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D. A. Bosch, G. Broggi, J. K. Krauss, Y. Lazorthes, and **J. G. Villemure**

Hommage to Lauri Laitinen

M. Hariz
Umea, Sweden; London, UK

Lauri Laitinen, one of the second generation European pioneers of functional and stereotactic neurosurgery is no longer. Lauri was born on December 14, 1928 in Northern Finland and passed away on November 9, 2005, in Aaland, an island between Finland and Sweden. This hommage to Lauri Laitinen will review some of his contributions to stereotactic and functional neurosurgery and their impact on today's practice.

Lauri completed his neurosurgical training at the University of Helsinki, where he presented a PhD thesis on craniosynostosis in 1956. He contributed clinically and academically to virtually all aspects of neurosurgery. However, it is in the field of functional and stereotactic neurosurgery that Lauri became widely known. The renaissance of surgery for Parkinson's disease (PD) is largely due to Laitinen who in 1985 re-vitalised the old Leksell's posteroventral pallidotomy of the firfties, and who demonstrated its effect on symptoms of post-levodopa PD. Laitinens seminal paper on pallidotomy from 1992 remains the most quoted single paper in the functional neurosurgical literature. Laitinen contributed also to other domains than movement disorders, not the least to the field of surgery for mental illness; he performed and analysed, together with Juhani Vilkki the neuropsychologist, all major stereotactic procedures for mental illness and devised in the 1970s new surgical interventions for psychiatric disorders such as the anterior mesoloviotomy, and the ventral rostral cingulotomy in a target that has become today a promising area for DBS treatment of depression.

Pain I

T1A1. Motor cortex stimulation (MCS) for advanced Parkinson disease (PD): long term clinical results

B. Cioni, M. Meglio, C. Sturiale, A. R. Bentivoglio, A. Fasano, F. Soleti, S. Daini, A. Daniele, and M. Zinno
Rome, Italy

Since 2003 we applied MCS in patients with advanced PD. Inclusion criteria were: – idiopathic PD; – at least 5 years disease's length; – disease in the advanced state; – DBS not accepted by the patient or contraindicated. Exclusion criteria were: – history of epilepsy or EEG epileptic activity; – alcohol or drug abuse; – mental deterioration; – psychiatric symptoms. 7 patients met these criteria, and were submitted to the implant of an epidural plate electrode over the motor cortex. Stimulation parameters were: 120 μs, 80 Hz, 3–4 V, delivered continuously. The clinical assessment before implant and at 1, 3, 6, 12, 18 and 24 months included: – UPDRS; – PDQL (Parkinson Disease Quality of Life scale); – MMSE (Mini Mental State Evaluation); – EEG: – oral medications and adverse events. The clinical evaluation was performed both in the off and in the on medication state and was videotaped. Mean follow up was 18 months (min 12, max 24 months) 1 patient (14.28%) was unresponsive. At 12 months the remaining 6 patients showed a statistically significant improvement in the global UPDRS, in the UPDRS II, in the UPDRS III and in the PDQL-39. The mean global UPDRS in off med improved by 35.4% at 3 months, by 20% at 12 months and by 25.3% at 18 months. The neuropsycological evaluation showed no impairment of superior cortical functions, particularly of verbal fluency. No adverse event or complication was reported. Our data confirm the efficacy and the safety of MCS in PD.

T1A2. MEPs to identify the optimal cathode position in MCS

J. Holsheimer, J. P. Nguyen, J. P. Lefaucheur, and L. Manola
Creteil, France

Aim. In MCS motor evoked potentials (MEPs) are recorded to identify the pain-related somatotopic region(s) of the motor cortex. Since stimuli are applied bipolarly, MEPs may originate near the negative pole (cathode), the positive one (anode), or both. The aim is to identify the stimulus polarity effective in inducing MEPs and in relieving pain.

Materials and methods. Two 4-electrode leads were placed in parallel on the dura and across the central sulcus. Identical suprathreshold stimuli were applied preoperatively by 14 bipolar electrode combinations and the magnitude of each MEP from a muscle in the pain region was noted. The largest MEPs were allocated to both the anode and the cathode of the corresponding bipole and the MEP-related anode and cathode positions were compared with those selected postoperatively to give most pain relief.

Results. Data of five patients with primarily upper limb pain were analyzed. MEP related cathodes prevailed over the premotor cortex (area 6), whereas the corresponding anodes were confined to

area 4 near the central sulcus. In each patient the cathode position in chronic stimulation corresponded with the anode position related to the largest MEP. The anodes in chronic stimulation were situated posteriorly over the central sulcus or the postcentral gyrus.

Conclusions. In bipolar MCS the optimal cathode position for chronic pain relief corresponds with the position of the anode giving the largest MEP of a muscle in the pain region. Applying this ''rule'' will accelerate the selection of the optimal bipole for therapeutic stimulation. The comparison of anodal and cathodal monopolar stimulation is currently under investigation.

T1A3. Efficacy of motor cortex stimulation in the treatment of deafferentation pain. A double blind randomized trial

J. D. Carillo-Ruiz, F. Velasco, C. Arguelles, and G. Castro
Mexico City, Mexico

Introduction. The purpose of the study was to evaluate the efficacy of motor cortex (MC) electrical stimulation (ES) in a variety of deafferentation pain syndromes, through a double blind randomized trial and one year follow up.

Methods. Eleven patients with severe unilateral deafferentation pain (VAS from 8 to 10) of different etiologies and topography were selected for motor cortex (MC) electrical stimulation (ES). In all patients, a 20 contacts grid was implanted through a craniotomy centered over CM contralateral to the painful area. The CM strip was identified using image. SEP, acute electrical stimulation, and cortico-cortical evoked potentials. A subacute therapeutic stimulation trial allowed to determine the most efficient pain of contacts to be used for chronic MCES. Thereafter, the grid was replaced by a 4 contacts electrode connected to an internalized stimulation system. Bipolar stimulation at 40 HZ, 90 µs, 2.0 to 7.0 V, 1-hour ON 4 hours OFF was used. Pain severity was evaluated through VAS, Bourhis, and McGill pain scales applied every month for 1 year. At days, 60 or 90 the stimulators were turned OFF for 30 days in an randomized and double blind fashion. Statistical significance was evaluated through a Wilcoxon test.

Results. Three patients did not report any improvement in the subacute stimulation trial and were excluded for chronic MCES. The others underwent long-term stimulation. Significant improvement of pain was induced by MCES ($p < 0.01$), that persisted during follow-up period. Turning OFF the stimulator increased pain significantly ($p < 0.05$). Improvement at one year was above 40% (40 to 86%) in all cases.

Conclusions. MCES is an efficient treatment for deafferentation pain of different etiologies and segmental distributions. Subacute stimulation trials are recommended to determine the optimal MC area to be stimulated and identify the responders. Turning OFF MCES in a double blind maneuver results in significant increase in pain.

Keywords: Deafferentation pain, motor cortex localization, electrical stimulation, double blind evaluation.

T1A4. Spinal cord stimulation (SCS) for neuropathic pain (NP). Indications based on somato-sensory evoked potentials (SSEPs)

M. Sindou, P. Mertens, G. Polo, H. Naous, and F. Mauguière
Lyon, France

Patient selection for SCS is currently based on preliminary percutaneous test (PPT). PPT is useful, but invasive and sometimes difficult to perform at cervical and upper thoracic levels; it increases infection risks and has false-positive and false-negative results. Because SCS is based on stimulation of dorsal column (DC) fibers, assessment of DC conduction by measurement of the central conduction time (CCT) of SSEPs can be considered a valuable method for selecting patients.

Method. The predictive value of pre-op. SSEPs to stimulation at the level of the painful area has been evaluated in 143 patients (pts) with a follow-up ranging from 1 to 16 y. Lesions responsible for pain were: 1°) in peripheral nerve(s) in 31, 2°) radicular in 67 (two-thirds being radiculopathies after ''failed'' lumbar surgery), 3°) root avulsion in 8 and 4°) at spinal cord in 37. Important, pts with total anesthesia in the painful territory, suspected on clinical and imaging bases to harbour a complete interruption of primary afferent fibers-centrally to dorsal root ganglion-, had not been retained as candidates to SCS. 111 pts had electrode implanted through an interlaminar opening and 32 percutaneously (strictly at the lumbar level, for safety reason).

Results. Statistical analysis showed that SCS was successful (i.e., pain relief >50%, at latest follow-up) in none of the pts with abnormal CCT [that is, CCT significantly prolonged-exceeding the mean classical value, plus 2.5 standard deviation- or when parietal response was abolished]. Conversely, SCS was successful in 75.5% of the pts with CCT within normal limits [$P < 0.005$]. Therefore we suggest that if CCT is abolished or significantly altered, the pt should not undergo SCS. On the contrary, if CCT is within normal limits, the pt can be a candidate, with probability of 75% of long-term efficacy.

Decision-making for SCS:

1. When the causal lesion of pain remains confined to the peripheral nerve(s), plexus(es) or spinal nerve(s) distally to the DRG, the patient may be candidate to SCS, whether the eventual associated sensory loss in the painful territory is partial or complete. SSEPs may help in confirming the peripheral location of the lesion.
2. For pain due to lesions located centrally to the DRG, either radicular or in the spinal cord, recordings of SSEPs are mandatory to confirm functionality of DC fibers.

T1A5. Assessment of the spinal cord stimulation about 106 cases along 12 years in our institute

J. Godard, N. Manzo, L. Di Tomasso, E. Tiberghen, B. Orhna, and A. Czorny
Besançon, France

Retrospectively we present our practice from 1993 to 2005 on the spinal cord stimulation (SCS) about 106 patients. From 1996 all patients were gated through a multidisciplinary pain center, so we observe an increasing of indications of SCS.

We try to assess medical and economic effects by SCS. There are 68 men and 38 women, 22 to 77 years old. The failed back pain syndrome often after one or more surgical procedure, is the first aetiology, 80 patients (75.7%). The duration of the pain is between one to four years (64%), only at eight years for 8 patients (7.7%). The visual analogy scale (VAS) and Stauffer Coventry score are used, and we include the useful life equipment and the unexpected events in ours results.

The choice of the electrode don't act up on the outcomes, but it seems the last electrode OCTA is interesting for the associated lumbar back pain. At long time, the results are better if there is an improvement of five points on the VAS. With Stauffer Coventry score, the good outcomes are 42.4% immediately and two years later 38% again. The failed outcomes are

early, 6.8% or later, 11.3%. Before 38 months, we must change 27 implants, and some complications become like displacement of electrode (4.8%) or local infectious disease (7.5%). Then the good profit between medical advantages and cost of implant isn't obtained.

Despite an increase in the number of studies over last 10 years, the efficacy of SCS remains average, less 50% after one year, nerveless it's about 65% in our practice. The cost remain again expansive from EUR 6000 for a standard implant to EUR 12000 for a synergy system. A best selection with a clinic pain centre and less complications must improve again the outcomes of SCS, improved life' quality and employment.

T1A7. Stereotactic thalamotomy for the treatment of cancer-related neurogenic pain

I. Balas, C. Llumiguano, and T. P. Doczi
Pecs, Hungary

Objectives. Cancer-related neurogenic pain is caused by a lesion in the somatosensory pathways. The medial thalamotomy was shown to bring a selective relief to all pain localization. Patients suffering from intractable pain due cancer underwent thalamotomy. Authors discuss indications, surgical technique and results of surgery.

Material and methods. Thirty patients with cancer-related pain, resistant to opiate therapy, underwent thalamotomy. Pain was assessed before the operation, and also at 1st day, at 3, 6, 9, and at 12 months postoperatively using visual analogue scale. The central lateral nucleus, centre médian, parafascicular nucleus, ventromedial nucleus of the thalamus were the targets. The target was localized on magnetic resonance imaging and cellular activity of the target was assessed.

Results. Postoperatively complete pain relief was achieved in 50% ($n=14/28$) at 1st day, in 39% ($n=7/18$) at 3 months, in 23% ($n=2/9$) at 6 months, in 33% ($n=3/9$) at 9 and at 12 months of the patients. Fifty to 100% pain relief was achieved postoperatively in 89% ($n=25/28$), in 89% ($n=16/18$) at 3 months, in 78% ($n=7/9$) at 6 months, in 66% ($n=6/9$) at 9 and also at 12 months of the patients. Two patients failed to relief pain postoperatively. Three patients with bilateral thalamotomy developed transient confusion.

Conclusions. Postero-medial MRI-guided stereotactic thalamotomy should be considered as safe and effective alternative for the treatment of cancer-related neurogenic pain.

Transplantation

T1B1. Strategies for nigrostriatal pathway reconstruction in experimental models of Parkinson's disease

J. A. Barcia, F. J. Sancho, M. C. Félez, C. Martínez, V. Benavent, M. E. Hernández, J. M. Gallego, M. Salmerón, J. L. Gómez-Ribelles, J. M. García-Verdugo, M. Monleón, and J. M. Soria
Valencia, Spain

Background. Cell therapy applied to neurologic diseases requires, besides the survival and differentiation of implanted cells, the growth and functional reconnection of neuritis. In the case of Parkinson's disease, this implies to find an adequate support for the axonal growth from the dopaminergic cells at the substantia nigra compacta (SNc) to the striatum.

Materials and methods. We used grafts of biomaterials seeded with either Schwann cells or olfactory enseathing glia cells to bridge the gap between the SNc and the striatum in rats subjected to axotomy of the median forebrain bundle and in rats subjected to the 6-OHDA model. As controls, we used peripheral nerve grafts.

Results. We have selected the adequate biomaterials (chemical composition, hidrophilia, pore size) to support axonal growth "in vitro" among several biocompatible candidates. "In vivo", grafts are invaded by TH-positive axons coming from the SNc.

Discussion. The reconstruction of the nigrostriatal pathway may be possible with the aid of scaffolding biomaterials, and this may have important implications in cell therapy for Parkinson's disease.

T1B2. Long-distance migration and multi-lineage differentiation of fetal human neural stem cells after transplantation into the rat brain

J. Maciaczyk, D. Maciaczyk, A. Klein, and G. Nikkhah
Freiburg, Germany

Neuororeplacement therapy based on the transplantation of human fetal neural tissue due to its beneficial effects in animal models of human diseases and in several clinical trials might become a valuable therapeutical alternative. The limited availability of human neural stem cells (hNSCs) derived from fetal neuraxis prompted us to expand these cells in vitro for an extended period of time and to study their potential after intracerebral implantation. Human NSCs derived from different fetal brain regions (neocortex, striatum, midbrain, spinal cord) were grafted into the rodent striatum and hippocampus. All grafts survived several weeks post-transplantation. In general, NSCs derived from neocortex and striatum generated larger grafts and showed more widespread cell migration as compared to NSCs from midbrain and spinal cord. In addition, grafting into the striatum resulted in a more distant migration compared to hippocampal transplantation. Typically, a number of hNSCs transplanted into the striatum were found to extensively migrate along white matter tracts reaching both rostral (anterior part of the corpus callosum with overlying cortex) and caudal (midbrain) brain regions. Consistently, the vast majority of migratory cells expressed the stem cell marker nestin even after 9 weeks. However, a fraction of grafted cells acquired a neuronal morphology and expressed doublecortin, tubulin or the transmitter GABA. Taken together, these data demonstrate long-term survival, long-distance migration, and neuronal differentiation of in vitro expanded hNSCs after transplantation. The availability of a large pool of grafted nestin-positive cells offers the possibility of further in vivo manipulation and recruitment of different neural phenotypes for cell replacement strategies in the CNS.

T1B3. Multipotent neural stem cells from the adult human brain: a potential tool for brain 'self-repair'

S. Châtelin, J.-C. Sol, S. Jozan, F.-E. Roux, and Y. Lazorthes
Toulouse, France

The presence of neural stem cells in the human adult subventricular zone and dentate gyrus raises the exciting possibility that adult neural progenitor cells might be utilized to replace damaged or lost neurons in neurological disorders. To use adult

neural stem cells (NSCs) for regenerative medicine, it is necessary to generate appropriate number of cells. Moreover, these cells should be well characterized notably in regard to their multipotentiality.

NSCs cultures were performed from the wall of the lateral ventricular roof in patients with ventriculoscopy or epilepsy surgery. Nestin-positive NSCs can be multiplied in vitro by supplementing serum-free medium with epidermal growth factor (EGF) and basic fibroblast growth factor (FGF2). In EGF/FGF2 FGF2 supplemented medium, multipotent neural stem cells are grown as self-adherent clusters of cells, called 'neurospheres'. The neurosphere-derived cells can be induced to differentiate into neurons, astrocytes and sporadically into oligodendrocytes by withdrawing the mitogen factors or by adding differentiating substances.

In this study, we have investigated the in vitro proliferation and differentiation of human adult neural stem cells (NSCs) into neurons in order to produce neural tissue for autograft or allograft from harvested stem cells. Indeed, transplantation of in vitro-expanded stem cells and/or their neuronal progeny into regions of degeneration could be a novel therapeutic strategy for the treatment of neurological disorders.

T1B4. Primate adult brain cell autotransplantation in a model of Parkinson's disease

J. Bloch, M. Kaeser, J. G. Villemure, and J.-F. Brunet
Lausanne, Switzerland

Introduction. Restoring function of the central nervous system is a challenging task, since the mature brain and spinal cord have a limited ability for self-repair. The large fetal transplantation experience mainly acquired the last two decades in the context of Parkinson's disease and Huntington's disease, has offered promising results, however, despite the great enthusiasm generated by this approach, ethical aspects and lack of fetal donors remain a major controversy. We have recently demonstrated that adult brain cells represent an attractive restoration alternative to bypass the caveats of fetal grafting in a model of cortical lesion. For this study, we evaluate the impact of such cortical cells when they are reimplanted in the striatum of MPTP monkeys.

Materials/methods. Primocultures were obtained from an open right prefrontal cortical biopsy in four monkeys. Cells were grown in vitro for one month and progressively expressed nestin. They were then stereotaxically reimplanted unilaterally in the caudate nucleus of each donor. Just prior to reimplantation, cells were stained with a PKH dye. The donors were treated with MPTP after the cortical biopsy and prior to the reimplantation. The animals were sacrificed four months after the autograft. Tissue sections were used for Thyrosine Hydroxylase (TH) immunohistochemistry, and compared with the tissue sections of two normal monkeys and two low-dose MPTP monkeys that did not receive autotransplants.

Results. Reimplanted cortical cells survive at least four months and they migrate in the whole striatum, bilaterally. No PKH positive cells express TH. In the most affected part of the striatum, the MPTP monkeys that were not reimplanted show a loss of 50% of the TH-ir cells, compared to the control monkeys. In the reimplanted MPTP-monkey the loss of TH-ir cells is estimated to 25% ipsilaterally to the reimplantation and to 35% in the contralateral side.

Conclusion. Primate adult brain cells can easily be obtained from cortical biopsies and kept in culture. They can be reimplanted in the caudate of the donor and survive in vivo. Moreover, they migrate in the whole striatum. The reimplanted cells seem to protect the dopaminergeic neurons against further degeneration. Their clinical impact remain to be demonstrated. However, these attractive results open new perspectives in the treatment of Parkinson's disease.

T1B5. Transplantation of autologous human adult neural stem cells and differentiated neurons for Parkinson's disease: long-term post-operative metabolic and clinical outcome

M. Levesque, T. Neuman, K. Palm, and M. Resack
Los Angeles, USA

Background. Neural stem cell-derived neurons offer new therapeutic alternatives for diseases of the central nervous system. Neural repair can be particularly valuable in progressive degenerative diseases like Parkinson's disease, where significant benefits were shown following transplantation of embryonic tissue. This and other approaches, however, carry inherent risks of immunological reaction, and infectious transmission, in addition to serious ethical concerns.

Methods. After undergoing a cortical biopsy, a patient's own neural stem cells were isolated, and expanded in vitro for several months. Dopaminergic differentiation was achieved in 15% of neural cells before transplantation. Cell suspensions were transplanted unilaterally into the left putamen. DOPA-PET studies and neurological evaluations were performed serially pre-operatively and post-operatively. No immunosuppressants were used.

Findings. At one year post-operatively, clinical motor scores improved by 37% while ''on'' medication and Fluoro-DOPA PET studies showed a 55.6% increase in dopamine uptake in the left putamen. At three year post-operatively, the overall unified Parkinson's disease rating scale (UPDRS) improved by 81% while ''on'' medication and 83% while ''off'' medication. Clinical motor scores improved by 88 and 91% (''on''/''off''). At five years post-operatively, clinical motor scores were back to baseline.

Interpretation. Adult neural stem cells derived from a patient's own tissue can become source of dopamine neurons, useful for grafting in the treatment of Parkinson's disease, with long-term improvement of motor symptoms. This approach has the potential of making neural stem cell therapy acceptable and available to a large number of patients.

T1B7. Modulation of the epileptic activity by intracerebral cell grafts or local infusion of neurotransmitters

J. M. Gallego, F. J. Sancho, S. Vidueira, L. Ortiz, A. Castillo, R. Galiano, R. Gutiérrez, M. Aliaga, M. E. Hernández, J. M. Soria, J. M. García-Verdugo, and J. A. Barcia
Valencia, Spain

Background. Intracerebral delivery of antiepileptic drugs may be a means to bypass the blood–brain barrier and to control epileptogenic activity within the brain. Here we report the results of intracerebral infusion of GABA at different brain locations and of cell grafting at the amygdala in the kindling model of epilepsy.

Material and methods. Fully amygdala kindled rats were implanted with an intracerebral cannula either at the ipsilateral amygdala or the dorsomedian (DM) nucleus, connected to a GABA-releasing infusion pump. Other animals kindled at the pyriform cortex were

implanted at the ipsilateral basolateral amygdala with either gabaergic neurons obtained from embryonic medial ganglionic eminence (MGE) or fibroblasts, both obtained from transgenic rats expressing green fluorescent protein. Seizure and neurologic behavior was recorded and inmunohistochemical and ultrastructural studies were carried out.

Results. Local delivery of GABA at the amygdala raised the seizure thresholds as compared to controls, while delivery at the DM slightly improved the seizure generalization. However, fibroblast infusion achieved a focal control which was more effective and long lasting than that obtained by MGE gabaergic cells. No behavioral side-effects were recorded in either experimental group.

Discussion. Intracerebral delivery of neurotransmitters may be a useful technique to modulate the epileptogenic activity. This may be done by local infusion of neurotransmitter producing cells. Fibroblasts have shown a surprisingly good local seizure focus activity control, possibly through the release of adenosine. This may be considered as a promising strategy to surgically modify epileptogenic areas, provided they not have teratogenic or other side effects.

Movement disorders I

T2A1. Chronic bilateral deep brain stimulation of GPi in treatment of the local and generalised forms of torsion dystonia

V. A. Shabalov, A. A. Tomskiy, E. D. Isagilyan, and A. V. Dekopov
Moscow, Russia

Objective. To estimate the results of deep brain stimulation (DBS) of globus pallidum internum (GPI) for the treatment of local and generalized forms of dystonia.

Material and methods. 17 patients (10 males and 7 females) have been operated (KINETRA). The middle age of patients was 31.4 ± 12.7 years, the average duration of the disease was 8.4 ± 6.2 years. There were 11 patients with generalized form of dystonia (idiopathic 7, secondary 4) and 6 patients with cervical dystonia (idiopathic 4, secondary 2). The indications for surgical treatment was drug treatment failure and ineffectiveness of Botox therapy. The results of surgical treatment was estimated with Global Outcome Scale (GOS). Fallow-up was from 9 till 48 month.

Results. DBS of GPI relief the severity of the movement disorders in all cases. Minimal improvement of movement disorders was occurred in 2 cases without significant dynamic of functions (1 ball). Moderate improvement was observed in 1 case with minimal dy-namic of functions (2 balls). 6 patients had moderate relief of movement disorders with improvement of functions (3 balls) and 8 patients had significant relief of movement disorders with significant with improvement of functions (4 balls). The best results was observed in patients with primary dystonia. Clinical effect of DBS increased during 6–9 month after the operation.

