-10) was 8-9/10. She was finally referred to our department for pain control. Under the impression of bilateral occipital neuralgia, repeated blocks of GON was temporarily effective for 1 hour 8 (VAS 4-5/10). MRI of cervical spine did not show an abnormality including craniocervical junction. However, a lower-lying PICA was noted in the right side. The distal loop extended to the level of the lamina of the C1. A subsequent computed tomographic myelogram the findings of the MRI, indicating the left PICA was anomalous and that it extended to the level of the C1.

The patient was taken to the operating room, where decompression of bilateral GONs and C2 roots, left C1 hemilaminectomy were performed. Thorough midline incision, the piercing point of trapezius, semispinalis, inferior oblique muscle were thoroughly pursued. In the left side, severe constriction-induced bulbous dilatation of GON was detected in the point where GON coursed through the semispinalis and dorsal root of C2 was constricted in the lateral exit of atlantoepistrophic ligament. The neurolysis of GON was performed under the microscopic vision. In the right side, the constriction was not prominent like the left GON, the entire course of C2 root and right GON was performed.

After dural opening of the left side of C1-2 dura, there was not definite vascular contact to C1, 2, 3 dorsal roots and root entry zone. The lower-lying PICA in the right side was not in contact with the dorsal roots of C2. Then, the wound was closed in routine manner. Immediately after operation, the neuralgic pain disappeared completely and mild, tolerable paresthesia and allodynia remained. Her VAS declined to VAS2-3/10. Her ON is tolerable with gabapentin (900 mg/day), ultracent (150 mg/day), amitriptyline (10 mg hs) with 12 months follow-up.

In this bilateral ON, the ON developed by entrapment in its extradural course along the posterior atlantoepistrophic ligament and its course along the semispinalis. The decompression by neurolysis of GON and C2 root is thought to be a reasonable surgical approach in treating medically refractory occipital neuralgia.

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## S11-Early Distribution of Intravenously Injected Mesenchymal Stem Cells in Rats with Acute Brain Trauma Evaluated by $^{99m}\text{Tc}$ -HMPAO Labeling

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Stem cell tracking is essential for evaluation of its migration, transplantation and therapeutic response. The aim of this study was to evaluate early distribution of intravenously transplanted rat bone marrow mesenchymal stem cells (BMSCs) in rats with acute cerebral trauma by labeling with  $^{99m}\text{Tc}$ -hexamethylpropyleneamine oxime  $^{99m}\text{Tc}$ -HMPAO.

$^{99m}\text{Tc}$ -HMPAO-labeled BMSCs were injected intravenously to trauma rats (n=14) and sham-operated controls (n=13). Gamma camera images were acquired at 4h after injection, and then organs were removed for gamma counting. Confocal microscope was used to confirm the migration of  $^{99m}\text{Tc}$ -BMSCs by co-labeling with PKH26. Cytometric analysis was performed to evaluate apoptotic or necrotic change until the seventh day after labeling.

$^{99m}\text{Tc}$ -BMSCs were distributed mostly to lungs, liver and spleen at 4 h, and uptake of these organs was not significantly different between traumatic rats and controls. Meanwhile, the cerebral uptake of ( $^{99m}\text{Tc}$ )-BMSCs was significantly higher in the traumatic rats than in controls (0.40% vs. 0.20%; p=0.0002). Additionally,  $^{99m}\text{Tc}$ -BMSCs' uptake of traumatic hemisphere was significantly higher than that of contralateral ones (0.27% vs. 0.13%; p=0.0001) in traumatic rats. Regardless of radiolabeling, BMSCs migrated to traumatic regions, but not to nontraumatic hemispheres. However, gamma camera failed to demonstrate  $^{99m}\text{Tc}$ -BMSCs in traumatic hemispheres. No significant apoptotic or necrotic change was observed until 7 days after radiolabeling.

Early distribution of BMSCs in traumatic brain disease could be monitored by  $^{99m}\text{Tc}$ -labeling, which does not induce cellular death. However, our data showed that the amount of migrated  $^{99m}\text{Tc}$ -BMSCs was not enough to be demonstrated by clinical gamma camera.

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