Conclusion. Chronic bilateral DBS of GPI is an effective method of treatment of the local and generalized forms of dystonia.

T2A2. Prospective evaluation of deep brain stimulation in segmental dystonia: a series of 15 patients

J. K. Krauss, C. Blahak, H. H. Capelle, K. Kekelia, H. Bäzner, E. Grips, R. Weigel, and J. C. Wöhrle
Hannover, Germany

Objective. Deep brain stimulation (DBS) has been shown to be a valuable treatment option in patients with otherwise refractory generalized and cervical dystonia. Little is known, however, on its effect for segmental dystonia affecting various body regions. The objective of the present study was to investigate prospectively the long-term effects of DBS in a larger series of patients with segmental dystonia.

Methods. Fifteen patients with refractory segmental dystonia were selected to undergo DBS (7 women, 8 men, age range 30–74). Thirteen patients suffered from primary dystonia, and two patients had secondary dystonia. The family history was negative in all instances. The preoperative duration of symptoms ranged between 1 and 35 years. Patients were scheduled either for pallidal DBS or for bifocal pallidal and thalamic DBS (patients with secondary dystonia or marked tremor). The prospective study protocol included assessment of the dystonia by the BFM, UDRS and the GDRS dystonia rating scales.

Results. The stereotactic surgeries were unremarkable and without side effects in 14 instances, while the operation had to be aborted in one patient due to cardiopulmonary problems. All operated patients were available for short-term follow-up (F I, at 4–9 months p.o.) and long-term follow-up (F II, at 12–36 months p.o.). Eight patients underwent pallidal DBS, and six patients had bifocal DBS. On the long-term follow-up 12 patients had pallidal DBS, and 2 had thalamic DBS. There was stable improvement of motor scores both on short-and long-term follow-up (BFM pre 53.8, F II 15.5; UDRS pre 35.4, F II 16.9; GDRS pre 27.5, F II 11.3) which was paralled by improved disability scores (BFM disability pre 6.0, F II 3.9). In three patients stimulation-induced dysarthria occurred with higher voltages which limited the therapeutical benefit in these patients.

Conclusions. Bilateral DBS is an effective treatment modality in patients with segmental dystonia. Overall, the results are comparable to those obtained in patients with generalized dystonia.

T2A3. GPi–DBS for orofacial or pharyngolaryngeal dystonia

T. Taira, T. Ochiai, S. Goto, and T. Hori
Tokyo, Japan

Deep brain stimulation (DBS) of the globus pallidum interna (GPi) is now widely accepted as effective treatment of idiopathic generalized dystonia. However, the role of GPi–DBS for orofacial or pharyngolaryngeal dystonia such as Meige syndrome and spasmodic dysphonia is not established. Orofacial or pharyngolaryngeal dystonia is generally treated with botulinum toxin injections, but the effect may be modest and transient and many patients seek better treatment. We have performed bilateral GPi–DBS in five patients with orofacial dystonia (Meige syndrome) and one patient with pharyngolaryngeal dystonia. Two of orofacial dystonia patients also had difficulty of speaking due to dystonic symptoms of the tongue and throat. The pharyngolaryngeal dystonia patient also had dystonic contraction of anterior neck muscles such as platysma. Effect of bilateral GPi–DBS with high frequency stimulation was satisfactory in all the patients and speech function improved significantly. Before we performed the operation, we had not expected sufficient improvement of speech function, because one of common side effects of bilateral GPi–DBS is dysarthria. However, although a larger series is required, we now strongly recommend GPi–DBS for otherwise intractable orofacial or pharyngolaryngeal dystonia.

T2A4. Idiopathic and secondary upper limb segmental distonia. The therapeutic role of chronic motor cortex stimulation

A. Franzini, C. Marras, L. Romito, G. Tringali, A. Albanese, and G. Broggi
Milano, Italy

Introduction. Upper limb segmental and focal dystonia is a rare condition which may happen secondary to discrete brain lesions due to stroke, trauma, and demyelinating diseases or may appear spontaneously as idiopathic condition. In both cases the pathogenesis of the disease is unknown and generally referred as ''unbalance'' of the basal ganglia-cortical loops. The severity of the disease is extremely variable in different patients ranging from minor loss of hand dexterity to mayor invalidating postural changes sometimes associated with arm and/or hand abnormal movements and wide jerks tremor.

Patients and methods. Six patients affected by acquired upper limb focal dystonia secondary to stroke (3 cases), multiple sclerosis (1 case) and idiopathic dystonia (2 cases) are reported. Patients complained extremely invalidating postural changes of arm and/or hand, and had previous uneffective botulinum toxin treatments. All patients resulted refractory to medical and conservative treatments.

All patients underwent neurostimulation procedures: GPi neurostimulation was the first choice treatment in four patients, VIM stimulation was the first choice treatment in one case, and motor cortex stimulation was the first choice treatment in one patient who complained also painful disesthesias referred to the involved limb and hand.

Results. GPi neurostimulation failed to improve upper limb focal dystonia in all patients; only the one with involuntary movements of the distonic arm obtained stable disappearance of his wide jerk tremor while the dystonic pustural changes remained unchanged (6 years follow-up). Similar results have been obtained by thalamic stimulation in one case. The patient affected by post-stroke dystonic hand who underwent chronic motor cortex stimulation as first choice treatment obtained significant and stable improvement of focal dystonia (8 years follow-up). Three out of four GPi electrodes has been removed. Following this experience 2 patients from the small series in which GPi stimulation failed underwent further surgery by implant of motor cortex stimulator. Impressive and stable improvement was obtained in one case (idiopathic) and minor transient improvement in the second case (post-ischemic).

Conclusion and discussion. Significant improvement of upper limb focal dystonia was obtained only by chronic motor cortex stimulation. GPi and VIM neurostimulation were useful only in the control of the involuntary movements associated with the dystonic posture. These data suggest that the pathophysiological mechanisms of postural changes (not responding to GPi and VIM DBS and responding to cortical procedures) are different from those involved in the origin of involuntary movements (responding to GPi and VIM DBS). Chronic motor cortex stimulation seems to be the first choice treatment of upper limb segmental and focal dystonia with prevalence of postural changes.

T2A5. Focal hand dystonia in instrumental musicians: A neurosurgically curable disorder

T. Taira, T. Ochiai, S. Goto, and T. Hori
Tokyo, Japan

Focal dystonia of the hand is common among instrumental musicians, and known as occupational dystonia. The natural prognosis is poor in terms of playing musical instruments, and most musicians have to give up their professional activity. The history of neurosurgical treatment of dystonia has shown that thalamotomy is effective for dystonic symptom of the distal part of the extremity. We have been successfully treating task-specific focal hand dystonia (writer's cramp) with stereotactic ventrooral (Vo) thalamotomy. Based on our experience, we have treated focal hand dystonia in six instrumental musicians with favorable results.

Four patients were guitarists and two were professionals of traditional Japanese string instrument. The all had marked difficulty in playing the instruments, but had no dystonic symptoms in ordinary daily activities. After detailed informed consent, we performed Vo thalamotomy. The target was chosen at 2 mm posterior to MCP, 1 mm above AC-PCl, and 13.5 mm lateral from the midline. During the operation, the patients were asked to play the musical instrument to confirm the effects of thalamotomy. The symptoms improved immediately after thermocoagulation. Four of the six patients returned to the previous professional activities. During the mean follow-up period of 25 months, the effect was persisted. Pre and postoperative mean stages of musician's cramp were 1.2 and 4.7 respectively (0–5, 0: unable to play, 5: return to professional performance). No major complications were noted. Although risks and benefits should be well taken into account, we consider Vo thalamotomy is a safe and effective treatment of otherwise intractable musician's cramp.

T2A6. Utilization of multiple simultaneous tracts for microelectrode recordings in deep brain stimulation

E. J. Boviatsis, M. S. Themistocleous, A. T. Kouyialis, P. Stathis, G. Tagaris, T. I. Bouras, and D. E. Sakas
Athens, Greece

Background. There is an ongoing debate about the use of multiple simultaneous tracts versus a single tract for intraoperative electrophysiology recordings for subthalamic nucleus (STN) deep brain stimulation (DBS). Groups using a single electrode suggest that there is a higher hemorrhage rate associated with the use of multiple simultaneous tracts.

Objective. The aim of this study is to report our experience with the use of multiple simultaneous tracts for microelectrode recordings (MERs) and compare our hemorrhage rate to the international literature.

Patients and methods. During a three-year period (2002–2005), 29 patients underwent surgery for implantation of 57 STN–DBS leads (28 bilateral, 1 unilateral). In all cases five simultaneous tracts were utilized for MERs. The occurrence of intraparenchymal haemorrhage was either identified by clinical symptoms or on the postoperative MRI, performed within 48 after the procedure.

Results. In this series, only one patient ($n = 3.44\%$) developed a small intraparenchymal hemorrhage. He recovered without permanent neurological sequel but required prolonged hospital stay. This is comparable to the international literature, quoting a hemorrhage rate of 2–8%.

T2A7. Relationships between MRI anatomy and electrophysiological spontaneous unitary recordings in the subthalamic region during stereotactic surgery for severe idiopathic Parkinson's disease

J. Coste, S. Siadoux, P. Derost, F. Durif, J. Gabrillargues, S. Hemm, and J. J. Lemaire
Clermont Ferrand, France

Objective. In the subthalamic area, the subthalamic nucleus (STN) is the main target for deep brain stimulation (DBS) in idiopathic

Parkinson's disease (PD). We aimed at analysing relationships between the MRI anatomy and spontaneous neuronal activity in order to confirm the potential of microelectrode recording to assist in the determination of the optimal surgical target.

Methods. Thirty trajectories were analysed. Procedures (8 bilateral surgeries) were performed under local anaesthesia after identification on 1.5T MRI (T2 weighted) of anatomical structures, STN, above STN (zona incerta, forel's fields) and substantia nigra (SN). Spontaneous neuronal activity was recorded (30 seconds, 0.5 mm step), simultaneously along the distal 10 mm on a central (covering optimally STN) and on a 2 mm anterior track. Intra operative X-Ray controls checked that the exploration tracts followed the planed trajectories. Chronic DBS (on central tract 14 times out of 16) dramatically improved PD. We calculated cell numbers and mean firing rates (MFR, average firing on 30 seconds) on 276 isolated neurons (after threshold and principal component analysis) regrouped according to anatomical structures. MFR were compared with a non parametric statistical test.

Results. 60% of spontaneously active cells were in the dorsal and lateral STN. MFR increased entering STN and SN ($p < 0.03$): 5.88 ± 1.06 spike.sec^{-1} above STN; 9.23 ± 1.22 spike.sec^{-1} in STN; 14.46 ± 2.32 spike.sec^{-1} in SN.

Conclusions. Anatomical boundaries and unitary recordings seem to be linked. We found a maximum number of spontaneously active neurons in the dorsal and lateral STN which is also known as a good surgical target for DBS in severe PD.

T2A8. A cross validation study of STN targeting on MRI: from stereotactic procedures and automatic registration algorithms to direct identification

F. J. Sanchez Castro, C. Pollo, R. Meuli, P. Maeder, J. G. Villemure, and J. P. Thiran
Lausanne, Switzerland

Background and purpose. Subthalamic nucleus (STN) Deep brain stimulation (DBS) has demonstrated its efficacy in the treatment of Parkinson's disease. Accurate targeting of the STN is a crucial step for the success of DBS surgery. MRI has shown to be reliable and allows direct targeting. Unfortunately, STN is not always clearly identifiable on standard T2-weighted images. In these situations, manual targeting procedures represent only an estimation of the real STN position. Recently, registration algorithms have been developed to automatically estimate the position of brain structures from segmented electronic atlases. However, their precision remains to be studied. We propose to evaluate the performance of different targeting methods (manual and automatic) compared to expert accuracy.

Material and methods. Position of 16 STN was assessed independently by 2 experts IR-T2-weighted MRI where STN were clearly identifiable (real target: RT). The RT coordinates were reported on the corresponding 3D T1-weighted images. The most clearly visible STN was considered as reference (atlas). Estimation of the target (ET) was performed on T1-weighted MRI using Schaltenbrand and Wahren atlas coordinates (AC-PC), as well as affine and non rigid algorithms (demons, B-splines, segmentation-based) applied on the atlas. Euclidian distances (ED) from ET to RT were calculated and compared to the expert variability using ANOVA test.

Results. ED were: AC-PC 1.96 ± 0.90 mm, Affine 2.42 ± 0.84 mm, Demons 1.77 ± 0.65 mm, B-splines 1.72 ± 0.48 mm, Segmentation-based 1.55 ± 0.73 mm. No statistical difference was noticed between segmentation-based algorithm and expert variability.

Conclusions. Segmentation-based algorithm provides similar accuracy as experts to estimate the position of the STN on MRI.

T2A9. Patient specific modelling and simulation of deep brain stimulation: A method for pre- and postoperative investigations

M. Åström, L. U. Zrinzo, M. I. Hariz, S. Tisch, P. Limousin, and K. Wårdell
London, UK; Umea, Sweden

Deep brain stimulation (DBS) is an established symptomatic treatment for movement disorders. However, the mechanisms responsible for the therapeutic effects are still being debated. The instant suppression of tremor in Parkinson patients and the delayed suppression of dystonic symptoms by DBS may be an indication that several different mechanisms may be involved. In order to increase the understanding of the clinical outcome of DBS, we have developed a method for setting up patient specific 3D finite element method (FEM) models of the brain using T2 weighted magnetic resonance images (MRI). The modelling is done by extracting preoperative MRI intensity data values which are classified into not only grey matter, white matter and cerebrospinal fluid, but also into a mixture of them. Each classified MRI intensity data value is then allotted its physical property. When simulating DBS the relevant physical property is the electrical conductivity. The conductivity properties are mapped in the FEM models at coordinates corresponding to their original location in the MRI data set. The result is a model with the same resolution as the MRI data set. After the electric DBS parameters are implemented in the model it can be solved on a standard computer. Various electrical entities such as the electric potential or the electric current density in the vicinity of the electrode can be visualized from different views. A potential of this method is to correlate the anatomical aspect of the electrical field to the effects and side effects of stimulation through a particular electrode contact.

T2A10. Dementia after STN–DBS: predictive value of preoperative hippocampal atrophy

S. Aybek, F. Lazeyras, A. Gronchi, J. Bogousslavsky, J. G. Villemure, P. Burkhard, and F. J. G. Vingerhoets
Lausanne, Switzerland

Background. Hippocampal atrophy (HA) is a risk factor for subsequent development of dementia in Alzheimer's Disease but such prognosis value of HA has not been tested in PD. Some advanced PD patients may develop dementia in the years following subthalamic deep brain stimulation (STN–DBS) and the identification of a preoperative marker in at-risk patients would be of great interest.

Objective. To compare preoperative hippocampal volumes between STN–DBS PD patients who subsequently developed dementia and those who did not.

Method. From a cohort of 57 consecutive STN–DBS PD patients, 14 developed dementia in the 3-year follow-up (PDD). We identified 14 matched controls (PDnD). On the preoperative 3D MPRAGE MRI images, hippocampal volumes were delineated by a blinded investigator using manual segmentation and total brain volumes were obtained by automatic segmentation.

Results. PDD had smaller hippocampal volume then PDnD (1.95 ± 0.29 ml; 2.23 ± 0.26 ml; $p < 0.05$). This difference reinforced after normalisation for the total brain volume ($1.64 \pm 0.24 \times 10^{-3}$, $1.95 \pm 0.30 \times 10^{-3}$; $p < 0.01$). Total brain volume (1198 ± 183; 1140.7 ± 108 ml), age at onset of the disease (54.2 ± 8.1; 55.9 ± 10.2), duration of disease (15.0 ± 5.1; 13.7 ± 5.4), mean follow-up (37 ± 13 months; 33 ± 14 months) did not differ significantly ($p > 0.6$) between PDD and PDnD.

Conclusion. These results suggest that: a) as in Alzheimer's Disease, HA may be a predictor of development of dementia in PD; b) the development of dementia following STN–DBS is related to the extension of PD rather than to a direct effect of stimulation.

Epilepsy I

T2B1. Comparison of clinical outcome with the extension of selective amygdalohippocampectomy for treating mesiotemporal epilepsy

G. Vaz, C. Grandin, K. van Rijckevorsel, and C. Raftopoulos
Brussels, Belgium

Objective. Surgical strategies for treating refractory mesiotemporal epilepsy (RMTE) are still matter of discussion. Selective amygdalohippocampectomy (SelAH) is considered an effective therapeutic option with a low morbidity; but, it is unclear if the results in seizure control are related to the extension of resection. Our purpose was to compare long-term seizure outcome with the extension of resection in RMTE patients treated with SelAH.

Methods. We performed SelAH in 31 patients of whom 26 were followed-up for more than 12 months. All these 26 patients (mean age 32 years, range: 8–54, 5 males, 20 left) had typical MTE (unilateral ictal focus confirmed at work-up) refractory to several antiepileptics. Mean follow-up was 34.3 months (range: 13–54). Seizure outcome was compared to volume of resected cortex measured on postoperative MRI.

Results. Neuropathology findings suggested a mesiotemporal sclerosis in 7 patients, reactive gliosis in 12, microdysplasia in 2, gliomas in 4 and 1 remained undiagnosed. Clinical results were Engel I in 17 patients, II in 8, and III in 1 patient. Two tumoral cases died from possible sudden unexpected death in epilepsy 2–3 years after surgery. Eight patients developed asymptomatologic superior quadranopsia after surgery, 4 transiently. There was no correlation between the postoperative clinical evolution and the extent of SelAH.

Conclusions. Our results show that after SelAH, patients with MTE were seizure free in 65% of cases and considerable improvement in 31%. No correlation was observed between seizure outcome and the amount of resection. Morbidity was low, limited to asymptomatic quadranopsia in 4 cases.

T2B2. Subtemporal amygdalohippocampectomy-operative and neuropsychological outcomes

T. Hori, T. Ochiai, and Y. Kubota
Tokyo, Japan

Objective. Evaluation of operative, neuropsychological, and neuropathological results after subtemporal amygdalohippocampectomy for refractory temporal lobe epilepsy in patients, who were followed 2 years and more after surgery.

Between 1991 and 2004, subtemporal amygdalohippocampectomy was performed in 26 consecutive patients with non-lesional medically refractory temporal lobe epilepsy. Neuropathological examination of the resected specimens was done in all cases and the whole cohort was used for evaluation of the immediate operative outcome. Comparative neuropsychological evaluation was done before and 2 months after surgery in 24 patients, and at 2 years follow-up in 19 of them. The verbal paired associates learning test was done before and 2 months after surgery in 19 patients; these data were compared between 13 individuals in whom the language-dominant hemisphere side was operated on and 6 of those in whom the language non-dominant side was operated on.

Seizure control was achieved in 84% of patients who attained Engel classes I and II, without definite permanent subjective complications except postoperative memory impairment in one patient. Neuropathological examination confirmed hippocampal sclerosis in 19 patients. No significant differences in intelligence quotient (IQ) were observed between the dominant and non-dominant side resection groups, and significant increases in verbal IQ, performance IQ and full scale IQ over time were observed.

Conclusion. No significant differences in the verbal memory test were marked between the dominant and non-dominant side resection groups, as well as between pre- and post operative scores.

T2B3. Selective amygdalohippocampectomy vs anterior temporal lobectomy: a comparison study of seizure outcome

H. Bate, U. C. Wieshmann, T. R. K. Varma, P. R. Eldridge, and A. T. Kouyialis
Liverpool, UK

Background. Mesial temporal lobe epilepsy is often refractory to medical treatment but surgery can be extremely effective in obtaining seizure control. The most widely utilised surgical procedures include Falconer's en bloc anterior lobectomy and selective amygdaldohippocampectomy proposed by Niemeyer and later by Wieser and Yasargil.

Purpose. The aim of this study was to compare the seizure outcome between these two different types of epilepsy surgery, namely selective amydalohippocampectomy (AHE) and anterior temporal lobectomy (ATLE) in patients with temporal lobe epilepsy.

Patients and methods. 114 patients with non-lesional temporal lobe epilepsy were included. Patients underwent ATLE if the non dominant hemisphere was affected or when the whole temporal lobe was atrophic. AHE was used in cases where the dominant hemisphere was affected. Standardised seizure outcome at 1 year following surgery was used.

Results. There was no statistically significant difference in gender, age at onset of epilepsy, age and duration of seizures at operation. There were no deaths. Five (16%) patients in the AHE group suffered complications, compared to 14 (17%) in the ATLE group most of which were transient and mild. Overall 46 (40%) of the 114 patients who underwent temporal lobe epilepsy surgery were seizure free at 1-year (Engel's class Ia). A good outcome (Engel's classes I and II) was significantly more frequent in ATLE than in AHE. (66% vs. 44% respectively, $p = 0.03$).

Conclusions. ATLE has a better seizure outcome compared to AHE. Complication rates between the 2 procedures are comparable and depend significantly on surgical experience.

T2B4. Temporal disconnection for intractable temporal lobe epilepsy: results of a series of 45 consecutive patients

S. Chabardès, L. Minotti, D. Hoffmann, P. K. E. Seigneuret, and A. L. Benabid
Grenoble, France

Temporal lobe epilepsy (TLE) is the most common form of intractable partial epilepsy in adults. Surgery (lobectomy or amygdalo-hippocampectomy) is effective in most patients. We report

safety and efficacy in non lesional TLE of the disconnection, without removing it, of the lateral neocortex, the hippocampus, para-hippocampus and amygdala, sparing veins and arteries. 62 patients with temporal or extratemporal epilepsy (1998–2004) had disconnection of the epileptogenic zone. 45 TLE patients (35 yrs ± 10, mean duration 24 ± 10 yrs, 16 males, 29 females, handedness: 12 left, 33 right) underwent temporal disconnection (20 left, 25 right) under neuronavigation. 16 patients (35%) underwent additional pre-surgical depth SEEG. Outcome was assessed using Engel's classification.

At two years follow-up, 38 patients (84.4%) were seizure free (Engel's I), among which 26 (58%) were Ia. Four patients were class II and 3 class IV. Post-operative persistent morbidity included mild hemiparesia ($n = 1$), mild facial paresia ($n = 1$), quadranopia ($n = 23$), hemianopia ($n = 1$). Verbal memory was worsened in 69% of the dominant lobe disconnections. MRI control showed 2 non symptomatic thalamic or pallidal limited ischemias, 2 temporal horn cystic dilatation, one requiring surgical reintervention without sequella. There was one case of postoperative phlebitis.

EEG showed temporal spikes at 6 months in 27% of patients with seizures compared to 8.5% of seizure free patients, and at one year in 19 and 6%, respectively.

Comparative studies are required to evaluate the temporal disconnection as an alternative to lobectomy in non lesional TLE.

T2B5. Stereotactic intrahippocampal transection interrupts seizures in a mouse model of temporal lobe epilepsy

J. Pallud, B. Devaux, and A. Depaulis
Paris, France

Surgical resection of mesial temporal structures is an effective treatment for intractable mesial temporal lobe epilepsy (MTLE) but is frequently associated with permanent cognitive morbidity. In a surgical alternative to resection we developed in the kainite (KA) model of MTLE in mice a stereotactic procedure of intrahippocampal transection to disrupt longitudinally projecting axonal circuits in the hippocampus.

Twenty-two C57BL/6 adult mice were stereotactically injected with KA in the dorsal hippocampus and equipped for stereo-EEG recordings with two depth hippocampal electrodes, the most anterior placed at the KA injection site. When spontaneous recurrent focal discharges occurred 3 weeks after KA injection–, a transversal intrahippocampal transection was stereotactically performed between the two depth electrodes. Eight animals underwent the same procedure except the hippocampal transection and served as controls. After continued recordings, all animals were sacrificed and histologically examined.

After complete intrahippocampal transection including the dentate gyrus and hilus ($n = 7$), no discharge was recorded from the posterior hippocampal electrode while discharges persisted at the KA focus level recorded from the anterior electrode, but with a reduced frequency and longer duration. After incomplete intrahippocampal transection sparing the dentate gyrus and hilus ($n = 7$), no modification of discharges (in duration and frequency) was recorded for both hippocampal electrodes, as was also observed in the control group ($n = 8$).

Complete transversal transection of the dentate gyrus and hilus stops ictal discharge spread within the hippocampus from a generator located at the KA injection site. Furthermore, complete transections also modify the generation of focal discharges. These results suggest the role of longitudinally projecting axonal circuits of the hippocampus in the generation and spread of focal ictal discharges in this model of MTLE.

T2B6. Stereotactic amygdalohippocampectomy in the treatment of medial temporal lobe epilepsy (MTLE)

R. Lišcák, M. Kalina, Z. Vojtech, T. Procházka, and V. Vladyka
Prague, Czech Republic

Introduction. Minimally invasive percutaneous single trajectory thermocoagulation for stereotactic amygdalohippocampectomy was used to treat MTLE.

Method. Group of 15 patients with MTLE were treated using stereotactic thermo-lesion of amygdalohippocampal complex (4 times at right side, 11 times at left side). The target was reached through single trajectory using MRI stereotactic localisation. Thermocoagulation of the whole amygdalohippocampal complex was planned according individual anatomy in each patient.

Amygdalohippocampectomy was performed by string electrode with 10 mm active tip and from 17 to 30, median 24 lesions was performed in all patients along the 30–35 mm trajectory in amygdalohippocampal complex. The procedure was performed under local anestesia and the duration of the procedure did not exceed 2 hours, from which 1 hour at OR.

Results. The procedure was well tolerated by all patients with no new neurological deficit. The follow up ranged 6–24 months. 5 patients are followed longer then 12 months, 3 of them are Engel I and 2 Engel II (updated data will be present).

Conclusion. Stereotactic amygdalohippocampectomy is minimally invasive procedure, which can replace in selected patients with MTLE selective resection of amygdalohippocampal complex.

T2B7. Radiosurgery in mesial temporal lobe epilepsy: long-term outcome

J. Régis, M. Tamura, F. Bartolomei, and P. Chauvel
Marseille, France

Objective. The short term safety efficacy of Gamma Knife Surgery (GKS), using 24 Gy, in patients presenting with mesial temporal lobe epilepsies (MTLE) have been demonstrated by several teams. However, till now no long term follow up was available.

Methods. Since March 1993, 53 patients presenting with MTLE have been operated in Marseille University Timone Hospital. A total of 38 patients with unilateral MTLE have been operated more than 3 years ago. All the 17 patients (9 females, 8 males) treated more than 4 years ago at the state of the art (24 Gy at the margin) have been reevaluated. The target was essentially including the anterior parahippocampal cortex the ventral part of the amygdaloid nucleus and hippocampus (head and body).

Results. The median age was 34 years (mean 35, min 22, max 46) and the median age at the onset of the epilepsy was 10.5 years (mean 8.5, min 1 and max 27).

The MTLE was on the dominant side in 9 cases (53%). The median follow up is 8 years (mean 7.7, min 4 and max 10). At the last follow up 12 were still seizure free (70.5%) one have been operated due to a failure. Seizures have stopped with a median delay of 14 months (mean 13, min 1 and max 19). A visual field have revealed a deficit in 8 patients (47%). Neuropsychological testing have failed to identify any deficit and specially no verbal memory deficit when the MTLE was on the dominant side.

Conclusion. Long term results of GKS in MTLE are confirming the very good safety efficacy observed on the short term. Memory sparing on the long term seems to be a major advantage over microsurgical resection.

T2B8. Amygdalohippocampal stimulation for intractable temporal lobe epilepsy

C. Pollo, M. Seeck, G. Foletti, S. Vullemioz, C. Boex, L. Spinelli, E. Pralong, D. Debatisse, and J. G. Villemure
Lausanne, Switzerland

Background and purpose. High-frequency (HF) amygdalo-hippocampal stimulation (AHS) has recently been proposed as a therapeutic option for intractable temporal lobe epilepsy. Although preliminary results are promising, long-term efficacy of this technique as well as stimulation paradigms or implantable device are still under evaluation. We report our experience regarding the surgical technique and effect on seizure control.

Material and methods. Six patients with intractable epilepsy unsuitable for resective surgery were selected for unilateral AHS. All cases but one showed strictly unilateral epileptogenic zone located in the mesial temporal lobe, 3 were right sided, one left, one bilateral predominantly left.

A 3D T1-weighted MRI was performed under stereotactic conditions. The Pisces-Quad electrode was implanted through a posterior approach at the junction between the hippocampus and the parahippocampal gyrus with the distal contact located within the inferior aspect of the amygdalo to avoid intraventricular trajectory. External extension was provided to perform deep EEG recordings for 3–4 days. The Soletra stimulator was then implanted under general anesthesia. Monopolar stimulation was delivered simultaneously through the 4 contacts at a frequency of 130 Hz, pulse width 450 μs, and amplitude up to 1–2 V.

Results. Follow-up from 5 months to 3 years shows a significant decrease (50–95%) of seizure frequency in all the patients. No stimulation-induced side effects were noticed.

Conclusion. HF-AHS is safe and effective as an alternative treatment for medically intractable temporal lobe epilepsy in selected cases. Further controlled trials and fundamental research are needed for the assessment of long-term efficacy and a refined understanding of mechanisms of action of electrical stimulation.

T2B9. Electrical stimulation of the hippocampus (ESH) in patients with intractable temporal lobe epilepsy: A double blind and long term follow up study

F. Velasco, A. L. Velasco, M. Velasco, and F. Jimenez
Mexico City, Mexico

Purpose. Evaluation of long term efficacy of ESH in the treatment of complex partial seizure in patients with intractable mesial temporal lobe epilepsy.

Methods. Nine patients were studied. They had at least a 6 month basal period during which a careful seizure record was obtained. They all underwent bilateral hippocampal electrode implantation to establish focus laterality and location. Three patients had bilateral and 6 had unilateral foci. Diagnostic electrodes were explanted and definitive Medtronic electrodes were implanted directed to the hippocampal foci. Position was confirmed with MRI and afterwards the DBS system internalized. Patients signed the informed consent approved by the Hospital's Ethics Committee and started a double blind stimulation protocol. Patients attended every 3 months for seizure count and neuropsychological tests.

Results. Follow up went from at least 18 months to 5 years. Patients were divided in two groups: 5 had normal MRIs and 4 had hippocampal sclerosis. Patients with normal MRI had a seizure reduction of >95%. Patients with hippocampal sclerosis had a seizure reduction of >50%. Both groups had neuropsychological tests which showed memory improvement. During the double blind period there was significant differences between the ON and OFF stimulation conditions. No patient showed adverse effects. One patient had to be explanted after 2 years due to skin erosion in the trajectory of the system, and seizures progressively returned to the baseline levels. All others had maintained improvement through out the follow up.

Conclusions. ESH provides a non lesional method that improves seizure outcome without deterioration of memory in patients with unilateral or bilateral hippocampal epileptic focus. The results are significantly better in patients without temporal lobe sclerosis.

T2B10. Deep brain stimulation in patients with intractable epilepsy: clinical experience in 5 cases

J.-K. Lee, S. H. Hong, J.-K. Kang, and T.-S. Ko
Seoul, Korea

Neuromodulation therapy using implantable electrical stimulation device has been applied for patients who are not considered as good candidates for resective surgery for intractable epilepsy. While numerous studies regarding the efficacy of vagus nerve stimulation has been produced from ample clinical experiences, only anecdotal reports are available for the outcome of deep brain stimulation (DBS) in patients with epilepsy at present.

We performed bilateral chronic DBS in patients with intractable epilepsy, targeted at the subthalalmic nucleus (STN) in 2, and at the anterior nucleus of the thalamus (ATN) in 3 patients. The patients who underwent STN–DBS were both female of 19 years of age, and one had shown bilateral cortical dysplasia on brain magnetic resonance (MR) images. ATN–DBS was performed in male patients, 25 to 34 years of age, one of whom had undergone previous resective surgery which had failed to sufficiently reduce the frequency of seizures. The other two had multifocal epilepsy and primary generalized epilepsy.

After STN–DBS, one patient showed 50% reduction of seizure frequency at 18 month-follow up, while the other remained unchanged. In patients with ATN–DBS, the seizure frequency was reduced by 30, 50, 50% at 3 month-follow up. The real efficacy of DBS for epilepsy surgery needs to be determined from long-term follow up in more patients.

Oral posters I

T2C1. Image guided robotized radiosurgery based on the microanatomy: Advantages in CISS with gadolinium enhancement

M. Hayashi, J. Regis, T. Ochiai, K. Nakaya, M. Chernov, M. Izawa, T. Hori, and K. Takakura
Tokyo, Japan

Rationale. Gamma Knife Radiosurgery is one of "Image guided surgery" for brain tumors. Precise tumor visualization is needed for complete dose planning to control tumor progression. In particular, the surrounding vital structures adjacent to the tumors should be defined more clearly to keep their underlying function. We selected a special sequence of MRI dedicated to skull base and suprasellar tumors. We report its technical usefulness and clinical evaluation.

Method and results. We used high quality MRI and CT. For skull base and suprasellar tumors, we used a dedicated sequence "3D heavily T2WI axial 0.5 mm thickness with gadolinium enhancement" according to Timone University method. Each structure adjacent to the tumor was visualized more clearly than that of

without gadolinium, because tumor became lucid on the MRI without changing the findings of surrounding structures after gadolinium injection. For acoustic tumors, we could visualize 5th, 7th, and 8th nerves in not only cisternal portion but also in intrameatal portion. As for cavernous sinus tumors, we could visualize the optic nerve, pituitary gland, lateral wall of the sinus and other nerves located in the cavernous sinus. For suprasellar tumors, we could completely distinguish between tumor and adjacent optic pathway. Finally, we performed optimal dose planning in every tumor to keep high conformity and selectivity to keep their underlying function.

Conclusions. We demonstrated to establish optimal dose planning for brain tumors with dedicated special sequence of MRI. In the near future, we hope that most patients will benefit from this technique and have less neurological deficit.

T2C2. A cine-MRI study after endoscopic lamina terminalis fenestration for treatment of hydrocephalus associated to pineal region tumors

M. Iacoangeli, A. Di Rienzo, M. Dobran, F. Formica, and M. Scerrati
Ancona, Italy

Background. Obstructive hydrocephalus is associated with pineal region tumors in more than 80% of cases. Endoscopic third ventriculostomy (ETV) is increasingly used as alternative treatment for obstructive hydrocephalus. We starting to use a new technique: the endoscopic lamina terminalis fenestration (ELTV). The aim of this study was to determine the utility of cine phase-contrast MR imaging to determine the efficacy of ventriculostomy across time and whether CSF pulsation is restored after ELTV.

Methods. Four patients harbouring pineal region tumors have been treated in the last year. Flow void changes in the floor of the third ventricle and the stroke volume at the site of the ventriculostomy were quantified. The technique of ELTV consists of direct tumor removal by Krause approach then through the same posterior third ventricle opening the endoscopic lamina terminalis ventriculostomy was performed.

Results. The patency of ELTV was confirmed by the restoration of pulsate motion characteristics of CSF circulation. The stroke volume registered at ventriculostomy was maintained with time and in one patient returned at the level of the aqueduct. Immediate CT scan after the operation showed air in the parasellar region suggesting patency as well.

Conclusions. In our opinion, the ELTV after direct surgery for pineal region tumors, offers the following advantages: relatively simple technical adjunct, safe approach through a ''natural'' way, no transparenchymal tract, same patient position, no external device needed. Quantitative analysis with phase-contrast MR imaging indicates that ELTV is an efficient technique for restoring CSF pulsation, with efficacy being maintained during time.

T2C3. Characterization of subthalamic nucleus (STN) by T2-weighted 3-Tesla magnetic resonance imaging (3T MRI)

P. Browaeys, C. Pollo, J. Bloch, J. G. Villemure, S. Binaghi, P. Schnyder, P. Maeder, and R. Meuli
Lausanne, Switzerland

High frequency electrical stimulation of the subthalamic nucleus (STN) is the most commonly used deep brain stimulation (DBS) therapy for advanced Parkinson's disease. Accurate targeting of the STN is a crucial step for the success of DBS surgery.

MRI has shown to be reliable and allows direct targeting. Unfortunately, STN is not always clearly identifiable on standard T2-weighted images and most institutions still rely on coordinates provided by stereotactic atlases, which represent an estimation of the real STN position. In order to reduce critical discrepancies which could occur between actual and predicted STN positions, we evaluate a direct targeting of STN, based-on 3T MRI capacities. In 10 patients selected for STN–DBS, a 3T T2w axial acquisition was performed in non stereotactic conditions 2 days before surgery. The day of surgery, we acquired a framed (CRW, Radionics) 1.5 T MPRage sequence. Co-registration of both acquisitions was done by dedicated software (Framelink, Medtronic).

Targeting was then realized on the 3T T2w axial images, with additional informations provided by coronal and sagittal reconstructions allowed by 1.5 mm slices thickness.

Accuracy of co-registration was assessed on the 3 planes in the region of interest. On axial slices, superior portion of the STN was clearly recognizable in all cases as a small, hypointense, lens-shaped structure, located 10–12 mm lateral to the anterior portion of the red nucleus.

Direct visualization of the STN on 3T T2w MRI may contribute to optimise electrode placement in DBS surgery. Further validation should include more cases and correlation with electrophysiology and clinical efficacy.

T2C4. Treatment of spasticity with intrathecal baclofen pump. A review of 33 patients, follow up and outcomes

J. Godard, L. Di Tomasso, Y. Beaudic, R. Billon-Grand, B. Parratte, and E. Erger
Besancon, France

Intrathecal baclofen therapy (IBT) is an effective means of treating intractable spasticity and dystonia in a pediatric and adult population. We present a retrospective review of 33 cases, 28 adults and 5 children, during a follow up 'ten' years.

Complications and results in accordance diagnosis were performed. An assessment of Asworth score, spasms and functional independence before an after treatment were reported.

The average Asworth score was 4 before to 2 after the pump. A very good personal satisfaction for 60% of cases, only 10% was unchanged. All the pump are implanted hypodermic. Postoperative complications are numerous, both at the time of implantation and throughout life of implanted system, 30% in our series (disconnection 1, migration of catheter 4, cutaneous infections 3, skin necrosis 1 and dysfunction of pump 1). No pharmacological incidence is in our cases. IBT remained effective treatment in the long term. The incidence of complications must be reduced, mainly on the catheter with technical improvements.

T2C5. A new treatment of neurogenic bladder dysfunction: the sacral nerve stimulation

A. Lavano, M. De Rose, A. Grassi, F. Abbate, and C. D. Signorelli
Cantazaro, Italy

Background. Patients with neurogenic bladder dysfunction who do not respond to medical and conservative treatments such as

anticholinergics and intermittent self-catheterization are very difficult to manage. Sacral nerve stimulation (SNS) is becoming an alternative treatment in those patients but clinical experiences reported in literature are limited.

Methods. Four patients with bladder dysfunction associated with neurogenic disorders underwent sacral nerve stimulation: 2 patients had urinary incontinence (1 mielitis and 1 polinevrites) and 2 had urinary retention (both incomplete spinal cord lesion). Preoperative management included voiding diaries for 4 continuous days, urodynamic study, uretocystography, sacral plane x-ray. Sacral nerve stimulation consisted in two procedure: Pheripheral nerve evaluation and permanent implantation of electrode and pulse generator.

Results. Patients with neurogenic incontinence became dry during PNE subchronic test and stayed dry after implantation and at 12 month follow-up; drugs use was no longer required after implantation. Urodynamic results revealed improvement of maximum bladder capacity and volume in one patient while no significant improvement in the other one.

Concerning patients with urinary retention one stopped catheterization during PNE subchronic test, the other one reduced catheterization to once every two days with residual volume significantly decreased. In those patients symptomatic results obtained were confirmed by urodynamic study and remained stable after implantation and at 12 month follow-up.

Conclusion. SNS is an appealing, successful modality of treatment for neurogenic urinary incontinence and retention. The high efficacy, the relative simplicity of the procedure and the low complications rate make this treatment breakthrough in those pathologies.

T2C6. Benefit-risk-ratio of 5-channel-microelectrode-recording in deep brain stimulation (DBS)

J. Vesper, F. Amtage, Ch. Wille, G. Nikkhah, and Ch. Ostertag

Freiburg, Germany

There is no doubt that microelectrode recording has become important for target determination in chronic DBS. It remains disputed whether microelectrode recording results in a higher risk for complications. We examined therefore retrospectively the patients, who were operated using of microelectrode recording (MER) between October 2003 and November 2005. 46 patients underwent DBS using MER. In 37 patients electrodes were implanted bilaterally, in 9 patients unilaterally, targets were in 34 cases the subthalamic nucleus (STN), in 4 cases of the ventral intermediate nucleus (VIM), in 8 cases the internal pallidum (GPi). On a regular basis 5 electrodes for each side were used (combined micro/macro electrode, MEkit system Inomed, Teningen, D). The mechanical microdrive and the ISIS recording system were used. Recording started at 10 mm before the calculated final target in 0.5–1.0 mm incremental steps. Within the 46 patient's altogether 384 trajectories were performed. In only 66 out of 83 macroelectrodes (80%) were placed into the central trajectory. After placement of the final macroelectrode, a postoperative stereotactic CT was performed, in order to confirm the position of the electrodes and exclude bleedings. Initial postoperative stereotactic CT investigations were performed in all patients. In only two cases complications associated to MER appeared, one venous infarction, one symptomatic hemorrhage.

After rheologic therapy hemiparesis of both patients resolved completely. With the remaining patients no complications were seen. However in eight patients only one trajectory was used. These were patients with reduced medical condition or pronounced brain atrophy and/or a female patient with a history of previous thalamotomy. The operation time did not extend by the use of the MER. The intraoperative complication rate when using the MER for the DBS is not higher according to our data if compared with regular stereotactic biopsies (1.9% in 5000 patients, Tilgner J *et al.*, Neurosurgery 2004). The MER with the DBS is low-risk and safely feasible.

T2C7. Aggressive integrated treatment for multiple brain metastases: the role of surgery and radiosurgery

F. Formica, M. Iacoangeli, S. Chiriatti, M. Cardinali, A. M. Mauro, C. Bomprezzi, and M. Scerrati

Ancona, Italy

Background. Through the last years the treatment of metastatic brain cancer has progressively evolved toward a multimodal and more aggressive approach, granting a survival mean time longer than one year, also in patients with multiple brain metastases.

Methods. We analyzed a series of 14 patients affected by multiple brain metastases treated at our Institute, between January 2003 and January 2006. Primary tumor sites were lung (7 cases), prostate (3), kidney (1), breast (1), gross bowel (1); neuroendocrinal carcinoma with unknown primitive location was found in 1 case. The mean number of lesions was 3 (ranging from 2 to 8). In all cases only the symptomatic and/or life-threatening lesion, more than 3 cm in diameter, was operated on. In 7 cases radiosurgery was performed in residual lesions (max 2) far away from the craniotomy and less than 3 cm in diameter.

Results. Up to January 2006, three patients died: one patient (RPA Class 2) two months after surgery and the other two (RPA Class 1) 10 and 11 months later. In 4 cases there was recurrence and/or progression of the operated cerebral lesions. In patients submitted to radiosurgery 3 had recurrence and/or progression of the treated lesions.

Conclusions. The improved standard systemic therapy and the advent of radiosurgery makes multiple brain metastases not an absolute contraindication to the surgical treatment. In well selected patients (RPA Class 1) it is possible to improve the length and the quality of life even removing only the life-threatening lesion or that causing acute neurological symptoms.

T2C8. A comparison of two treatment methods of lung cancer brain metastases: whole brain radiation therapy (WBRT) and radiosurgery (SRS)

E. Wolny, A. Tukiendorf, A. Grzadziel, A. Idasiak, S. Blamek, and L. Miszczyk

Gliwice, Poland

Purpose. The aim of the study was to compare two radiotherapy methods of treatment patients with brain metastases from non-small-cell lung cancer (NSCLC): whole brain radiotherapy (WBRT) and radiosurgery (SRS) and to evaluate impact of factors such as metastases volume and their number, age of patients, presence of extracranial metastases and performance status for survival.

Materials and methods. 57 patients (17 men and 40 women; age 31–74, mean – 55.8) suffering from brain metastases, treated with WBRT or SRS between April 2001 and April 2004. The primary tumor was a histologically confirmed non small-cell lung cancer.

Thirty-four patients were treated with WBRT alone, 23 patients with SRS alone. In the group treated with WBRT, 13 patients had a solitary metastasis and 21 patients had 2 or more metastases.

In the group treated with SRS: 14 patients had a solitary metastasis and 9 patients had 2 or more metastases. The performance status in Zubrod scale ranged from 0 to 3. The volume of lesion varied from 1.0 cm^3 to 50 cm^3.

Twelve patients in the analyzed group had extracranial metastases. All of them were treated with WBRT.

SRS was performed using linear accelerator (dose ranged from 12 to 20 Gy) and WBRT was performed delivering five 4 Gy fractions.

Median survivals were estimated using Weibull regresion.

Results. Comparison between survivals for patients with single and multiple metastases did not show significant difference ($p = 0.3$).

We did not observe statistically significant difference in time of survival between patients treated using both methods – WBRT and SRS ($p = 0.39$) and we did not observe statistically significant difference between survivals of patients with performance status equal to Zubrod 0 and 1 vs. Zubrod 2 and 3 ($p = 0.15$).

Conclusion. SRS seems to be a good palliative treatment modality for patients with brain metastases of lung cancer having the same effectiveness in comparison to WBRT and seeing shorter, easier and probably less toxic for patients.

T2C9. The new stereotactic radiosurgery: the latest gamma knife treatment strategy for acoustic schwannoma; image guided and robotized micro-radiosurgery

M. Hayashi, J. Regis, T. Ochiai, K. Nakaya, M. Chernov, M. Izawa, T. Hori, and K. Takakura
Tokyo, Japan

Rational. Gamma Knife radiosurgery has become a standard treatment ranked with surgical operation for acoustic schwannoma from the perspective of tumor growth control and audio-facial nerve function preservation. Now we are looking to establish a new treatment technique to improve shrinkage rate, shorten the recovery term and even to recover functioning. The advent of the new model of Gamma Knife (Model C-APS robotized system) has enabled precise dose planning with 0.1 mm level adjustment.

Methods. We developed original MRI sequences to have a clear understanding of cranial nerves distribution especially from cisternal portion to internal acoustic meatus. Additionally, a fusion image with CT scan (portrait even facial notch-Bill's bar) has helped us to understand anatomical relationship, opening the way to deliver ''perfectly conformal treatment''. We keep higher dose (80%) line area inside the tumor aiming at its shrinkage rather than just controlling it. So far we have treated 127 cases with this technique at our institution.

Results. Among them, 66 patients were followed more than 12 months. Tumor shrinkage rate was seen in 67.6% (76.0% for patients with more than 24 months follow-up), facial nerve preservation rate 100%, and hearing preservation rate 89.3%. Four (6.0%) patients showed recovery in functioning. Transient enlargement was observed in most cases, but no severe complications were found.

Conclusions. We only have preliminary results yet, but the clinical result is surely a great breakthrough compared to the previous treatment. We presume that longer follow-up and more treatment cases will firmly establish this method as an absolute treatment option for acoustic schwannoma.

T2C10. Endoscopic aquaductoplasty in trapped fourth ventricle syndrome: a neuronavigation guided suboccipital approach

O. Van Damme, F. Dewaele, E. Baert, and J. Caemaert
Ghent, Belgium

Object. Endoscopic techniques have proven to be a valuable alternative for shunting procedures in the management of hydrocephalus. Endoscopy may render patients independent of shunts, thus avoiding shunt complications and failure. Different treatments of isolated fourth ventricle have been proposed: suboccipital ventriculoperitoneal shunt, microsurgical fenestration or endoscopic fenestration. We report 2 cases of trapped fourth ventricle syndrome in which an endoscopic aquaductoplasty by means of a trans-fourth ventricle approach resulted in a successful outcome.

Methods. Two patients, a 24-year old male and a 25-year old female, both having a history of hydrocephalus and ventriculoperitoneal shunting, presented to our department with signs of intracranial hypertension due to an isolated fourth ventricle. The diagnosis was established on magnetic resonance imaging, which clearly showed a dilated fourth ventricle and rather small supratentorial ventricular dimensions. In order to avoid and additional intracranial catheter and considering the limited space in the lateral ventricles, we performed an endoscopic aquaductoplasty via posterior approach, thus creating a communication between the fourth and the third ventricle. The endoscope was introduced in the fourth ventricle through a suboccipital burr hole, according to a neuronavigation planned trajectory. The membraneous occlusion of the aquaduct was fenestrated with a Fogarty balloon catheter.

After this procedure both patients were relieved of their preoperative intracranial hypertension symptomatology. Postoperative imaging confirmed the regression of the fourth ventricle dilation.

There was no permanent morbidity. During the followup one patient underwent a shunt revision because of shunt dysfunction.

Conclusions. In our experience, performing cerebral aqueductoplasty via the suboccipital trans-fourth ventricle approach is both technically feasable and effective and should be considered as an possible therapeutic measure for trapped fourth ventricle syndrome.

T2C11. Human foetal striatal transplantation in Huntington's disease. First Italian clinical trial at the University of Florence. Preliminary report

P. Gallina, G. Vannelli, M. Paganini, L. Lombardini, R. Saccardi, M. Macucci, S. Piacentini, R. Mura, E. D'Alessio, C. Mechi, and N. Di Lorenzo
Florence, Italy

Human fetal striatal transplantation (HFST) is being explored as a possible therapeutic intervention in Huntington's disease (HD). HFST has been shown to be feasible, safe and, according to recent reports, able to provide several years of improvement and stability. So far, this therapeutic effect has been demonstrated in a very small population of patients and larger studies are necessary to evaluate the value of this therapy. After approval of the National Ethich Committee and the legal permission of the Italian Health Ministry, in 2005 a clinical program of neural transplantation, has been started in Italy for the first time. Twenty genetically defined HD at relatively early stages, followed for at least one year, were enrolled, according to the Core Assessment Program for Intracerebral Transplantation in HD, in the Florence Neurotransplantation Program. Since February 2006, three patients underwent bilateral graft in two sessions 1 month apart. Small blocks of tissue obtained from the whole ganglionic

eminence of a fetus (10–11 weeks post-conception) were implanted in the caudate nucleus head and in the pre- and post-commissural putamen by means of a robotic-assisted-stereotactic procedure.

Immunosuppression was started one day before the first grafting with ciclosporin A, prednisolone and azathioprine. Surgery was uneventful in all patients. Magnetic resonance imaging performed at 1 week after each procedure, did not detect any complication and showed the needle tracks visible within the appropriate anatomical targets. Patients were scheduled for clinical and imaging evaluation at 3–6 and 12 months to assess grafts maturation and neurological results.

T2C12. The DREZ surgery for pain of brachial plexus injury origin

M. Spaic, S. Petkovic, and N. Markovic
Belgrade, Serbia-Montenegro

Introduction. Patients with pain of brachial plexus avulsion injury origin are considered to be excellent candidates for the DREZ surgery. The DREZ operation aims at ablation of the second order dorsal horn neurons of deaferented cord segments shown to be involved in pain generating. There is a doubt regarding the efficacy of the DREZ surgery in treating the pain caused by the nonavulsion mechanism of brachial plexus injury.

Patients and methods. The long term result in treating chronic neuropathic pain using the DREZ lesioning with Sindou's Microsurgical DREZotomy (MDT) in the group of 10 patients (8 males and 2 females, aged 22–70 years, of mean age 46.6 years, follow up period 24–96 months, average 50.6 months) is reported. Six patients developed pain after traumatic avulsion, while 4 patients suffered gunshot supraclavicular injuries of the brachial plexus.

All the patients underwent Pain Interview, neuroradiological and electrophysiological evaluation.

Result. The patients with pain of brachial plexus avulsion origin respond favorably on MDT so that 4 (67%) of them reported complete while 2 (33%) reported satisfactory long term pain relief. In the group of patients with gunshot brachial plexus injuries neither patient experienced satisfactory either initial or the long term pain relief.

Discussion. Our results implied the different underlying neuropathic mechanism for the chronic pain caused by avulsion versus gunshot injury of the brachial plexus.

Conclusion. The Microsurgical DREZotomy proved to be a causative procedure in treating chronic pain of brachial plexus avulsion origin.

T2C13. Sulcal vessels in the dorsolateral sulcus of the spinal cord are an important landmark during microsurgical DREZotomy

T. Taira, T. Sasaki, T. Ochiai, S. Goto, and T. Hori
Tokyo, Japan

Microsurgical DREZotomy is effective to control intractable pain due to spinal root avulsion. One of possible complications of this surgery is postoperative motor weakness of the ipsilateral leg due to unintended injury to the pyramidal tract. Therefore intraoperative identification and preservation of the pyramidal tract are very important. This is usually done with electrophysiological approaches such as motor evoked potentials and direct stimulation of the cord.

In our series of 35 consecutive DREZotomy, we have observed that there are tiny vessels between the gliotic tissue in the dorsolateral sulcus of the cord and the pyramidal tract. After we started intentionally preserving these vessels, we have not experienced leg weakness. Histological investigation of the normal spinal cord also revealed that there are such tiny vessels on the medial wall of the pyramidal tract. As sulcal vessels are a good landmark to open the dorsal midline sulcus during surgery for intramedullary spinal tumors, the vessels located on the lateral wall of the dorsolateral sulcus are good landmark to avoid injury to the pyramidal tract during microsurgical DREZotomy.

We present detailed anatomy of the dorsolateral sulcus of the cord with special emphasis on the vessels and the pyramidal/spinocerebellar tracts, which facilitates microsurgical DREZotomy.

T2C14. Neurophysiological navigation in the trigeminal nerve (TN) for accuracy of RF-thermorhizotomy (Th-Rh) for trigeminal neuralgia: video demonstration

M. Sindou and H. Arishima
Lyon, France

Th-Rh of the TN is an effective and safe treatment of trigeminal neuralgia provided lesioning of the sensory fibers is performed precisely at the triangular plexus and selectively in the rootlets corresponding to the trigger zone. To control the accurate placement of the electrode tip, electrical stimulation testing prior to thermal lesioning is of prime importance. The use of a current of 5 Hz makes its possible not only to evoke paresthesias (as the 50 Hz stimulation proposed by Sweet in his original description of the technique does) but also to produce clinically observable motor twitches in the face (Radiofrequency generator, Radionics Inc., Burlington, Mass., USA). Topography of these phenomena depends upon the location of the electrode within and along the trigeminal system.

Direct masticatory responses (DMR) occur at low intensity (in the range of 0.1–0.3 V) when electrode tip reaches the Foramen Ovale. Similar twitches occur when tip is situated deeply, posterior to the porus of Meckel's cave (i.e., above the upper petrous ridge and posterior to the clivus on lateral X-ray). The latter situation is supposed to correspond to the superomedial border of the trigeminal root where the motor branch joins the sensory root. In between these two locations, when masticatory responses are obtained at low intensity, electrode is assumed to be too close to the motor branch.

Clinically observable facial evoked motor responses (EMR) – which are trigemino-facial reflexes- can be noticed either in the upper (orbicularis oculi); the middle (levator labii) and/or the lower part (orbicularis oris) of the face; this is indicative of electrode tip location in respectively V1, V2, V3 territory.

According to our two-thousand case experience the best location of the electrode is the one where the threshold for eliciting DMR is high and the threshold for evoking facial EMR in the area corresponding to the trigger zone is low.

DMR and facial EMR – which are obtainable even when the patient is given (light) general anesthesia – can be a helpful, objective, indicator of accurate location in the trigeminal root.

T2C15. Percutaneous trigeminal ganglion balloon compression for the treatment of secondary trigeminal neuralgia

C. Constantine and C. Elisabeth
Patras, Greece

Recently, several groups reported successful treatment of trigeminal autonomic cephalalgias (TAC), using deep brain

stimulation (DBS) of the posterior hypothalamus. There is no consensus about surgical options in patients with non classical trigeminal neuralgia (TN). We undertook a prospective analysis of our patients receiving percutaneous trigeminal ganglion balloon compression (PTGBC) over a four-year period. We decided to compare the results using this method in different types of trigeminal neuralgia, and we present our treatment algorithm.

This series includes 25 patients who underwent PTGBC for TN from December 2001 to December 2005. They were males and females, 9 and 16 respectively, the mean age of the patients was 62 years. The majority of the patients (1st group, $n = 18$) suffered from classical TN, whereas an other group of patients (2nd group, $n = 7$) suffered from other TN (4 patients with secondary TN due to multiple sclerosis (MS), 1 patient with secondary trigeminal neuralgia due to posterior fossa brain tumor), and 2 patients with trigeminal autonomic cephalalgia (TAC).

All patients, from both groups, experienced pain relief postoperatively with mild facial numbness over all branches of the trigeminal nerve, within 24 hours after the operation ($p = 0.532$). Early pain recurrence was observed in 1 patient (4%) from the second group, whereas late pain recurrence was reported in 2 patients (8%) from the first group. No significant difference was found in pain recurrence between the two groups ($p = 0.53$). Both patients with TAC are free of pain with a mean follow-up of 36 months.

There is no general consensus for neurosurgical treatment of medical refractory non classical TN. In our series, there were similar results of successful treatment using PTGBC for classical TN, secondary TN, and TAC. In our treatment algorithm we propose the use of PTGBC as initial neurosurgical treatment for patients with non classical TN, included secondary TN and TAC. It seems reasonable to try initially with a percutaneous method, keeping DBS as the last chance for refractory cases.

T2C16. Modification of event-related Beta synchronization induced by motor cortex electrical stimulation for control of neuropathic pain

N. Reyns, E. Houdayer, E. Labyt, J. L. Bourriez, P. Derambure, and S. Blond
Lille, France

Motor cortex electrical stimulation is a promising technique for the control of drug resistant neuropathic pain. Nevertheless its mechanisms remain unclear. The aim of this study was to investigate the modifications of event-related beta synchronization (beta ERS) induced by electrical stimulation of motor cortex (MCS) in patients presenting central or peripheric neuropathic pain. Four patients, compared to controls, were included: 2 with superior limb neuropathic pain, 2 with neuropathic facial pain. EEG was recorded from a 128 electrodes cap. Beta ERS (13–25 Hz) was computed with respect to the end of right and left self-paced finger extensions. Each patient was recorded before and after implantation of an extradural quadripolar electrode for MCS.

Patients with superior limb neuropathic pain presented a preoperative abnormal pattern of beta ERS. MCS restored a contrololateral beta ERS but had also ipsilateral effects. In case of facial neuropathic pain, MCS had less standardized effects.

Motor cortex stimulation was able to restore beta ERS patterns in cases of neuropathic pain. Recovery of beta ERS would have a somatotopic organization since beta ERS following finger movement was less restored in case of MCS for facial neuropathic pain.

T2C17. Spinal cord stimulation (SCS) in treatment of chronic pain syndromes

E. D. Isagulyan, V. A. Shabalov, and A. A. Tomskiy
Moscow, Russia

Objective. To evaluate the efficacy of chronic spinal cord stimulation for patients with neurogenic pain syndromes resistant to drug therapy.

Methods. 17 patients (10 male, 7 female) aged 19–75 years (mean age 47.5) with severe neurogenic pain syndromes underwent implantation for chronic epidural stimulation of the spinal cord by a standard technique for the period from 2000 to 2006: 8 patients (pts) had failed back surgery syndrome (FBSS), 6 – spinal cord injury, 1 – Lerish's syndrome, 1 – phantom-pain syndrome and 1 – CRPS I type. ''MATTRIX'' or ''ITRELL III'' systems were implanted. Pain syndrome intensity and its influence on the quality of life was assessed by VAS and verbal-color test.

75% decrease of pain syndrome was considered as absolute recover; 50–75% decrease of pain syndrome was considered as good recovery, 30–50% of pain decrease – as satisfactory. Other results were considered as unsatisfactory.

Results. In catamnesis (6 months – 5.5 years, average – 25 months) absolute recovery was marked in 5 patients, good recovery in 8 pts, 2 pts showed satisfactory results and in 2 cases results were considered as unsatisfactory.

Negative results were marked in patients with FBSS. In both cases the patients have been underwent more than 4 spinal surgeries and the pain anamnesis was more than a 5-year before the application of SCS.

Conclusion. Chronic spinal cord stimulation is an efficient method of control of severe pain syndromes. Repeated anatomic operations like meningoradiculolysis results in poor SCS prognosis. One shouldn't ignore SCS for patients with diagnosed chronic pain syndrome.

T2C18. Deep brain stimulation of the posterior hypothalamus for chronic cluster headaches

J. Vesper, A. May, G. Nikkhah, and C. Weiller
Freiburg, Germany

Primary chronic cluster headache (CCH) is a rare but severe pain syndrome. Positron emission tomography (PET) studies have shown that the posterior inferior hypothalamic grey matter is activated during cluster headache attacks as well as in short-lasting unilateral neuralgiform headache attacks with conjunctival injection and tearing (SUNCT). Because of these specific changes it became a target for deep brain stimulation (DBS). We considered first to propose criteria for selecting chronic cluster headache patients for hypothalamic deep brain stimulation (May, Vesper *et al.*, Schmerz, 2005). We enrolled two patients so far suffering from refractory chronic cluster headache in a pilot trial of DBS in the ipsilateral posterior hypothalamus using the stereotactic coordinates published previously (Franzini *et al.*, 2005). Preliminary results of two cases of suffering from right-sided primary CCH for 30 and 12 years are presented. Headaches were resistant to any pharmacological therapy or treatment was limited by major drug side effects.

Using a stereotactic approach a microelectrode (Inomed, Germany) was inserted in the right posterior hypothalamus. Recordings of single neurons and test stimulation were performed in order to provoke typical side effects like diplopia, panic attacks and vertigo. This was followed by implantation of the final macroelectrode (3389, Medtronic, USA). Electrodes were externalized.

During the next day of test stimulation both frequency and intensity of the attacks as well as adverse events were noted. Generators (Soletra, Medtronic) were than implanted under general anaesthesia. The procedures were well tolerated with no significant adverse events. By means of DBS (stimulation parameters: 2.0/2.5 V, 130 Hz, 90 μs) patients reported an immediate positive effect with decrease of pain attacks of 50–80%. Hypothalamic DBS is an effective and safe procedure to relieve medically refractory CCH and SUNCT. DBS of the ipsilateral inferior posterior hypothalamus is an experimental treatment option and will be offered to selected patients in a prospective trial.

T2C19. Deep brain stimulation of the subthalamic nucleus (STN–DBS) for Parkinson's disease

T. Ohira

Tokyo, Japan

Deep brain stimulation of the subthalamic nucleus (STN–DBS) for Parkinson's disease has been performed since 2000 in Keio University Hospital. We present our methods and results of STN–DBS for Parkinson disease.

Methods. STN–DBS system was implanted bilaterally in 40 cases of Parkinson's disease. A tentative target from the atlas was modified by direct and indirect visualization of STN by MRI and confirmed by intraoperative electrophysiological recording from semi-micro electrodes.

Results. 1) STN was successfully identified by the 1st track in 94% of the cases. In other cases, STN was identified by the 2nd track. The mean recording distance of the STN activity was 6 mm. The coordinates of the tentative target from the atlas were modified in 50% of the cases by visualization of STN by MRI. 2) Mean improvement of the motor UPDRS score after bilateral STN–DBS was 55%. It also improved on–off and DID due to the 50% (mean) reduction of the L-Dopa doses.

Conclusions. STN–DBS is very effective surgical treatment for the advanced Parkinson's diseases. Precise electrodes placement by MRI and electrophysiological monitoring is essential for good results.

Navigation – imaging

T3A1. Intraoperative MRI: Clinical experience and new developments using a low-field mobile system with local shielding

M. Levivier, D. Wikler, D. Baleriaux, O. De Witte, B. Pirotte, and J. Brotchi

Brussels, Belgium

Introduction. Intraoperative magnetic resonance images (iMRI) allows to reevaluate anatomical relationships during brain surgery.

Methods. Since October 2002, we use a low-field mobile system with local and mobile radiofrequency shielding in a regular operating room (originally 0.12 Tesla PoleStar N10, and since January 2004, 0.15 Tesla PoleStar N20, ODIN-Medtronic/SNT). Since June 2004, we prospectively integrated iMRI images within the navigation planning (Stealth, Medtronic/SNT), to evaluate and correct for brain shift during surgery.

Results. 186 procedures were performed using the system. There were 94 craniotomies (51%), 1 stereotactic biopsy, and 91 transphenoidal procedures (49%). A few patients were scheduled for operation with iMRI, but the system could not be used because of limitation with respect of lesion location and/or patient's anatomy. Among the 94 craniotomies, there were 52 primary CNS tumors (55%), 9 craniopharyngiomas, 9 meningiomas, 8 epilepsy surgeries, 4 metastases, and 12 other lesions (schwannomas, teratoma, cavernoma; chordoma, . . .). In this setting, the entire regular neurosurgical equipment could be used; only anesthesia monitoring was MR-compatible, because of wires with permanent connection to the patient. Integration of iMRI within neuronavigation, including preoperative PET data, allowed to adapt the surgical planning and procedure in selected cases. Image quality, influence on surgery, and limitations of the system will be also illustrated and discussed.

Conclusions. iMRI is a new step in the development of neuronavigation. The use a system with portable shielding in a standard room represents one more step towards the acceptance of iMRI in the neurosurgical community, especially when integrated in neuronavigation.

T3A2. Neuronavigation with fiber tracking of the optic tract

M. B. Glaser, P. Grunert, P. R. Dellani, K. J. Werhahn, P. Stoeter, and A. Perneczky

Mainz, Germany

Objective. Clinical relevancy of neuronavigation with fiber tracking of the optic tract during neurosurgical procedures.

Method. The optic tract was visualized via diffusion tensor imaging (dti), imported in a magnetic resonance imaging-3-D-data-set and transferred in a conventional neuronavigation system (Vector Vision®, Brain LAB). Before surgery the approach was planned (i-plan®, Brain LAB). During surgery the optic tract could be depicted in relation to the extent of the tissue removal. So the visual fields of 7 patients with temporal lobe epilepsy (6 females and 1 male, age range 19–60 years), 1 patient with a ganglioglioma in the proximal optic radiation (female, 28 years) and 1 patient with a meningeoma of the trigonum of the left lateral ventricle (female, 51 years) before and after surgery were examined.

Results. In all cases the performance of the fiber tracking of the optic tract was possible and the import into the navigation system successful. After surgery in 3 of the 9 patients a new contralateral homonymous quadrantanopia (1 complete, 2 partial) was found. So far in the group of amygdalahippocampektomies only 1 patient had one seizure during follow up while suffering a diarrhoea.

Conclusion. Neuronavigation with the integration of the dti reconstructed optic pathways seem to indicate the correct site of this functional important tissue. Therefore it is helpful especially in planning an approach near the optic radiation to avoid postoperative visual deficits.

T3A3. Comparison of a neurosurgical robotic system (NRS) and optical tracking image guided system (OTIGS)

M. S. Eljamel

Dundee, UK

Image guidance had gained its rightful place in modern neurosurgery. Most of these systems use skin based fiducials for registration and optical tracking for navigation. A newly designed neurosurgical robotic system, (Pathfinder-Armstrong, UK) was recently introduced and tested to compare its performance against the OTIGS used in the department. Both systems were tested under the same conditions using skin fiducials glued to the surface of a neurosurgical head Phantom and axinal thin slice CT scan protocol.

The registration accuracy of the OTIGS was 4.5 mm compared to 0.61 mm in the NRS.

The application accuracy of the OTIGS was 2 mm on the surface of the phantom compared to <1 mm in the NRS. Similarly the application accuracy of the OTIGS was 4 mm in depth targets compared to <1 mm in the NRS. In these Phantom studies the NRS outperformed the OTIGS and had provided submillimetric accuracy making the NRS as accurate as the stereotactic frame.

T3A4. Return of the phantom: image-guidance accuracy and the real world

C. R. Mascott and J.-C. Sol
Toulouse, France

Background. We recently reported quantitative studies of true in vivo (application) accuracy of image-guidance systems during craniotomy. When using implanted screw fiducials for registration, we found accuracies of 1.7 ± 0.7 mm.

Conversely, other registrations based on adhesive fiducials or surface matching paradigms resulted in accuracies in the 4.0 ± 1.7 mm range. This phantom study was designed to elucidate sources of registration error when using scalp-adhesive fiducials or surface-matching paradigms.

Methods. Nine radiologically identifiable targets were used to assess localization error in a cylindrical phantom using a Stealth Station. Adhesive fiducials were placed on the phantom surface before volumetric image-acquisition (CT and MRI).

Point-based registrations included use of 5 or 10 adhesive fiducials. We postulated that using the adhesive markers for registration in the phantom was akin to the use of skull fiducials in patients, since there is no scalp related movement. Thus, we also used multiple registrations where random or systematic 3 mm error of fiducial localization was introduced in order to simulate scalp-induced errors. Surface-matching paradigms using 45 or 100 points were also assessed.

Results. 5 and 10 point registration resulted in a target localization error of 1.5 ± 0.6 mm. Registration using 5 or 10 points with 3 mm systematic or random fiducial localization error resulted in target localization error of 2.7 ± 1.4 mm. 45 point and 100 point surface matching registrations yielded target localization error of 3.2 ± 2.1 mm.

Conclusions. We caution that accuracy reported in other phantom studies should be viewed as being predictive of surgical accuracy when using skull-implanted fiducial markers for registration.

T3A5. The utility of signal frequency plotting for the prediction of subthalamic nucleus location during deep brain stimulation surgery for Parkinson's disease

S. F. Danish, J. T. Moyer, G. H. Baltuch, J. L. Jaggi, and L. H. Finkel
Philadelphia, USA

Introduction. Classical neurophysiological localization techniques have relied on qualitative descriptions of regions along the microelectrode track. Many algorithms require spike discrimination, which can be subjective in nature. We investigate a quantitative algorithm to detect the location of the subthalamic nucleus.

Methods. Thirteen microelectrode tracks were analyzed in 10 patients undergoing STN deep brain stimulation for PD. The microelectrode signal was preamplified, filtered, digitized, and imported via SpikeII analysis software.

An event marker trace recorded spike occurrences, which were plotted using a 20 second time period at a 22 kHz rate. The entry and exit points of STN were predicted based on these plots. Each prediction was compared to STN entry and exit as denoted by the neurophysiologist. Voltage thresholding was varied as an increasing percentage of the noise voltage band.

Results. Entry point prediction of STN was within 0.25 mm of the neurophysiologist's reading in 12/13 patients (92.3%), and within 1.0 mm in all 13 patients. The exit point prediction of STN was within 0.25 mm in 9/13 (69%), and within 1.0 mm in 11/13 patients (84.6%). There was no change in entry or exit prediction when voltage thresholding was varied between 100 and 300 percent of the noise voltage band.

Conclusions. Signal intensity plotting provides a fast and reliable algorithm to predict the entry and exit of STN along the microelectrode track. This method provides accurate results independent of operative variables that make other quantitative analyses difficult. Intraoperative signal intensity plotting may be a useful complementary method for target localization.

T3A6. Intracerebral measurements during DBS-implantation using optical methods

K. Wårdell, P. Blomstedt, J. Antonsson, O. Eriksson, J. Richter, and M. Hariz
Linköping, Sweden

One possible way to increase the precision, accuracy and safety during stereotactic procedures could be intracerebral recording of optical signals. The aim of the study was to investigate if laser Doppler perfusion monitoring and diffuse reflection spectroscopy could be used in order to differentiate between gray and white matter as well as to identify vessels. Measurements were done with a thin electrode equipped with optical fibers along the shaft on ten patients undergoing DBS-implantation (ethically approved). Total light intensity (TLI) and microvascular perfusion (Periflux 5000) as well as reflection spectra (Avaspec) were captured during 60 sec, respectively.

Software for data acquisition and analysis was developed in Labview. Values were registered in the target and along the trajectory at 30, 20, 10, 5, 2.5 mm from the target. Recorded data were analyzed and compared to MR- and CT-images in order to relate the signal to tissue type. Pulsative perfusion that agreed with the heartbeat was identified at all measurements positions. In three sites the perfusion was more than eight times higher than in the surrounding sites, indicating blood vessels in the vicinity. Low TLI- and spectroscopy values could be related to gray tissue found in the MRI whereas higher values were often related to white tissue. In addition, an inverse relation between perfusion and TLI was in general found. The perfusion values were relatively higher in what was considered grayish matter. In conclusion, optical signals appear to differentiate between gray and white brain matter and to identify blood vessels.

T3A7. Quantification of true in vivo ("application") accuracy in frame-based stereotactic surgery

C. R. Mascott, P. Cheynes, J.-C. Sol, J. Sabatier, J.-A. Lotterie, I. Berry, and Y. Lazorthes
Toulouse, France

Background. The majority of studies to assess the accuracy of frame target localization have been in phantoms rather than patients. We have taken advantage of electrodes placed in the subthalamic nucleus to assess the accuracy of a commonly used stereotactic frame in patients.

Methods. The study involved the placement of 20 STN electrodes in 10 patients. A CRW-fn frame (Radionics), was used with volumetric MRI acquisition (1 mm cuts, MPRAGE, Siemens 1.0 T). Planning was performed with Radionics software. After placement of the depth electrodes, a volumetric CT (1 mm cut, Siemens Sensation) was obtained with the frame still in place. Image fusion was performed on an image-guidance workstation (ImMerge, StealthStation, Medronic Colorado). The intended position of each depth electrode was compared to the visualized position of the electrode tip in CT and the absolute location error was measured. The clinically relevant error regarding the distance of the electrode contacts to the designated target (STN) was also measured as the perpendicular from the target to the electrode.

Results. The absolute (Euclidian) localization error was 3.5 ± 0.9 mm with a maximal error of 4.6 mm. The clinically relevant error was 1.7 ± 1.0 mm with a maximal error of 3.7 mm.

Conclusions. The measured absolute error using a common frame based system and planning on optimized volumetric MRI acquisition was acceptable but less accurate than usual assumptions concerning stereotactic frames. Implications and possible sources of error are discussed.

Spasticity

Neurophysiology

T3B1. Spastic equinus foot: prospective study of clinical, electrophysiological and biomechanical parameters of the triceps surae before and after lidocaine soleus nerve motor block, and after selective tibial neurotomy

B. Kévin, R. Philippe, L. Daniel, P. Chantal, and D. Philippe
Poitiers, France

Spasticity is clinically determined by an unusual resistance to the passive mobilization of limb segment. This resistance to the passive stretching is the sum of two components: 1) the force generated by the muscular reflex contraction 2) the force generated by the viscoelastic properties of the muscle, in the lack of any muscular contraction.

This prospective study was designed to study the clinical, neurophysiological and biomechanical modifications at the level of the triceps surae generated by a central nervous system lesion, to characterize the action of the lidocaïne motor block and of the selective tibial neurotomy on these parameters.

20 patients with spastic equinus foot are included in this study. The clinical (Ashworth score, Physician rating scale), muscular biomechanical (ankle stiffness, inertia), and electrophysiological (H and T reflexes, stretch reflex) assessments are performed before and after soleus nerve motor block with lidocaine. The same assessments are performed after neurotomy.

Patients with spastic equinus foot present modifications of the viscoelastic properties of the triceps and modifications of the electrophysiologicals parameters. The selective tibial neurotomy modify the clinical, electrophysiological and mechanical parameters. The lidocaine block is predictive of the results of the surgery.

This study confirms the practical value of the selective superior soleus nerve motor block to assess the spastic equinus foot, and to predict the results of the selective tibial neurotomy. From the electrophysiological study, it can be concluded that lidocaine preferentially blocks type Ia proprioceptive fibres rather than motoneuron fibres, and modify the properties of the stretch receptors.

T3B2. Continuous infused baclofen in the treatment of spastic cerebral palsy: a prospective multicenter study

Y. Lazorthes, M. Sindou, S. Blond, R. Cavagna, B. Scherpereel, J. Godard, D. Orenstein, Ph. Paquis, S. Gangloff, R. Duthel, and B. Irthum
Multicenter-France

Objective. Assess the benefits of continuous intrathecal baclofen infusion (CIBI) in children with spastic cerebral palsy, on spasticity, as on motor and functional performance.

Material and methods. Twenty-four patients with severe diffuse spasticity were selected in 11 French centers, over a 2-year period, using rigourous criteria (age: 6–18 years, mean Ashworth score: 3 in the lower limbs, failure of oral baclofen treatment. A double blind screening was performed in all patients by the administration of successive intrathecal doses of baclofen (from 12.5 to 100 g. Following a successful trial, patients were considered for the implant (SynchroMed® system). Assessment over 2 years included spasticity scoring (Ashworth scale) of limbs, quantitative functional evaluation (gross motor function measure scale) and a qualitative questionnaire.

Results. Trial procedures resulted in a significant average drop in Ashworth scores in lower limbs from 3.7 to 1.8. Despite good clinical effects on spasticity, 5 patients were not implanted. 17 patients were followed for two years. Effects on lower limbs spasticity remained stable as was the case in upper limbs (respective average scores: 2.4 and 1.7) as the daily average dose was increased from 124 to 185 g between 6 and 24 months. Though average GMFM scores remained stable along the study, qualitative evaluations indicated that pain was reduced and ease of mobility and sleep were improved. Patients, families and medical staff expressed a high level of satisfaction.

Complications occurred in 10 patients, mostly in the first months, none leading to any pump explant.

Conclusions. The results of this study confirms the efficacy of CIBI in reducing severe spasticity in children with cerebral palsy and its clear benefits in patients care and comfort.

T3B3. Intrathecal Baclofen infusion in severe spasticity due to acquired brain injury

B. Cioni, R. Formisano, M. Meglio, L. D'Angelo, and L. Di Muro
Rome, Italy

We report our experience with intrathecal Baclofen (ITB) infusion in the treatment of severe spasticity due to acquired brain injury. The study included 10 patients. The etiology of hypertonia was a severe brain trauma in 8 cases and a cerebral focal anoxia following subarachnoid hemorrhage in 2 cases.

Other inclusion criteria were: age 15 years or older, spasticity resistant to other pharmacological and physical modalities, no allergy to Baclofen, signed informed consent. The mean time since the injury was 49 months, in 5 cases being less than 12 months. ITB was continuously infused via an implantable electronic pump. Mean follow-up was 45 months (mean 6, max 114 months). The clinical evaluation included: muscle tone utilizing the Ashworth scale, painful spasms, neurovegetative storms, as well as functional assessment, and adverse events.

The initial mean daily dose of ITB was 137.8 μg, and at maximum follow up it was 186.5 μg. Muscle hypertonia significantly decreased both at upper and lower extremities, painful spasms disappeared in 5 cases and were reduced in 1 (complained by 6 patients before treatment). Neurovegetative storms, present in 4 cases before

ITB, disappeared in 3 cases, while in the forth case were greatly reduced. A functional improvement was present in terms of caring, dressing, skin ulcers, wheelchairing, walking, sleeping. In the 4 cases of minimal consciousness, a more evident relationship with the environment was referred by the caring persons. Our experience confirms the clinical usefulness of ITB in spasticity due to acquired brain injury, particularly in cases of minimal consciousness.

T3B4. Sleep EEG recording from deep brain electrodes placed in the peduncolopontine nucleus area in Parkinson disease patients

G. D. Marca[1], A. Insola[2], D. Restuccia[1], L. Padua[3], P. Caliandro[3], and P. Mazzone[4]
Rome, Italy

Background. Single-cell recordings from the Pedunculopontine nucleus (PPT) of cats and rats have identified groups of cells whose firing rates correlate with both wakefulness and rapid-eye-movement (REM) sleep. In human pathology, PPT is thought to play a role in the parasomnia ''REM behavior disorder (RBD)''.

Objective. To study sleep EEG activity simultaneously from scalp electrodes and from chronic deep brain stimulating electrodes implanted within the PPT in patients treated with deep brain stimulation for Parkinson disease.

Patients. Two male patients, aged 68 and 66, affected by Parkinson diseases, who received implantation of deep brain stimulating electrodes of the PPT nucleus area. Patient gave their written informed consent to the study.

Methods. Polysomnographic recording were performed during hospitalization, in spontaneous nocturnal sleep, lasting from 11 pm to 6 am in the next morning. Montage included scalp EEG electrode (C4 and C3 referred to contralateral mastoid); EOG, sub mental muscles surface EMG, EKG, and 3 contacts within the deep PPT electrode. Sleep staging was performed visually according to the criteria of Rechtschaffen and Kales, EEG analysis was performed both visually and with spectral analysis (FFT and Morlet Wavelet).

Results. Surface recording showed that both patients had preserved architecture of scalp-recorded sleep EEG, including all NREM and REM stages, with recognizable v-waves, spindles, K-complexes and delta activity. One patient presented a clinically overt RBD, with consequent lack of EMG atonia during REM. PPT recording showed mixed-frequency, high amplitude activity, with a predominance of 1–2 Hz rhythms, persisting during all sleep stages and partially reduced during REM.

Discussion. PPT recording during sleep show mixed frequency activity, with prevalence of low-frequency rhythms during NREM; this suggests that PPT may play a major role in the modulation of NREM, as well as REM sleep. No ponto-genicolo-occiptal (PGO) waves were detected. The results must be evaluated bearing in mind that recordings were not collected from normal subjects, but from severe Parkinson patients, taking politherapies.

T3B5. Biochemical and electrophysiological changes of substantia nigra pars reticulate driven by subthalamic stimulation in Parkinson's disease patients

A. Stefani, S. Galati, E. Fedele, P. Stanzione, and P. Mazzone
Rome, Italy

To understand the events underlying the clinical efficacy of deep brain stimulation (DBS) of the subthalamic nucleus (STN), electrophysiological recordings and microdyalisis evaluation were carried out in Parkinson's disease (PD) patients from substantia nigra pars reticulata (SNr), one of the two basal ganglia (BG) nuclei targeted by STN output.

Clinically effective STN–DBS caused a significant increase of SNr firing rate. The post-stimulus histogram (PSTH) showed an excitation peak at 1.92–3.85 ms after STN stimulus. The spontaneous irregular discharge of SNr neurons changed into a grouped firing pattern during STN–DBS producing an oscillatory activity at individual neuron level around 130 Hz as showed in the autocorrelogram (AutoCrl). The Fast Fourier Transform (FFT) analysis showed a peak at 130 Hz and a second one at 260 Hz. Accordingly, in the interspike intervals (ISIs) distribution, the mode was earlier and skewness more asymmetric. Biochemically, the increased excitatory driving from STN was reflected by a clear-cut cyclic guanosine 3′,5′-monophosphate (cGMP) increase in SNr.

These results indicate that the beneficial effect of deep brain stimulation in PD patients is paralleled with a stimulus-synchronized activation of the STN target SNr. Our findings suggest that, during STN–DBS, a critical change towards a high-frequency oscillatory discharge occurs.

T3B6. Effect of deep brain stimulation in the internal pallidum, excitatory or inhibitory?

E. Pralong, D. Debatisse, C. Pollo, and J.-G. Villemure
Lausanne, Switzerland

Besides clinical efficacy, the mechanisms of action of deep brain stimulation (DBS) are still debated One drawback in understanding DBS effects is that two electrodes (one DBS electrode and one microrecording electrode) are seldom placed in the same structure. To shed light on this issue, we have taken the opportunity to record the response of globus pallidus externus (GPe) and internus (GPi) neurones to 100 Hz stimulations in a case of Lesch-Nyhan syndrome (LNS) where four pallidal electrodes were implanted.

The stimulating electrodes were positioned in the anterior portion of the GPi (+5.9 mm AP, 13.8 mm LAT, +0.7 mm VERT). Fifteen neurones were recorded before and after 100 Hz DBS stimulation at 6 mA and 0.1 ms duration on each posterior pallidum (+1.6 mm AP, 18.2 mm LAT, −0.5 mm VERT). Three types of response were observed, 5/15 neurones were inhibited during the 10 seconds epoch immediately after DBS stimulation. This effect was followed by a rebound increase in firing rate. Most of the inhibited neurones were located in the homolateral GPi. 6/15 neurones were unaffected by DBS and 4/15 neurones were stimulated immediately after DBS stimulation these neurones were observed in the GPe.

These observations support the fact that DBS exercises two complementary actions. Locally DBS induces a reversible inhibition of neurone firing rate while at the same time distantly exciting the main afferents to and/or efferents from the GPi. Both actions would result in a strong GPi inhibition that does not preclude increased outflow from the GPi.

Oral posters II

T3C1. Protection of nigral cell death by bilateral subthalamic nucleus stimulation

Y. Temel, V. Visser-Vandewalle, and H. W. M. Steinbusch
Maastricht, Netherlands

In Parkinson disease (PD), the subthalamic nucleus (STN) becomes hyperactive (disinhibited) which is reported to cause

excitotoxic damage to midbrain dopaminergic neurons. Here, we examined whether silencing of the hyperactive STN by chronic bilateral deep brain stimulation (DBS) increased the survival of midbrain dopaminergic neurons in a rat model of PD. High-precision design-based stereologic examination of the total number of neurons and tyrosine tydroxylase (TH) immunoreactive neurons in the substantia nigra pars compacta revealed that STN–DBS resulted in a significant survival of these neurons. These data provide the first evidence in vivo that bilateral STN–DBS is useful for protecting midbrain dopaminergic neurons from cell death in PD.

T3C2. Deep brain stimulation of the STN in Parkinson's disease

X.-P. Zhou, X.-W. Hu, X.-F. Jiang, and L.-X. Wang
Shanghai, China

Objective. The objective of the study presented here was to describe the technical approach and to assess the efficacy and safety of deep brain stimulation of the subthalamic nucleus and ventralis intermedius in Parkinson's disease (PD).

Methods. Eighty-six patients with medically intractable PD underwent surgical treatment of STN stimulators between January 2000 and December 2004 in Changhai hospital, Shanghai, Simultaneous unilateral implanting was performed in 40 cases, bilateral implanting was performed in 46 cases. All implants were the products of Medtronic., Inc. The target was identified by a combination of MRI neuroimaging and microelectrode recording. We compared scores on the motor portion of the unified Parkinson's disease rating scale (UPDRS) when the stimulation was turned on or off.

Results. All patients followed up range 6–36 months, mean followed up 11.3 months. Improvement of the UPDRS motor scores was 45.2 when the stimulation was turned on and 20.7 when the stimulation was turned off without any undesirable side effects.

Conclusion. Our finding showed that the stimulation of subthalamic nucleus results significant control of the motor symptoms of the patients. The subthalamic nucleus (STN) is a target in the surgical treatment of Parkinson's disease (PD). STN stimulation is the ability to reduce the dosage of dopaminergic medications.

T3C3. Levodopa induced dyskinesias and surgery in Parkinson disease. A review

J. Guridi, J. A. Obeso, M. C. Rodriguez-Oroz, and M. Manrique
Pamplona, Spain

Objetive. L-Dopa induced dyskinesias (LID) is one of the major complications of the chronic treatment in patients with Parkinson's disease (PD). LID arise from an abnormal pattern of neuronal activity from the basal ganglia to cortex through the globus pallidus and thalamus. Surgical procedure induce an antidyskinetic effect through different physiological mechanism and in parallel with the antiparkinsonian response in the same target.

Method/Results. This presentation is a review of the ablative and stimulation surgeries in PD in the thalamus, globus pallidus (GPi) and subthalamic nucleus (STN). The assessment of the studies shows different percentage of LID reduction mainly in the GPi and STN.

Conclusion. Pallidal surgery would reduce LID by a direct impact in the pallido-thalamic pathway indicating a disruption that would eliminate the dyskinesia. Antidyskinetic effect of the STN may be induced by the great impact of the surgery in this target, ablative or stimulation procedures, inducing an antifluctuant effect in the basal ganglia (direct antidyskinetic affect) and by dopaminergic reduction (indirect antidyskinetic affect).

T3C4. Deep brain stimulation in the globus pallidus to treat dystonia: symptoms improvement, neuronal recording and muscular activity in ten patients

C. Magariños-Ascone, I. Regidor, M. Gómez-Galán, L. Cabañes-Martínez, and R. Figueiras-Méndez
Madrid, Spain

Deep brain stimulation was applied in the globus pallidus to treat dystonia in ten patients. One year after surgery the Burke-Fahn-Marsden movement score was significantly lower than at preoperative values ($P<0.01$). At the second year after surgery the mean decrease reached 65% ($P<0.001$) with no motor symptoms worsening. Cells of the internal segment globus pallidus (GPi) discharged in a bursting mode with cyclic increments in the mean discharge of up to 300% but at lower rates than in parkinsonian patients. Neurones showed low threshold calcium spikes burst and spontaneous vigorous increments in the bursting activity. A synchronic activity was found between pairs of GPi neurones. Movement modulated the cells tested with most cell incrementing the firing rate. Passive manipulations revealed a distinct code for flexion and extension and complex responses for voluntary movements. Spectral analysis of the co-contracting antagonistic muscles during dystonia demonstrated frequency power shifts towards the low frequencies band in the more affected limb and increments in power between 50 and 600 Hz in the opposite muscle. The background EMG activity grossly diminished with stimulation in the surgery room and the power density incremented during voluntary contraction suggesting that electromyographic records may be a valuable complementary tool to discern the best appropriated region within the GPi.

T3C5. Complete alleviation of off-period dystonia in cases with Parkinson's disease after bilateral STN neurostimulation

A. Savas, C. Akbostanci, B. Elibol, and Y. Kanpolat
Ankara, Turkey

Text. Dystonia is one of the most disabling symptom in cases with Parkinson's disease. Although on-period dystonia is directly levodopa and dose related, little is known regarding the reasons of off-dystonia. In this study, we investigated the effect of bilateral STN neurostimulation in cases with Parkinson's disease suffering from motor fluctuations and on- and off-dystonia.

10 cases with Parkinson's disease with akinetic symptoms, motor fluctuations and on- and off- dystonia underwent bilateral subthalamic nucleus (STN) neurostimulation (20 targets) using CT/MRI image fusion technique.

Physiological confirmation of the targets was done using microelectrode recording. Postoperative MRI scan showed the correct placement of the electrodes in the STN. Postoperatively, the average UPDRS scores decreased from 36.4 to 25.1 in the on-period; and from 58.5 to 38.9 in the off-period.

Off-period dystonia was immediately and permanently alleviated in all cases. On the other hand, l-dopa doses and on-period dyskinesia were remarkably reduced from 13.3 to 4.6, when measured using UPDRS motor examination scorring. The results of bilateral STN neurostimulation suggest that the procedure is the most important treatment method and provides the best functional

improvement, especially in cases with dominantly akinetic and right symptoms. On the other hand, this procedure known to be effective in relieving tremor and dystonic symptoms. The decrease in on- dystonia may be partially or completely related to the reduction of dose of L-Dopa. However, alleviation of off-dystonia is directly related the therapeutic effect of STN neurostimulation; and it seems to be a sign of correct placement of the electrodes.

T3C6. Short term follow up results of GPi–DBS for dystonia

T. Ochiai, T. Taira, S. Goto, M. Hayashi, and T. Hori
Tokyo, Japan

Purpose. There are many reports that GPi-HFS for generalized and segmental dystonia is effective. We show our experience of GPi-HFS for dystonia.

Material and methods. Thirty-three (F:M = 9:24, mean age 43) generalized and segmental dystonia cases were treated with GPi–DBS. 31 cased were DYT1 negative and 2 cases were not examined.

Our protocol was that 4 electrodes (2 electrodes in one side) were inserted temporarily in postventral pallidum (PVP) and 3 mm anterior from PVP. After stimulation test in three weeks, optimal electrodes were selected.

Evaluation was performed with BFM scale in pre- and discharge (2 months) and >6 months follow up.

Results. Total BFM scale was improved in 60.35% (pre: 37.7 and discharge: 15.0). In last follow up (>6 months), BFM scales was 9.0, which was 77.13% improvement. Concerning with a duration, an effect is low in cases more than five years. Concerning with a sex, men is 53.4% improvement and women 44.3% improvement.

Conclusion. GPi–DBS was effective not only DYT1 but also non-DYT1 cases. Further improvement more than 15% was seen more than a half year. Men is more effective than women.

T3C7. The effect of deep brain stimulation in the treatment of oromandibular dystonia with cervical dystonia

K.-J. Lee and Y.-W. Kim
Seoul, Korea

Objective. Although bilateral globus pallidus internus (GPi) deep brain stimulation (DBS) has been demonstrated to be an effective treatment for primary generalized dystonia, the role of DBS in the treatment of refractory focal dystonia is less well established.

We report the results, subsequent course, and 6 months follow-up evaluation of a patient with oromandibular dystonia (OMD) were present in addition to cervical dystonia, who underwent bilateral GPi–DBS implantation.

Patient sample. A 60-year-old woman had a 2-year history of progressively severe, OMD with cervical dystonia that was refractory to medications.

On examination, she was found to exhibit constant jaw muscle spasms that shifted the mandible to extreme right or left lateral excursion, a ''chattering of the teeth'', cervical dystonia and altered speech due to mandibular dysfunction.

Her symptoms initially respond well to treatment with oral medication and botulinum toxin injection but a gradual loss of efficacy was noted. Bilateral deep brain-stimulating electrodes were inserted in the both posteroventral GPi using MRI-guided stereotaxy under local anesthesia. The patient was followed up for 6 months.

Result. The patient did experience a 50–60% reduction of symptoms during the 6 months of follow-up. She reported marked decrease chattering of teeth and occasional jaw spasm during times of stress.

Conclusion. We concluded that bilateral GPi–DBS may be an effective and safe treatment modality for oromandibular dystonia who obtain disappointing results from conventional treatment. Further studies and long-term follow-up are needed in a larger population of patients with focal dystonia.

T3C8. Motor cortex stimulation in severe Parkinson's disease

A. Landi, F. Vergani, N. Ronchini, R. Cilia, M. Parolin, E. Pirola, A. Antonini, and E. P. Sganzerla
Monza, Italy

Objective. To report the clinical results of chronic epidural motor cortex stimulation (MCS) in advanced Parkinson's disease (PD).

Patients and methods. Twelve patients affected from primary PD were operated on with MCS. Selection criteria were the same used for DBS, i.e. primary severe PD, residual response to L-Dopa, evidence of on-off periods and dyskinesias, lack of cognitive or psychiatric disorders; patients were excluded from DBS for the age (mean age 73.4 ± 2.1; disease duration 15.2 ± 3.0 years). Surgery was performed under general anesthesia; primary motor cortex of the dominant hemisphere was identified with high resolution CT scan, according to the anatomical landmarks; during surgery, a neuronavigation system allowed to place the electrode over the motor strip, epidurally. Intraoperative Somatosensory Evoked Potentials confirmed the positioning. Postoperative UPDRS was obtained at 3, 6 and 12 months in on-off stim conditions. Drug intake decrease was also considered. Statistic was carried on with ANOVA multiple tests (significant for $p < 0.5$).

Results. Eight patients with one year follow-up were considered. Mean preoperative UPDRS III was 52.2 drug off/32.2 drug on; after one year follow up UPDRS III was 45.2 stim on-drug-off and 30.0 stim-on/drug-on; dyskinesias decreased of about 30%; drug assumption decreased of 20%. Best motor results concerned axial symptoms. No surgical complications were experted.

Discussion. MCS seems to moderately improve motor performance and decrease dyskinesias in advanced PD; in addition, drug intake is reduced. Results are less striking that for DBS; moreover, MCS might be indicated in elder patients.

T3C9. Subthalamic nucleus stimulation in Parkinson's disease: anatomical and electrophysiological localization of active contacts

F. Godinho, S. Thobois, G. Polo, and P. Mertens
Lyon, France

Objectives. 1) To assess the anatomical localization of the active DBS contacts targeted to the subthalamic nucleus (STN) in Parkinson's disease patients; 2) to analyze the spatial distribution of the active contacts in relation to the dorsal and the ventral electrophysiologically-defined borders of the STN and the stereotactic theoretical target.

Methods. Twenty-eight patients underwent bilateral high-frequency stimulation of the STN (HFS–STN). An indirect anatomic method based on ventriculography coupled to electrophysiological techniques was used to localize the STN.

Clinical improvement was evaluated by the UPDRS III. The normalized stereotactic coordinates of the active contacts, dorsal

and ventral electrophysiologically-defined borders of the STN were obtained from intraoperative X-rays images. These coordinates were represented in a 3D stereotactic space and in the digitalized atlas of Morel.

Results. HFS–STN resulted in significant improvement of motor function (62.8%) in off-medication state and levodopa-equivalent dose reduction of 68.7% ($p < 0.05$). Most of the active contacts (78.6%) were situated close to (± 1.6 mm) the dorsal border of the STN (STN–DB), while 16% were dorsal and 5.4% were ventral to it. Similar distribution was observed in the atlas. The euclidean distance between the STN–DB distribution centre and the active contacts distribution centre was 0.31 mm, while the distance between the active contacts distribution centre and the stereotactic theoretical target was 2.15 mm.

Conclusion. In our series, most of the active electrodes were situated near the STN–DB. This suggests that HFS–STN could influence not only STN but also the dorsal adjacent structures (zona incerta and/or Fields of Forel).

T3C10. Unilateral pallidotomy vs unilateral electrical stimulation of GPi in bilateral symptoms of Parkinson disease at one year follow-up

F. Jimenez, A. Madrigal, F. Velasco, M. Velasco, A. L. Velasco, J. D. Carrillo, A. Cervantes, J. Soto, and G. Castro

Mexico City, Mexico

Objective. To compare the effects of unilateral pallidotomy vs. unilateral electrical stimulation of globus pallidus internus (GPi) on the bilateral symptoms of patients with Parkinson's disease at one year follow up.

Methods. Thirty patients with Parkinson's disease (Hoehn and Yahr stage 3 to 5 in off medication) were included. Patients were randomly divided into two groups. 15 patients were treated by radiofrequency pallidotomy (P). Other 15 patients in were treated by electrical stimulation (ES) of unilateral GPi. Both procedures were performed through stereotactic techniques (using a Zamorano-Dujovni stereotactic frame and Praezis Inc. fusion imaging) directed to the postero ventral area of the GPi. Transoperative macro-stimulation was performed in all patients, while micro-stimulation was also performed in the stimulation group. Postoperative MRI was performed in all patients. Clinical evaluations using unified Parkinson's disease rating scale (UPDRS) were performed before surgery and 1, 3, 6, 9 and 12 months after surgery in on and off conditions and in on and off stimulation conditions.

Conclusion. Both procedures improved contralateral and ipsilateral symptoms, even though there was major improvement with contralateral signs. Therefore, we conclude that unilateral pallidotomy and unilateral stimulation of GPi improves bilateral signs of Parkinson's disease at year of follow-up.

T3C11. Control of secondary dystonia with GPi deep brain stimulation with microelectrode recording

T.-K. Lee, S.-H. Yang, K.-S. Lee, S.-S. Jeun, Y.-K. Hong, M.-C. Kim, and C.-K. Park

Seoul, Korea

Introduction. Authors report an experience of Control of secondary dystonia with GPi deep brain stimulation with microelectrode recording.

Patient and method. A 37-year-old man had intracranial hemorrhage on Feb, 1997 and gradually developed a disabling involuntary movement involving left distal and proximal part of upper arm. Since June he developed titubation and then he could not walk. On neurologic examination, He had no limitation of extraocular movement without nystagmus, ataxia of the both arm and generalized mixed tremor were noted. He had no control of tremor and involuntary movement with medication as propranolol, primidon, clonazepam. His tremor and involuntary movement worsened and became untolerable. The authors performed stereotactic GPi–deep brain stimulation with MRI-guided and Microelectrode recording. Optimal location within a given target nucleus was found to depend on the patient's exact symptomatology. Medtronic 3387A electrode and Resume IIR implantable plus generator (IPG model 7424, Medtronic Inc., Minneapolis, USA) were implanted.

Result. With GPi stimulation, improvement of his postural and action tremors and involuntary movement were almost abolished in left proximal part of upper extremity. There was no seizure activity or stimulation-related complication.

Conclusion. Authors consider that GPi deep brain stimulation could be an effective means of controlling involuntary movement involving proximal upper limb.

T3C12. Bifocal pallidal and subthalamic deep brain stimulation in sporadic dystonia-parkinsonism

H. H. Capelle, C. Blahak, H. Baezner, W. Fogel, J. C. Woehrle, and J. K. Krauss

Hannover, Germany

Objective. We report the results of chronic deep brain stimulation in a patient with sporadic dystonia-parkinsonism, using a multifocal approach and eventually stimulating the subthalamic nucleus (STN) and posteroventral lateral globus pallidus internus (GPi), bilaterally.

Background. Rapid onset dystonia parkinsonism (RDP) is characterized by development of axial and appendicular dystonia within hours to few weeks accompanied by rigidity, postural disturbance and bradykinesia. Thus far, there have been no positive reports on deep brain stimulation in this rare movement disorder.

Methods. We report a 39 year-old man with sporadic RDP, who underwent multifocal GPi and STN–DBS for treatment of his movement disorder. Since stimulation of the STN resulted in improvement of the parkinsonian symptoms and also dystonia was ameliorated the patient optioned for chronic subthalamic DBS, and the STN electrodes were connected to an IPG.

Results. Within 2 months after the operation severe dystonia recurred and another IPG for pallidal stimulation was added. With this bifocal approach of bilateral STN and GPi–DBS, tremor, rigidity, bradykinesia and dystonia were well controlled with a follow-up of 11 months.

Conclusion. The marked clinical improvement of dystonia when adding GPi–DBS to STN–DBS in RDP supports the concept of amelioration of abnormal involuntary movements in PD patients with STN–DBS by adding GPi–DBS. In contrast to PD, in RPD with the presence of marked dystonia early on, this approach may even be first choice.

T3C13. Bonding problems in dual channel pulse generators

F. Alesch, J. Buchroithner, J. Wernisch, and H. Lanmüller

Vienna, Austria

Deep brain stimulation is a highly effective modality in the treatment of advanced Parkinson's disease. It allows a significant

reduction of dopaminergic drugs. Nevertheless DBS is not curative; switching off the stimulation brings the patient back to the pre-surgical status. Depending on the patient's status this can be dramatic, resulting even in an emergency. From 11/03 to 05/06 we observed a total of 12 cases with failure of a dual channel pulse generators (KINETRA) implanted for chronic stimulation of the subthalamic nucleus in patients with Parkinson's disease. In all cases a sudden and severe deterioration of the patient's neurological condition occurred with re-apparition of disabling symptoms. Destructive analysis of the generators revealed an interruption of the electric connection between the battery and the hybrid (electronic) part of the device by broken or lifted bond wires. Interruption of electrical power reboots the device and brings it back to factory settings with the output switched off, the buffered serial number lost.

Bonding quality and/or design issues are potential reasons for these failures. As a cause we suppose relative movements between the hybrid and the battery leading to low cycle fatigue fractures due to insufficient stiffness of the device. The efficacy of the therapy resumed immediately after device exchange.

As a corrective measure the manufacturer has meanwhile added epoxy between both components to increase the stiffness of the device.

Patients with KINETRAs from earlier manufacturing series should be aware about this potential problem of their implant.

T3C14. Evaluation of C2 root ganglionectomy in the management of cervicogenic headache

E. Emara, A. Imam, and M. Elsayed
Jeddah, Saudi Arabia

This is a preliminary retrospect study in the management of 275 patients presented with cervicogenic occipital headache. All have been subjected to medical treatment and physiotherapy There was no satisfactory response in 137 patients who were offered C2 root nerve block with immediate pain relief. The pain relief was variable with mild to moderate pain recurrence in 67 patients who had good pain relief with the previous conservative treatment but it was severe and not effective in the remaining 70 patients who were subjected to radiofrequency thermocoagulation. The pain was recurrent in 11 cases 15.71%.

These 11 patients were offered again the conservative line of treatment with fair pain relief control. Percutaneous radiofrequncy thermocoagulation was a very effective easy safe way to control the cervicogenic headache.

Movement disorders II

F1A1. Subthalamic nucleus stimulation: one year follow-up in a large, single centre cohort of Parkinsonian patients

S. Blond, M. Tyr, G. Touzet, N. Reyns, F. Cassim, D. Devos, P. Krystkowiak, L. Defebvre, and A. Destée
Lille, France

The aim of this study is to evaluate the clinical outcome of subthalamic nucleus–deep brain stimulation (STN–DBS) at 12 months in a series of 100 consecutive parkinsonian patients treated in Lille and then to discuss the presurgical clinical characteristics according to these results.

Hundred and three patients with severe Parkinson's disease have been treated by bilateral STN–DBS in our department from May 1998 to March 2003. The clinical assessment was based on the UPDRS part II, III and IVB, the Schwab and England and cognitive evaluation. The UPDRS III score decreased by 43%, the UPDRS II score fell by 34% and the severity of dyskinesia-related disability decreased by 61%. The mean levodopa dose (or levodopa – equivalent dose) decreased by $41.3\% + 37$ from $1222 + 456$ mg at baseline to $721 + 445$ mg at one year. The Mattis Scale score was stable in 94% of the patients were scored more than 130 before surgery. Evaluation of effects of STN–DBS on mood was also performed and correlated to the past history of the patients and the management of dopaminergic treatment.

The main surgical complications following this treatment were: infection ($n = 7$); intracerebral hematoma ($n = 5$) electrode fracture ($n = 3$). Incorrect lead placement was noted in 8 patients.

The efficacy and safety of STN–DBS seen to be generally stimular to these reported by other group: the occurrence of adverse effects cannot be predicted with certainty. Many factors must be evaluated: an excellent dopasensibillity but also the disease's progression profile, the neuropsychological fragility and the quality of the patient's home case environment.

F1A2. Long term outcome in 50 consecutive advanced PD patients treated with STN–DBS

Ch. Wider, J. G. Villemure, C. Pollo, J. Bogousslavsky, P. Burkhard, and F. Vingerhoets
Lausanne, Switzerland

Objective. To describe the long-term follow-up of 50 consecutive PD patients treated with STN–DBS.

Background. Little is known about long-term outcome in advanced PD patients treated with STN–DBS, since few studies have been performed on complete cohort of consecutive patients.

Methods. We prospectively studied a cohort of 50 consecutive patients who underwent bilateral STN–DBS more than 4 years ago. Evaluations took place at baseline, 6 months, 2 and 4–5 years in "on" and "off" conditions, with UPDRS and neuropsychological examinations.

Results. Three patients were lost to follow-up, but are reportedly alive. Seventeen patients died, but none within the first 6 months: 3 suicides, 1 myocardial infarct, 7 infections (sepsis, pneumonia), 2 pulmonary embolisms, 1 cancer, 1 anaphylaxis, and 2 unknown.

From 34 patients who reached 4–5 years follow-up (4 died thereafter), 21 were evaluated in "med off/stim on" conditions. Compared to preoperative "med off" values, they had a 29.56% reduction of UPDRS III ($33.24 + 12.85$; $47.19 + 12.56$, $p < 0.05$). For the whole 34 patients cohort, "treatment on" scores worsened (30.44 ± 11.40; 24.91 ± 8.75, $p < 0.05$), whereas dyskinesia and fluctuations remained dramatically improved (>80% reduction, $p < 0.001$). Levodopa-equivalent was reduced by 60%, 11 patients requiring no medication. Mean voltage increased (3.07 ± 1.55; 2.45 ± 0.47, $p < 0.05$). Long-term adverse events comprised 1 delayed infection of implanted material, 16 osteoarticular complications, and 11 dementias.

Conclusions. This study shows that STN–DBS remains highly beneficial after 4 years, mostly on parkinsonism, motor fluctuations and medication need. It also underlines that STN–DBS does not prevent and may favour the occurrence of age or disease related impairments. Further studies are needed to establish whether STN–DBS influences mortality in PD.

F1A3. Placement of the most efficient contact in patients implanted with STN–DBS in Parkinson's disease

J. Guridi, M. C. Rodriguez-Oroz, M. Alegre, M. Manrique, and J. A. Obeso
Pamplona, Spain

Objective. There is a recent controversy whether the most effective contact in DBS–STN in patients with Parkinson's disease (PD) is located dorsally to the STN, in the zona incerta or in the STN. The objective of this study is to delimitate the position of the most effective contact for chronic stimulation based in physiological parameters.

Methods. We have studied the placement of the contact evaluating the maximal antiparkinsonian efficacy in patients with PD and treated with STN–DBS by recording the local field potential (LFP) through the four contacts once the electrode had been implanted. Oscillatory activity in the STN in rest condition and the evaluation of the energy changes during a four second period around self induced movement were studied by means of time-frequency transforms. Analysis was focused on beta frequency band for the ''off'' condition and on gamma frequency band for ''on'' condition. It was considered to be inside the STN those contacts through neuronal (oscillatory) activity recorded. The biggest changes in the recorded activity in relation to movement could correspond with the most effective clinical contact.

Results. Eight patients with PD and 15 STN were studied. In any case, the recording electrode used for chronic stim showed an oscillatory activity in beta and gamma band frequency respectively in ''off'' and ''on'' state indicating the placement in the STN. In 8 cases the contact chosen for chronic stim coincided with the contact showing the biggest energy changes in relation to movement and in 5 cases adjacet to it.

Conclusion. The study reveals that the most effective contact used in DBS–STN in PD is, most of the times, within the borders of the nucleus. Dorsal region is the area where the STN stim conveys a higher antiparkinsonian benefit in most of cases.

F1A4. Evaluation of the spatial distribution of activated electrode contacts and their correlation to anatomical structures in deep brain stimulation of the subthalamic nucleus for treatment of advanced Parkinson disease

W. Eisner, F. Sohm, E. Wolf, J. Müller, R. Bauer, and T. Fiegele
Innsbruck, Austria

Introduction. Deep brain stimulation is an accepted and safe surgical treatment for many movement disorders, especially for advanced parkinson disease (PD). The positions of the active electrode contacts for internal pallidal stimulation and thalamic stimulation are situated within the target nucleus (1). The stimulation of the subthalamic nucleus seems to be effective in and above the target.

Material and methods. Intraoperatively we define the best electrode placement by using 5-channel microrecording und semimacro stimulation and by clinical observation of the stimulation effects and side effects. Decisive are the clinical effects on rigidity, bradykinesia, tremor the occurrence of diskinesias and the absence of side effects. The second lowest electrode contact of the quadripolar Medtronic electrode 3389 is placed there. The postoperative programming of the stimulator is done by neurologists, unaware of the spatial position of the electrode contacts in respect to anatomical structures, solely guided by clinical effects. Documentation was performed with the UPDRS motor score. Postoperatively we analized the spatial distribution of the selected active electrode contacts in a series of 72 implanted electrodes by using postoperative stereotactic helical computed tomography projected in the preoperative imaging and the Talairach space.

Results. The average measurements of the chosen electrode contacts in respect to the AC–PC line showed a laterality of 12.5 mm, 2.2 mm under AC–PC line and 0.3 mm behind the midcommissural point.

Conclusion. Our findings show clearly that the clinical most effective electrode contacts are projected in the superior third of the subthalamic nucleus but also in adjacent (superior located) anatomical structures, namely lenticular fascicle and zona incerta.

F1A5. Three-dimensional spatial distribution of the stimulating electrodes in human subthalamic nucleus (STN) in advance Parkinson disease (PD): study of the optimal contact localization and stimulation-related side effects

N. Torres, C. Chen, S. Chabardes, P. Krack, V. Fraix, P. Pollak, and A.-L. Benabid
Grenoble, France

Text. This study evaluates the optimal and stable site for STN stimulation in PD and the sites producing side effects, in 202 bilaterally implanted STN patients (404 electrodes). The coordinates of the electrodes were expressed using ventriculographic landmarks. Each contact was tested and stimulation parameters, numbers of changes in active contact, estimated battery drain, were registered at 3, 6 months and then yearly. Contacts not changed during at least 1 year were defined as 'stable contacts' (SC). At 3 months, side effects at low threshold (<2 volt) of each contact were clinically defined and compared with SC.

The stable group (SC), (103 patients: 77 right and 76 left electrodes), and the unstable group, (54 patients: 40 right and 41 left electrodes), had statistically different vertical coordinates ($p < 0.01$), SC being more dorsal. Battery drain was statistically lower in the stable group than in the unstable one. UPDRS scales were similar. Side effects recognized at <2 volts were: limbs contraction, dyskinesia, paresthesia, eye deviation. The distribution of contacts related to dyskinesias and binocular eye deviation along verticality (z) were significantly different from SC, but not in laterality (x) or in antero-posterior axes (y). The contacts related to paresthesia and contraction were significantly different from SC along the three axes.

The optimal location of the active contact determines not only the immediate benefits of stimulation, but also their stability along time. Side effects relate to the location of the electrode in the surrounding structures.

F1A6. Is STN–DBS as effective when procedure is done under general anesthesia? A prospective study of 110 patients

J. Regis, T. Witjas, J. P. Azulay, M. Sethian, C. Chabot, M. Tamura, and J. C. Péragut
Marseille, France

Objective. To assess the long term effect of bilateral chronic subthalamic nucleus (STN) stimulation after a general anesthesia (GA)

procedure. A precise localization of electrodes is requires to obtain the best clinical improvement with STN stimulation. Optimized choice of the final electrodes localization is based on a rigorous protocol defined by Limousin *et al.* (1995): anatomical targeting, electrophysiological recording and clinical testing with stimulation. This evaluation need that patients remained awakened and cooperative despite important stress and fatigue during the operation.

Alternative procedures which may be more comfortable have not been evaluated.

Design/methods. We evaluate consecutive 110 consecutive patients (77 men, mean age: 61 ± 7 years, mean evolution duration: 13 ± 4.2 years, mean Hoehn and Yahr score: 3.4 ± 0.9, Schwab and England score 54.7 ± 18.7, Mattis Dementia Rating Scale (MDRS) score: 136 ± 6.2) treated by bilateral chronic STN stimulation. Assessments were performed before and every years from 1 to 5 years after surgery. Stereotaxic MRI and electrodes implantation were performed under a single light GA (sevoflurane + alfentanyl) which allowed us to record the typical STN signal in all patients (5 microelectrodes on each side). Under this procedure detection of capsular side effects induced by stimulation was possible. Evaluation of UPDRS, Beck Depression Inventory, MDRS), PDQ 39 and psychiatric follow-up was done pre and postoperatively.

Results. Five serious postoperative adverse events occurred: one transient delirium, one general infection requiring temporary removal, on pulmonary embolism and two electrodes repositioning. The motor disability was improved by 61% (mean motor score while OFF medication before surgery (35 ± 14.5) compared to the last evaluation performed to the 12-month evaluation performed after surgery while OFF medication-ON stimulation (14 ± 8.8).

Activity of daily living (UPDRS II) improved by 45% in OFF condition. The dose of dopaminergic treatment was reduced by 63% MDRS score remained unchanged in 102 patients. The main behavioural change observed in near 30% of patients was a reduction of spontaneous activity (apathy) despite dramatic motor improvement. New cases off depression were not found, 1 suicidal attempt was noted, 2 transient hypomania resolved spontaneously.

Conclusion. Comparison of these results to the main previous studies which used local anesthesia show no significant difference. The preoperative microelectrode recording and detection of the most severe side effects induced by capsular stimulation are still rehable but are conditioned to a specific GA procedure. Immediate postoperative follow-up was simple. The efficacy of STN stimulation is not modified by GA which give more comfort to the patient. Nevertheless, the procedure still requires a very rigorous technique at each step: carefully selected patients, high quality anatomical targeting, multiple recording.

F1A7. Parkinson's disease progresses in patients treated by STN–DBS

F. J. G. Vingerhoets, H. Russmann, Ch. Wider, B. Robert, C. Lee, P. R. Burkhard, and J. G. Villemure
Lausanne, Switzerland

Text. Objective: Subthalamic (STN) deep brain stimulation (DBS) for advanced Parkinson's disease (PD) with motor fluctuations has been suggested to alter PD progression.

Aim. To study the longterm clinical evolution of PD patients "Off medication and Off STN–DBS" in order to estimate PD progression.

Methods. Thirty PD patients (age: 65 ± 8 y; disease duration: 14 ± 4 y) treated by STN–DBS were assessed in practically off medication by UPDRSIII before implantation and three hours after turning STN–DBS off: 0.9 ± 0.5 y after implantation and 2.6 ± 1.3 y thereafter. Results were compared to those of 50 medically treated patients (64 ± 8 y; duration 8 ± 4 y) assessed twice 5.0 ± 1.5 y apart.

Results. Compared to preoperative assessments, UPDRS III at first follow-up worsened to 56.7 ± 14.2 ($p < 0.01$). It worsened further at last assessment to 60.3 ± 12.7 ($p < 0.01$).

Worsening was observed for bradykinesia (24.4 ± 4.9; 31.7 ± 6.4; 34.6 ± 5.2; $p < 0.01$), rigidity (8.4 ± 2.9; 10.7 ± 4.6; 12.2 ± 4.4; $p < 0.01$) and axial subscales (7.0 ± 3.2; 8.1 ± 4.4; 9.4 ± 4.9; $p < 0.05$); tremor remained unchanged (5.1 ± 4.6; 6.1 ± 5.0; 4.1 ± 3.5; $p = 0.15$). At the same time points on stimulation UPDRS III (23.1 ± 8.2; 25.6 ± 12.9; 30.7 ± 15.3) as all subscales were improved compared to preoperative Off mediication results ($p < 0.01$). Levodopa equivalent dosages increased between follow-up ($190 \pm 260\,\mathrm{mg/d}$; $360 \pm 420\,\mathrm{mg/d}$; $p < 0.01$) remaining inferior to preoperative dosages ($1200 \pm 570\,\mathrm{mg/d}$, $p < 0.001$). Postoperative rates of progression for bradykinesia (0.6 ± 1.6/y), rigidity (0.5 ± 1.4/y), and axial signs (0.5 ± 1.4/y) were similar to those observed in medically treated patients (0.4 ± 1.0/y: $p > 0.5$; 0.5 ± 0.8/y: $p > 0.7$; 0.9 ± 1.0/y: $p > 0.2$), but tremor evolved differently (-0.4 ± 0.9; 0.1 ± 0.5: $p < 0.001$).

Conclusions. UPDRS III off medication and off STN–DBS worsened over 3 years, mainly in relation with bradykinesia, rigidity and axial signs: all reflecting disease's progression. Estimate rates of progression were similar to those observed in medically treated PD except for tremor which improved in STN–DBS patients. These results suggest that a) Parkinson's disease's progression is not significantly affectedby STN–DBS, b) a long term effect of STN–DBS on tremor seems to build up over time.

Pain II

F1B1. Demonstration of activation and somatotopy in the human sensory nociceptive trigeminal system using 3 T based fMRI

C. Hayhurst, S. Basu, P. R. Eldridge, T. R. K. Varma, T. Nurmikko, A. Zaman, and N. Roberts
Liverpool, UK

Objective. The anatomical substrate of the neuronal network involved in pain perception is described as the pain matrix and reorganisation of the matrix is known to occur in neuropathic pain states. The objective is to demonstrate somatotopy and reorganisation of the pain matrix with fMRI in volunteers and in patients with neuropathic pain.

Materials and methods. Eleven healthy volunteers underwent fMRI on a 1.5 Tesla platform and data analysed at group level has demonstrated the pain matrix and somatotopy. The experiment has now been transferred to a 3 T scanner to demonstrate this at an individual basis. Ten volunteers and five patients with facial pain including trigeminal neuralgia have been scanned and data analysed.

Results. In volunteers at 1.5 T group analysis has demonstrated somatotopically organised activations in the brain stem, ventroposterior thalamus and sensory neocortical areas. At 3 T not only are the findings replicated but are proven to be demonstrable on an individual rather than group analysis. The imaging is shown to be practical in individual patients and early analysis of somatopy presented.

Conclusion. 3 T fMRI can demonstrate somatotopically organised components of the trigeminal sensory system at an individual basis. The translation of 1.5 T based group result to 3 T based individual analysis in volunteers and patients proves the robustness of the methodology for further application to investigate reorganisation of somatotopy in neuropathic pain states.

F1B2. Microvascular decompression (MVD) for trigeminal neuralgia (TN)

M. Sindou and J. Leston
Lyon, France

Few publications report on large series of primary trigeminal neuralgia (pTN) treated with microvascular decompression (MVD), long-term followed, and studied using Kaplan–Meier (K–M) analysis; not all of the patients had decompression of the root from compressive vessel without additional cut or coagulation of adjacent root fibers. Therefore the authors report such a study in a series of 362 consecutive patients having a clearcut vascular compression and treated with ''pure'' MVD.

At one year of FU, success rate (= pt totally pain-free – not only of paroxysmal pain but also of permanent background – and without any medication) amounted at 81.2%, pts with still a background of pain but without the need of medications at 3.6%, and failures at 15.2%; at latest FU (8 y on average) at 80, 4.9 and 15.1%, respectively. K–M analysis estimates probability of total cure at 15 years at 73.38%.

Prognostic factors on outcome were studied, using univariate analysis at one year of FU and K–M survival analysis at 15 years of FU.

- There was no influence of: gender and age (at the very most a slight tendency to lesser efficacy in younger females), past-history of systemic hypertension, side of the neuralgia, type and site of the compressive vessel.
- There was no difference in cure rate between ≪typical≫ TN (i.e., with paroxysmal pain only; 65.5% of the population) and ≪atypical≫ TN (i.e., with the association of a permanent background of pain: 34.5%) [$p = 0.98$].
- There was no pejorative influence of the duration of symptoms before surgery [$p = 0.66$] and of previous (failed) surgery [$p = 0.54$].
- Outcome was slightly less favourable when V3 was involved and several divisions affected [$p = 0.001$]: V1 = 100% of success, V1 + V2 = 95%, V2 = 83%, V3 = 83%, V2 + V3 = 82%, V1 + V2 + V3 = 62.1%.
- The more severe the vascular compression, the better the result [$p = 0.003$]. There was a slightly less favourable outcome in patient with arachnoiditis around the root [$p = 0.003$].
- Long-term result was less favourable when the prosthesis to maintain the vessel a part was in direct contact with the root [$p = 0.01$].

Consideration of these findings should help to better define indications of MVD in relation of the other therapeutic alternatives.

F1B3. Clinical and radiological findings in patients experiencing immediate pain relief after stereotactic radiosurgery (SRS) for trigeminal neuralgia

A. A. F. De Salles, A. Gorgulho, N. V. Bezrukiy, J. King, S. Zhang, M. Selch, J. De Marco, N. Agazaryan
Los Angeles, USA

Introduction. The purpose was to evaluate pain relief, numbness and radiological changes in patients experiencing immediate pain relief (within 48 hours) after stereotactic radiosurgery (SRS) for trigeminal neuralgia (TN).

Materials and methods. From January 1996 to October 2004, 135 patients received SRS for TN at UCLA. Hundred twenty-four patients had comprehensive follow-up. Immediate pain relief was observed in 23(19%) patients. Mean age was 63.45 years (44–79 years), 7(30%) underwent prior procedures, 13(57%) were female. Twenty (87%) patients had Essential TN (ETN), 2(9%) Secondary TN and 1(4%) had Atypical TN. Twenty-two (92%) patients received 90 Gy while 2 received 70 Gy. A 5 mm collimator was used in 23(96%) cases, 7.5 mm in 1(4%). Numbness was evaluated using a 1–5 grading scale. Follow-up MRI scans were obtained during 2 years post-SRS.

Results. Excellent/Good pain relief was achieved in 20(87%) patients. Recurrence occurred in 7(29%) patients after mean 12.42 months. Two underwent repeated SRS and had excellent pain outcome. Nineteen (79%) patients remained pain-free at mean follow-up of 25.1 months (0.8–93.8 mo). Some degree of numbness was observed in 13(57%) patients. Among those who graded numbness, 30% reported severe numbness. There was no correlation between pain relief and numbness ($p = 0.602$) nor between numbness and prior procedure ($p = 0.313$). No anesthesia dolorosa/weakness was noticed. Sixteen patients had follow-up MRI and 11(68.75%) presented pons and/or nerve enhancement.

Conclusions. Patients with immediate pain relief remained so in long-term follow-up and experienced significant incidence of numbness as well as pons/nerve enhancement on post-operative MRIs. Recurrence rate approached previously described. Numbness or prior treatment did not correlate with pain control.

F1B4. Clinical response to Cyberknife radiosurgery in trigeminal neuralgia patients with and without neurovascular compression on MRI

T.-K. Lee, M.-C. Kim, B.-O. Choi, I.-B. Choi, Y.-N. Kang, and J.-S. Jang
Seoul, Korea

Instruction. The purpose of our study was to evaluate whether the presence of neurovascular contact (NVC) at the root entry zone of the trigeminal nerve on the fusion images between constructive interference in steady state three-dimensional magnetic resonance imaging and three-dimensional time of fly magnetic resonsnce angiography of offending vessels in patients with trigeminal neuralgia effect on response to CKRS.

Methods. The constructive interference in steady state three-dimensional magnetic resonance imaging (CISS 3-D MRI) and the three dimensional-time of fly-magnetic resonsnce angiography (3D-TOF MRA) were performed in 30 consecutive patients with trigeminal neuralgia patient with CKRS. Both CISS 3-D MRI and 3D-TOF MRA were transferred to a workstation with image fusion software installed (SC&J Company Window 3.1 workstation with Coreplan, Seoul, Korea). The coregistration of the two sets of images (CISS 3-D MRI and 3D-TOF MRA) was done by finding an optimal rigid transformation (i.e., rotation, translation, and scaling factor) between them. This fusion methods showed the relationship between the fifth cranial nerve root and offending artery causing neurovascular compression in 21 of 30 patients with trigeminal neuralgia since March, 2004.

Results. The early results of 21 patients with neurovascular comression and 9 patients without neurovascular comression undergone Cyberknife radiosurgery for TN showed that pain relief was achieved in 28 patients within the first 7 days after the treatment. The average dose delivered at the 80% isodose line was 62.4 Gy. All of nine patients releved pain within 7 days after the treatment in group without neurovascular comression. All of these patients are now pain free and medication free after a 12-month follow-up period. Nineteen patients reported onset of pain relief within 7 days in 21 patients with neurovascular comression undergoing

Cyberknife radiosurgery for TN. Two patients were controlled with medical management and became improvement of pain. There was no mortality or morbidity for initial Cyberknife.

Conclusion. These results indicate that cyberknife radiosurgery effective means of pain control for idiopathic trigeminal neuralgiais with or without neurovascular compression. Cyberknife radiosurgery in management of trigeminal neuralgiais can relieve early pain in patients with trigeminal neuralgia.

F1B5. Incidence of trigeminal nerve dysfunction after trigeminal neuralgia radiosurgery: a comparison between 3 treatment strategies

N. Massager, N. Tamura, J. Regis, and M. Levivier
Brussels, Belgium

Objective. To analyze the incidence of facial numbness or dysesthesias following gamma knife radiosurgery (GKR) for trigeminal neuralgia (TN), when 3 different strategies of planning are used.

Methods. We reviewed the patients treated for TN with GKR in Marseilles and Brussels. In both centers, the plexus triangularis target was used. For patients with a large perimesencephalic cistern, a maximum dose of 90 Gy wasused (group 1, both centers). For patients with a small cistern, to reduce thedose delivered to the brainstem, either the maximum dose was reduced (group 2, Marseilles), or plugs were used (group 3, Brussels).

Results. The data of 358 patients were analyzed (group 1: 169 patients (Marseilles = 109 + Brussels = 60); group 2: 140 patients; group 3: 49 patients). The incidence of trigeminal nerve dysfunction was 21% in group 1, 7% in group 2, 49% in group 3. We found a statistically significant relation betweentrigeminal dysfunction and use of plugs. We found a significant association between incidence of facial hypo/paresthesias and the mean dose delivered to the nerve: average values of the mean dose delivered to the trigeminal nerve were 38.01 Gy for group 1, 32.17 Gy for group 2 and 42.86 Gy for group 3.

Conclusion. Use of plugs increases the mean dose delivered to the trigeminal nerve and is associated with an increased incidence of trigeminal nerve dysfunction. To reduce the irradiation of the brainstem during GKR for TN, reduction of the prescription dose seems to be a better option than beam channel blocking.

F1B6. The restore rechargeable neurostimulation system: a prospective outcome study

J. K. Krauss, J. P. Van Buyten, G. H. Spincemaille, V. Tronnier, G. Beute, J. J. Pallarés, M. Sindou, F. Zucco, J. De Andres, E. Buchser, A. Constantini, and Y. Lazorthes
Multicenter-Europe

Spinal cord stimulation (SCS) is a treatment option for patients with chronic neuropathic pain. A new SCS system with a rechargeable neurostimulator battery was made available for clinical evaluation in December 2004. Patients enrolled in the restore rechargeable neurostimulator study and implanted with the new system are being followed to characterize pain outcomes over 12 months. This prospective open-label study is being conducted in 12 European centers. Baseline measurements were collected after patient informed consent. After implant and wound-healing, recharging was permitted. Patients' ability to recharge was assessed one month post-implant. Outcomes measurements including VAS, pain relief, paresthesia coverage, Oswestry Disability Index and EQ-5D were collected 3, 6, and 12 months post-implant.

Of 45 patients enrolled, 42 proceeded to implant. Of these, 41 met prospective analysis criteria for the primary objective assessing ability to recharge. All 41 successfully recharged independently (95% LCB = 93.0%). Recharging was rated easy or somewhat easy by 79% (14% rated it difficult or somewhat difficult).

Data from 41 patients were available for analysis of pain outcomes at 6 months (6 m), with 25 patients having reached 12 months (12 m) of follow-up. Comparing baseline to 6 m and 12 m, the mean VAS score for the primary pain area was reduced from 7.2 ± 1.5 to 3.6 ± 2.7 ($p < 0.001$) 6 m, 3.7 ± 2.5 ($p < 0.001$) 12 m.

Patient self-reported percent pain relief was $63 \pm 28\%$ 6 m, $61 \pm 30\%$ 12 m. EQ-5D health status improved from a score of 0.21 ± 0.32 to 0.54 ± 0.32 ($p < 0.001$) 6 m, 0.50 ± 0.34 ($p = 0.005$) 12 m. Oswestry scores also improved from mean score 52 ± 11, categorized as severe disability, to a moderate disability category mean score of 35 ± 18 ($p < 0.001$) 6 m, 33 ± 18 ($p < 0.001$) 12 m.

All patients successfully recharged the neurostimulator battery, and the majority rated the usability easy or somewhat easy even after only limited experience with the device. Significant improvements in pain reduction, quality of life, and functional status were maintained 12 months post-implant.

F1B7. Internal capsule stimulation for pain control

D. Richardson
New Orleans, USA

A retrospective analysis of thirty four patients with deep brain stimulating electrodes implanted in the internal capsule for pain control were reviewed. Follow up extends from 23 to 1 year. The evolution of target sites, stimulation parameters and long term results will be presented. The current indications for DBS for pain relief, target sites and stimulation techniques for internal capsule implantation as opposed to thalamic nuclear stimulation will be discussed.

Epilepsy II

F2A1. Disconnective surgery for drug-resistant focal epilepsy

M. Cossu, F. Cardinale, L. Castana, and G. Lo Russo
Milano, Italy

Postoperative dislocation of residual brain into the surgical cavity with consequent collection of extracerebral fluid may occur either after anterior temporal lobectomy (ATL), in patients with brain atrophy, or in patients submitted to extensive multilobar resections. Anatomical disconnection of the epileptogenic tissue may be an alternative in patients in whom this complication is likely to occur. Thirteen patients (9 males, 4 females), operated on in the last year, received disconnective surgery for the treatment of drug-resistant focal epilepsy. In no patient a neoplasm was suspected at MRI. Seven patients (aged 42 to 62 years) were submitted to unilobar temporal lobe disconnections and 6 patients (aged 3 to 32 years) underwent multilobar temporal-parietal-occipital disconnections. In all the temporal disconnections a small superior temporal gyrectomy was performed to facilitate access to the temporal stem. Two patients with a multilobar disconnection had received previous resective surgery. One multilobar disconnection was associated with partial resection of the parietal lobe. The postoperative course was similar to that of patients receiving resective surgery and no brain dislocation were observed at long-term postoperative MRI. Three patients are seizure-free 12 months postoperatively.

Six months after surgery, two patients are seizure free and one still has seizures. In the remaining cases, no follow-up is available so far. In most patients, postoperative EEG showed persistent epileptic activity restricted to the disconnected regions. Disconnective surgery in focal epilepsy is a reliable alternative to resection in selected cases, which helps in preventing surgical complications secondary to ATL and to extensive multilobar resections.

F2A2. Dysembryoplastic neuroepithelial tumors: heterogeneity in imaging presentation, epileptogenicity and surgical strategy

B. Devaux, F. Chassoux, S. Rodrigo, B. Turak, E. Landré, and C. Daumas-Duport
Paris, France

Dysembryoplastic neuroepithelial tumors usually present with early onset partial epilepsy and suggestive imaging features, in particular a cortical location and absence of mass effect or tumor growth. Seizure outcome after resection is reported as favourable, however optimal resection extent is still debated and their identification on imaging may be misleading particularly for the non-specific histological forms.

From 1990 through 2005, 60 patients (mean age: 27 ± 13 yrs) out 412 operated for intractable partial epilepsy were found to have a DNT. On MR imaging five different patterns were observed: pseudo-cystic, pseudo-polycystic, homogeneous megagyric, heterogeneous megagyric and diffuse. The tumor was temporal in 76% of cases, temporal + other lobe in 12% and extra-temporal in 12%. Thirty-three patients underwent a SEEG investigation, 30 of those had 1 to 4 electrodes implanted within the tumor tissue. All spontaneous seizures originated from the tumor, but epileptogenic zone (EZ) was found limited to the image-defined tumor volume only in patients with pseudo-cystic or pseudo-polycystic forms, while in patients with other imaging patterns EZ involved structures beyond the image-defined tumor limits. Based on this information, resection extent was classified in total lesionectomy only, total lesionectomy associated with adjacent cortex or with larger corticectomy, incomplete/subtotal lesionectomy associated with adjacent cortex or with larger corticectomy.

Following resection (mean follow-up: 6 yrs), 83% of patients were in Engel's Class I, 3.5% in Class II, 10% in Class III and 3.5% in Class IV. Class II to IV outcome was associated with older age, incomplete resection and megagyric/diffuse MRI type.

This suggests a complete lesionectomy in pseudo-cystic/polycystic forms of DNT, an extended tumor resection in most megagyric forms and a large or a lobar resection in diffuse forms. Indications for invasive monitoring should be limited to diffuse and some megagyric forms of DNT.

F2A3. Focal cortical dysplasia in children: which presurgical investigations?

S. de Ribaupierre, C. Bulteau, G. Dorfmüller, M. Fohlen, C. Jalin, K. Meagher-Villemure, E. Perez-Roulet, M. Seeck, O. Delalande, and J. G. Villemure
Lausanne, Switzerland

In children with focal cortical dysplasia, extensive presurgical evaluation is essential to determine the epileptogenic zone. However, strategies differ, and use of intracranial recording is controversial, and will depend on the surgeon's habits, localization and aspect of the lesion and other investigations available (PET, SPECT). We retrospectively analysed children operated in two centers, Lausanne (Vaud-Geneva program) and Paris, from 2000 to 2004. The two teams having slightly different approaches, we tried to evaluate outcome in function of presurgical investigation, histological classification, size and localisation of the epileptic focus.

Fifteen children were operated in Lausanne, while 35 in Paris. The patient population was equivalent with respect to mean age at seizure onset (21–22 mo), age at surgery (7.2 y) and mean duration of epilepsy (5.3–5.4 y). In both centers pre-operative investigations consisted of scalp video-EEG recording and MRI. However, in Lausanne, the majority of patient had additional SPECT and PET images, and no invasive recordings. While in Paris, 23 children had either grids or depth electrodes, 10 had a foramen ovale. 2 had no intracranial recording. Mean follow-up period is 24 mo for the two populations with excellent outcome in both series, better for temporal epilepsy than extratemporal.

Conclusion. Extensive presurgical evaluation is essential to guide the surgical strategy. If there is an excellent correlation between preoperative video-EEG, MRI, SPECT and PET, intracranial recording might not be needed. However, in the presence of discordance, or when nuclear medicine is not available, invasive monitoring may be needed in order to achieve good surgical results.

F2A4. Neuromodulation of the centromedian thalamic nuclei in treatment of generalized seizures and quality-of-life improvement in patients with Lennox-Gastaut syndrome

A. L. Velasco, F. Velasco, F. Jimenez, and M. Velasco
Mexico City, Mexico

Purpose. Our aim was to evaluate the efficacy of (ESCM) electrical stimulation of the centromedian thalamic nucleus in treatment of generalized seizures of the Lennox-Gastaut syndrome (LGS) and improvement of patient disability.

Methods. Thirteen patients with LGS were studied. They had severe tonic clonic generalized seizures (TCG) and atypical absences (AA). All patients had at least a 6-month baseline before bilateral implantation to the centromedian (CM) nuclei of the thalamus to undergo therapeutic ESCM. Once implanted, they were temporally externalized through a retromastoid point for electrophysiologic confirmation of their placement. After target confirmation, stimulation parameters were set. Patients came for follow up assessment of seizures and neurophysiologic test every 3 months during an 18-month period of time; AED therapy was not modified.

Results. The surgical procedure as well as electrical stimulation was well tolerated by all patients. There were no side effects with the therapeutic stimulation parameters used, and patients were not aware of device activation. Two patients were explanted due to repeated and multiple skin erosion that could not be controlled by plastic surgery procedures.

Overall seizure reduction was 80%. The three patients with poorest outcomes for seizures control did not improve their ability scale score. In contrast, the two patients rendered seizure-free are living a normal life at present. The remaining eight patients experienced progressive improvement, from being totally disabled to becoming independent in five cases and partially dependent in two.

Patients with adequate electrode placement had a seizure reduction >87%. To consider that an electrode is correctly placed, both stereotactic placement and neurophysiologic responses are taken into account.

Conclusions. ESCM provides a non-lesional, neuromodulatory method with improvement in seizure outcome and in the abilities of patients with severe LGS.

F2A5. Long-term safety of deep brain stimulation of mammillary body and mammillothalamic tract in patients with refractory epilepsy: experience with five cases

B. Abu-Serieh, A. Ivanoiu, K. van Rijckevorsel, G. Mary, M. de Tourtchaninoff, C. Grandin, T. Duprez, and C. Raftopoulos

Brussels, Belgium

Objective. In animal models, significant anticonvulsive effect was demonstrated by lesioning or stimulating mammillary body (MB) or mammillothalamic tract (MTT). In humans, the role of MB-MTT complex in episodic memory formation warrants comprehensive cognitive evaluation in any protocol of deep brain stimulation (DBS) of this complex. We herein report the long-term safety of DBS of MB-MTT in severe refractory epilepsy (RE).

Methods. Five men (aged 41–53 years) were included in a randomized double-blinded study. Electrodes were bilaterally implanted in one-stage (contacts 0-MB, 1-MTT). Each target had two phases (ON/OFF) lasting three months each separated by a one month washout period. A blinded neuropsychologist assessed mnemonic function at baseline, postimplantation, and at initiation and termination of phases. Brief stimulation trials were performed before randomization to disclose DBS adverse events.

Results. Mean follow-up was 24.8 months (range: 12–34 months). No adverse events were observed immediately postimplantation or during prerandomization stimulation trials. At baseline, two patients had normal mnemonic function while it was impaired in the others. Patients' mnemonic performance fluctuated during phases presumably owing to peri-or postictal states. In one patient, electrodes were reimplanted bilaterally because of traumatic sepsis and patient' desire. Immediately, he developed an amnesic syndrome similar to that reported after anterior diencephalic damage. His condition improved slowly on a one year follow-up. To date, only this patient showed deteriorated mnemonic performance.

Conclusions. DBS of MB-MTT in RE seems safe and tolerated after first electrode implantation. Reimplantation should be cautiously considered because of substantial risks for episodic memory deterioration.

F2A6. Subdural electrode associated complications: a 20-year experience

K. N. Fountas and J. R. Smith

Augusta, Giorgia

Introduction. Implantation of subdural strip and grid electrodes represents a common methodology in the invasive evaluation of patients with medically refractory epilepsy. Although in the vast majority of cases their implantation is safe, the occurrence of implantation-associated complications can be occasionally troublesome. The purpose of our current communication is to identify the most commonly occurred complications and calculate their frequency in our institution.

Material and methods. In a retrospective study, 185 patients (104 males and 81 females) undergoing subdural strip/grid electrode implantation during a 20-year period, were examined. Their age ranged between 16 and 48 years, while their mean age was 23.6. AdTech (AdTech, Racine, WI, USA) strip and grid electrodes were used in all our cases. The anatomical location of implantation were: 26 implants in orbito-frontal area, 41 in mesial frontal,14 in mesial occipital, 13 in antero-basal area, 44 in interhemispheric areas while 180 in convexity areas (4 temporo-polar, 83 parietal, 17 occipital and 76 temporal). The monitoring period ranged from 2–25 days (mean 10.8 and median 7 days).

Results. The most commonly occurred complication in our series was the development of post-operative epidural hematoma in 3/185 (1.6%) patients, requiring emergent surgical evacuation. In 2/185 (1.1%) cases transient aphasia occurred, which was spontaneously resolved. A surgical subdural hematoma developed in 2/185 (1.1%) while in another 2/185 (1.1%) an infection occurred. Interestingly, in 2 patients (1.1%) significant brain edema was post-operatively evident; one of these patients was conservatively managed with no further consequences while the other one succumbed despite aggressive management of his intracranial hypertension. Finally, one patient developed post-operatively stiff lung syndrome secondary to aspiration and eventually expired. Another interesting observation in our series was the recording of non-habitual seizures in 5/185 (2.7%) patients.

Conclusions. Subdural electrode complications although rare can be troublesome and occasionally disastrous. Knowledge, early identification and prompt management of potential complications can minimize the risks associated with the surgical implantation of subdural electrodes.

F2A7. Long-term outcome and risk factors for seizure recurrence in temporal lobe epilepsy surgery

G. Villalba, J. Rumià, B. Fiol, J. González, S. Candela, T. Boget, and L. Pintor

Barcelona, Spain

Objective. The aim of this study is to analyze the long-term results of temporal lobe epilepsy (TLE) surgery and to evaluate risk factors for seizure recurrence after surgery. Methodology: 135 Drug-resistant TLE patients who underwent surgery (anterior temporal lobectomy, amigdalohippocampectomy, lesionectomy) in Hospital Clínic of Barcelona between 1995 and 2004, were retrospectively studied. The variables assessed were: frequency and kind of seizure before and after surgery (1, 3, 5, 8 years of follow-up), results of preoperative studies, duration of epilepsy, age at surgery, febrile seizure, kind of surgery, antiepileptic drugs, hystopathological study. Seizure classfication followed ILAE guidelines. Inclusion criteria were at least one year follow-up and presence of complete medical documentation. Univariate and standard logistic regression analysis were used to identify prognostic factors.

Results. 53.5% Never relapsed. Mean follow-up 4.5 years. Patients with ILAE 1–2 after surgery were: first year 67.7%, third year 79.5%, fifth year 51.2%, eighth year 60%. The likelihood of being seizure-free in patients initially(one year) seizure-free after surgery was: third year 91.4%, fifth year 82.6%, eighth year 85%. Normal preoperative MRI (p: 0.008), postoperative MRI with incomplete resection (p: 0.022), and normal or developmental disorders in hytopathological study (p: 0.022) were associated with increased risk of relapse after surgery. In the follow-up at eight years, 38% of patients were losed.

Discussion. An important fact in the TLE surgery literature is the small sample size of the studies, the short follow-up period, and the different methodology to achieve and interpretate the results. To know the likelihood of success in a long-term follow-up and the risk factors to relapse after surgery is essential for pre and postoperative counselling of patients and long-term postoperative management.

Conclusion. 1 – The efficacy of TLE surgery at the first year after surgery is highly predictive of the efficacy in a long-term

flollow-up. 2 – Normal preoperative MRI, postoperative MRI with incomplete resection and normal or developmental disorders in hystopathological study are the prognostic factors that in our patients predict poor outcome.

Radiosurgery

F2B1. Management of cystic craniopharyngiomas with colloidal 186Rhenium stereotactic intracavitary irradiation procedure

S. Derrey, N. Reyns, G. Touzet, H. Gauthier, P. Carpentier, P. Dhellemmes, and S. Blond
Lille, France

We review retrospectively the results of stereotactic intracavitary irradiation with colloidal 186Rhenium in the treatment of cystic craniopharyngiomas.

Among 54 consecutives patients included in a 186Rhenium stereotactic intracavitary irradiation procedure, 42 patients (29 males, 13 females, 38.7 years old) received therapeutic injection via an intracystic catheter introduced under stereotatic conditions. Mean follow up was 43 months [8–148]. Of these patients, 15 had had no prior treatment, 27 had before irradiation surgery or surgery and radiotherapy. The mean volume before irradiation calculated by RMI was 8.05 cm^3, the mean radiation dose was 381 MBq.

Cystic mean volume after irradiation was 2.2 cm^3 ($p < 0.001$ with pre-irradiation volume). At the end of follow up, complete resolution of cyst was observed in 17 patients (43.5%). For 12 patients (30%), cyst decreased more than 50%, for 5 patients (13%) volume decreased less than 25%. Cystic Volume remains unchanged or increased in 5 patients (13%). Eight patients (27%) had improved visual function and 2 have delayed worsening without cyst progression.

None endocrinological deterioration occurred. One patient showed memory deterioration 4 months after irradiation despite no change in cyst volume. In 10/17 patients, cognitive function increased and remains stable in the others. No mortality occurred.

186Rhenium Stereotactic irradiation for the treatment of cystic craniopharyngiomas is a safe an effective procedure with more than 70% tumor control rate. This strategy can be used in first intention for pure cystic craniopharyngiomas with thin wall or in second intention for cystic recurrence.

F2B2. Stereotactic radiosurgery for nonsecreting pituitary adenomas

R. Liščák, V. Vladyka, J. Marek, G. Šimonová, and J. Vymazal
Prague, Czech Republic

Introduction. The goal of nonsecreting pituitary adenoma radiosurgery is to halt the tumor growth and to maintain the performance of normal hypophysis and functionally important structures around the sella. Effectiveness of gamma knife radiosurgery was evaluated.

Method. During 10 years (1993–2003) 140 patients with nonsecreting pituitary adenoma were treated using Leksell gamma knife at our institution. Follow up longer than 3 years was available in 79 of them. Their age ranged 24–73, median 54 years. 85% of them had previous open surgery. 15 patients had contact of adenoma with optic tract. Normal function of hypophysis was in 14 patients, complete panhypopituitarism was in 48 patients, the rest had partial function of normal hypophysis. Volume of adenoma ranged 0.1–31.3, median 3.45 cm.

Marginal dose ranged 12–35 Gy, median 20 Gy.

Results. Follow up ranged 36–122, median 60 months. No growth of adenoma was detected, 90% of treated adenomas decreased in size, the volume reduced by median 61%. There was no impairment in perimeter after radiosurgery, 4 patient from 52 patients with abnormal perimeter improved. There was no impairment of oculomotor nerves function. Impairment in hypophysis function was observed in 2 patients.

Conclusion. Radiosurgery has reliable antiproliferative effect in nonsecreting pituitary adenomas. It is a safe treatment with low risk of morbidity. Short contact of nonsecreting pituitary adenoma with optic pathway is not contraindication for Gamma knife radiosurgery.

F2B3. Radiosurgery using computer-based micro-multi-leaf-collimator for large cerebral arteriovenous malformations

M. Maarouf, C. Kühn, J. Voges, H. Treuer, M. Hoevels, R.-P. Müller, K. Lackner, and V. Sturm
Cologne, Germany

Objective. To determine the efficacy and safety of LINAC radiosurgery using the micro-multi-leaf-collimator (μMLC-RS) in the treatment of large cerebral AVMs.

Methods and patients. From February 2001 through December 2005, 37 patients (F:M = 19:18, age 12–68 years, median 39 years) with large cerebral AVMs (volume 10 cm^3 or Diameter >30 mm) were treated with stereotactic μMLC-RS according to a prospective protocol. Prior to radiosurgery, 16/37 (43%) patients experienced intracranial hemorrhage, 6/37 (16.2%) seizure, 10/39 (26%) progressive neurological deficits and 5/37 cephalgia. Eleven of 37 patients (29.7%) were treated by endovascular embolization before radiosurgery. The median volume and diameter of the AVM-Nidus was 10.5 ± 11.5 cm^3 and 38 ± 9 mm (range, 3.01–6.4 mm), respectively. A median therapeutic dose of 13 Gy (range, 9–20 Gy) was applied to the surface of the nidus.

Results. Four of 37 (10.8%) patients developed new or progredient neurological deficits after a median clinical follow up of 28 ± 13.3 months (range, 2.5–56.4). Non of the deficits was permanent. One patient experienced a hemorrhage post radiosurgery. Twenty of 37 patients had a sufficient radiological follow up. Fifteen of 20 patients (75%) revealed an AVM obliteration on neuroradiological follow up (DSA/MRI).

Conclusion. Our preliminary results show that stereotactic LINAC-radiosurgery using the computerized micro-multi-leaf-collimator for the treatment of large cerebral AVMs is effective. There were no permanent treatment associated morbidity and mortality.

F2B4. Indications and results of radiosurgery with LINAC for the treatment of acoustic neuromas

R. Alexandre, P. Alessia, V. Jean-Guy, and M. Raphaël
Lausanne, Switzerland

Introduction. Radiosurgery is presently becoming an alternative to microsurgical resection of acoustic neuromas. The interest of radiosurgery consists in its lower morbidity compared to surgery and likely in similar rates of long-term tumor control. The goal of our study was to assess the clinical outcome (hearing preservation

and neurological complications) as well as tumor control after low-dose radiosurgery for unilateral acoustic neuromas.

Material and methods. Since April 2002, 33 patients with untreated acoustic neuromas underwent stereotactic radiosurgery using a linear accelerator (LINAC) and a micro-multi-leaf-collimator (mMLC, Brain Lab) at a low dose of 12 Grays. The average age was 57 years (range 29–73 years). The treatment volume was 0.03 to 6.04 cm^3 (median 1.90 cm^3).

The median follow-up period was 34 months (range 6–54 months).

Results. No morbidity was observed during the treatment. Preservation of a serviceable hearing (Class I and II according to the Gardner-Robertson scale) was achieved in 12 of 17 patients (71%). Radiological tumor growth control was obtained in all patients (100%). Trigeminal neuropathy was observed in two patients. One of these patients also experienced a slight facial weakness.

Discussion. Low dose radiosurgery provides a low rate of post therapeutic morbidity and yields the preservation of a serviceable hearing in 70% of cases. Tumor control is observed in all patients, but a longer follow-up period is needed to confirm the stability of the tumor size.

F2B5. Long-term hearing preservation for vestibular schwannoma after Gamma knife radiosurgery: analysis for patients with initial Gardner-Robertson class I

M. Tamura, C. Delsanti, P. Hughes Roche, J. Marc Thomassin, and J. Régis
Marseille, France

Objective. To evaluate the long-term hearing preservation of Gamma knife radiosurgery (GKS) for Vestibular Schwannoma (VS) in patients with initially a subnormal hearing (Gardner-Robertson class 1) and analyze the predictive factor for the hearing preservation.

Material and methods. Since July 1992 over 1600 vestibular schwannomas were treated by GKS and followed in Marseille Timone University hospital. NF2 disease patients and previously surgically treated patients were excluded. Among the patients with subnormal hearing (GR1) at the time of GKS, a minimum follow up of 3 years is available for 62 patients treated between July 1992 and January 2003 with marginal dose? 13 Gy (max 10 years, average 54.3 months, median 48 months) and analyzed to evaluate hearing preservation after GKS and the predictive factor for hearing preservation by the univariate and multivariate analysis.

Results. The average age was 46.2 years (range 17–76). According to Koos classification the lesion treated was a stage I in 5 cases, stage II in 16, stage III in 39, stage IV in 2. The initial symptom was hearing loss in 24 patients, tinnitus in 18, vertigo in 4, instability in 7. The median number of isocenter was 8 (range 2–45) and the average peripheral dose was 11.5 (range 9–13) Gy. At latest follow up, 49 (79.0%) patients had preserved a functional hearing (GR class 1 or 2), 33 of 62 (53.2%) patients were still in GR class 1 (subnormal), while 7 (11.3%) patients had lost their audition (deafness).

Three patients had failed tumor control and had resection surgically and 1 patient was retreated with GKS. Tumor control was achieved in 94% of the cases. One patient suffered transient facial palsy and 5 patients (2 transient) suffered trigeminal nerve injury. In statistic analysis, younger age ($p = 0.016$), an initial symptom different from hearing lost ($p = 0.013$), lower dose to the cochlea ($p = 0.011$), a larger intra-canalicular tumor volume ($p = 0.047$) have significantly higher possibility to preserve GR1 hearing after GKS for long time. Sex, tumor side, previous facial paresis, tumor location, maximum dose, peripheral dose, the number of isocenter and total tumor volume have no significant influence.

Conclusion. This study shows that Gamma knife radiosurgery have, on the long-term, a very high probability of functional hearing preservation for patients presenting with unilateral vs. Younger patients with no hearing loss as a first symptom, treated with low dose to the cochlea are more likely to preserve on the long term a functional hearing.

F2B6. LINAC radiosurgery for glomus jugulare tumors: long-term follow-up

M. Maarouf, F. El Majdoub, J. Voges, M. Kocher, H. Treuer, and V. Sturm
Cologne, Germany

Objective. To determine long term results of stereotactic LINAC radiosurgery (LINAC-RS) in the management of GJTs.

Methods. From May 1991 through September 2005, 22 GJTs patients (F:M = 18:4, age 29–80 years, median 60 years) were treated with stereotactic LINAC-RS for ongoing growth of either primary tumor or of the residual tumor following surgery. Fourteen of 22 patients with a median follow-up of 8.8 years (range: 5–14.6 years), were selected for retrospective analysis. A median single dose of 15 Gy (range 11–20 Gy) was applied to the surface of the tumor.

Results. Following LINAC-RS, 9 of the 14 patients (64%) had been improved clinically, 5 (36%) unchanged. Accessible neurological signs improved in 4 (29%) and remained stable in 9 (64%). One patient developed moderate facial nerve palsy (H & B II). MR examinations showed tumor shrinkage in 9 (64%) and no further progression in 5 patients (36%).

Conclusion. This study shows that stereotactic LINAC-RS for GJTs management is safe and highly effective providing long-term tumor control. Thus, radiosurgery is a promising treatment modality in the management of patients with GJTs and should be included in the discussion of treatment options.

For a good outcome an optimum dose conformation is obligatory, especially for intracranial tumor compartments. The use of a computerized μMLC for LINAC-RS has been encouraging. We expect that computerized μMLC will enable us to treat patients with larger tumors and to reduce radiation-induced side effects by minimizing the radiation exposure to adjacent healthy brain tissue and critical structures.

Oral posters III

F2C1. Effects of bilateral STN stimulation on cardiovascular autonomic regulation

T. Erola, T. Haapaniemi, E. Heikkinen, J. Tuominen, H. Huikuri, and V. Myllylä
Oulu, Finland

Background. Long-term heart rate variability (HRV), reflecting cardiovascular autonomic function, is impaired in patients with Parkinson's disease (PD). The mechanisms of this impairment are not well known. Recently, bilateral deep brain stimulation (DBS) of the subthalamic nucleus (STN) has been used to improve motor function of the patients with PD. The aim of this study was to investigate possible effects of bilateral STN-treatment on cardiovascular autonomic regulation.

Methods. Various time and frequency domain indexes, as well as non-linear indexes of heart rate variability (HRV) were measured from 24-hour ECG recording before and 12 months after bilateral STN-operation in 14 PD patients. The baseline HRV was compared to 57 age-matched controls without PD.

Results. Several long-term HRV indexes differed between the PD patients and the controls. There were no significant changes in any of the HRV measurements during the STN-treatment as compared to the baseline values although significant clinical improvement – as evaluated by the unified Parkinson's disease rating scale (UPDRS) – was observed after the operation.

Conclusions. Bilateral STN treatment does not have any measurable effect on cardiovascular autonomic regulation. This suggests that impaired autonomic function in PD is related to the disease process itself rather than to motor dysfunction.

F2C2. Accuracy of frameless DBS stereotaxs. The stealth station framelink and nexframe system Nexframe System Experience

P. Roldan, F. Talamantes, O. Cortes, V. Quilis,
W. G. March, and A. Salvador
Valencia, Spain

Introduction. We present our experience regarding the Stealthstation Framelink™ and Nexframe™ frameless systems accuracy in DBS functional neurosurgery.

Material and methods. We operated 15 patients with abnormal movement disorders since 2004 using the Stealthstation Treon™ and Framelink™ software combined with cap and tower Navigus™-Stimlock Nexframe system.

After positioning the Nexframe™ tower, we performed single microelectrode recording, followed by final electrode placement according to those micro recordings that best covered the whole STN area. Postoperative T1 MRI and pre and postoperative control fusion studies were routinely performed. Planned Framelink™ targets and electrodes' distal contact positions were measured in tri-orthogonal planes and probe's eye view, in order to assess the accuracy of the electrode positioning system.

Results. In order to include the target into the working area preoperative MRI must include at least a 3 cm space over the vertex. Average microrecording tracks were two in the first side vs. three in the second (generally left) side, where neumoencephalus and time-dependent brain-shift difficult microrecordings. Error $\pm$ SD distances between the actual and postmicrorecodngs planned targets in the *X*, *Y*, *Z* coordinates were (1.0 ± 1.1, -0.8 ± 1.9, -1.5 ± 1.9) for the first side and (-1.2 ± 1.5, -1.1 ± 1.3, -0.9 ± 1.4) for the second side.

Conclusions. The accuracy of frameless systems is similar to that of frame-based systems, with no differences in the clinical effects in our series, although the technique should still be slightly improved. Frameless systems constitute the future of functional stereotaxis, as are already being routinely used in brain biopsies, tumour navigation-guided surgery and even radiosurgery.

F2C3. Perioperative localization of subthalamic nucleus

R. M. Lehman and A. Nieves
New Brunswick, USA

Introduction. Bilateral DBS of the STN is an effective means of improving motor function in selected patients with advanced Parkinson's disease. Efficacy of surgery depends on accuracy of electrode placement. Ventriculography, CT/MRI, or MRI solely are used for anatomic placement with confirmation by microelectrode recordings and macrostimulation. Number of electrode tracts can be a factor in morbidity of the procedure.

Methods. Nineteen patients underwent simultaneous bilateral placement of STN–DBS electrodes. MRI acquisition in T1 axial sagittal volume, and T2 coronal.

Indirect coordinates coupled with adjustment based on direct targeting was then followed by microelectrode recording (MER) for final placement of DBS electrode and macrostimulation for efficacy and lack of side effects.

Results. At least 3 mm of characteristic STN–MER was our localizing criterion with no side effect on macrostimulation. Left brain was recorded first with efficacy and average of 1.68 tracts, and right brain 1.84 tracts. The range was 1–3. Severity of hemispheric affliction did not alter this difference. There were no hematoma or permanent complications. Anterior-posterior coordinate required averaging, and vertical moved no more than 1 mm.

Discussion. Anatomic variability of STN related to AC–PC line, coupled with MR inhomogeneities, requires diligence in both direct and indirect selection of the target before MER. This will reduce the number of recording tracts. Improved motor function (66%) and reduced risk of hematoma or infarction will follow with implantation. Neurophysiological profile deteriorated based on pre-morbid depression and may be related to reduction of dopaminergic medications.

F2C4. Bilateral subthalamic nucleus stimulation in the treatment of advanced Parkinson's disease. 5 years experience

M. Sobstyl, M. Zabek, H. Koziara, Z. Mossakowski,
S. Dzierzecki, and A. Zaczynski
Warsaw, Poland

Introduction. The objective of the study is the clinical assessment of bilateral subthalamic (STN) deep brain stimulation (DBS) in the treatment of advanced Parkinson's disease (PD).

Material. Nine patients with advanced PD underwent bilateral STN stimulation between July 1999 and January 2006. In all patients electrodes (Model 3389) were implanted into the STN with the aim of Leksell G frame.

Methods. The clinical rating tests included: the unified Parkinson's disease rating scale (UPDRS) and two motor timed test (rapid movements between two points and stand-walk-sit test). Preoperatively all patients were assessed in off and on condition. Postoperative evaluations were performed at 3, 6, 12 months, and thereafter every year in medication on and off condition and stimulation on and off condition. To analyze the preoperative to postoperative UPDRS scores Wilcoxon singed rank test was used. *P*-values less than 0.05 were considered significant.

Results. The stimulation effect was noted in the off state, resulting in a 59% improvement in motor scores of the UPDRS at 5 years follow-up, when compared to preoperative scores. At 5 years follow-up the stimulation effect in the on state was modest.

Conclusions. Bilateral STN stimulation is an effective and safe treatment for patients with advanced PD. Bilateral STN stimulation contributes to the improvement of parkinsonian symptoms in the off state and reduces levodopa induced dyskinesia. This can be correlated to the 50% reduction of daily levodopa dose 5 years postoperatively.

F2C5. Deep brain stimulation of the globus pallidus improves cognitive and motor dysfunction in a transgenic rat model of Huntington's disease

Y. Temel, C. Cao, A. Blokland, C. Schmitz, H. W. M. Steinbusch, and V. Visser-Vandewalle
Maastricht, Netherlands

HD is characterized by a progressive deterioration in cognitive and motor functions. Although the movement disorder can be treated pharmacologically, no effective therapies are available to treat the cognitive symptoms. Evidence suggests that altered activity of the globus pallidus externus (GPe) is responsible for at least part of the cognitive and motor symptoms of HD. In this study, we evaluated the effects of bilateral globus pallidus (GP; the equivalent of the GPe in primates) DBS on cognitive and motor symptoms in the first transgenic rat model of HD (tgHD rats). DBS of the GP with clinically relevant stimulation parameters resulted in a significant improvement of cognitive dysfunction. Furthermore, the number of choreiform movements was significantly reduced by bilateral GP DBS. Altogether, this study provides the first experimental evidence that DBS of the GPe can be used to treat cognitive and motor dysfunction in HD.

F2C6. Surgical experience in a large cohort of DBS patients with PD, ET and other disorders

J. L. Jaggi and G. H. Baltuch
Philadelphia, USA

Introduction. DBS is considered a safe surgical procedure but the precise incidence of complications in large samples in not well described. We analyzed the surgical morbidity and mortality in all patients who underwent DBS at our institution.

Patient population. Between February 1998 and April 2006 we implanted 745 DBS systems in 384 patients (127 women, 257 men). The leads were placed in the STN for PD in 297 patients (292 bilateral, 5 unilateral), in the GPi for PD in 20 patients (all bilateral), in the VIM for ET in 51 patients (8 bilateral, 43 unilateral), in the VIM for PD in 3 patients (all unilateral), in the ANT for medically refractory epilepsy in 7 patients (all bilateral), for generalized dystonia in the GPi in 3 patients (all bilateral), and for focal dystonia in the STN in 10 patients.

Results. Morbidity: 49 serious adverse events related to surgery were observed in 41 of 384 patients. Complications occurred in patients with PD in 36 and in ET in 5 cases. The most prominent were: Infection (4.2%), hemorrhage (1.3%), PE (1.0%), seizure (0.8%), pychosis (0.8%), venous infarction (0.5%), stroke (0.5%). A permanent sequale was observed in 5 patients. *Mortality*: Two perioperative deaths occurred, 4 days and 3 months following surgery due to PE and worsening dysphagia and repeated aspiration pneumonia, respectively.

Conclusion. There is a significant incidence of AEs associated with DBS surgery. The surgical mortality rate was 0.5% and the morbidity rate was 10.5%, both of which seem to be acceptable risks in neurological surgery.

T2C7. Deep brain stimulation (DBS) of the subthalamic nucleus (STN) in elderly patients

J. Vesper, S. Haack, G. Nikkhah, and C. Ostertag
Freiburg, Germany

There is an ongoing discussion regarding age limits of patients considered to deep brain stimulation (DBS). Current indications are tremordominant disorders, Parkinson's disease and dystonia. By means of analgosedation DBS surgery is more comfortable, especially for elderly patients. However, the value of DBS regarding the benefit-risk ratio in this patient population is still uncertain.

Bilateral electrode implantation in the STN was performed at two centers in a total of 73 patients, suffering from Parkinson's disease. Patients were analyzed retrospectively. For this study they were separated in two groups: group I (age <65 y, $n=37$) and group II (age 65 y, $n=36$).

Examinations were performed preoperative, at 6, 12 and 24 months follow-up. Age, UPDRS motor score (part III) on/off, Hoehn and Yahr scale, activity of daily living (ADL), L-Dopa medication and complications were determined. SigmaStat (Jandel scientific) was used for statistical evaluation.

Significant differences were found regarding the overall perfomance in the ADL score (group I: 48/71, group II: 41/62 points [preop/6 mo postop]) and in the rate of complications (group I: 4 intermittend psychosis, 4 infections in 8 patients, group II: 2 deaths [unrelated to surgery], 1 intracerebral hemorrhage, 7 intermittend psychosis, 3 infections, 2 pneumonia in 13 patients), ($p<0.05$). Interestingly changes in UPDRS score, Hoehn and Yahr scale, L-Dopa medication were not statistically different among the two groups. DBS in the STN is as effective in elderly patients as it is in the younger ones. However, careful selection and follow-up is required because of the higher risk for complications found in the elderly patient population.

F2C8. Quality of life of PD patients implanted in the STN

S. Raoul, S. Drapier, H. Desal, P. Sauleau, P. Ty Pham, P. Damier, M. Verin, and Y. Lajat
Nantes, France

Object. Subthalamic nucleus (STN) stimulation for patients with medically refractory Parkinson disease (PD) is expanding. We reviewed our experience with a large serie of consecutive patients.

Methods. From 1995 to September 2004, 75 patients with PD were implanted in the STN in our department of neurosurgery in Nantes (France) UPDRS was performed on these 75 patients to assess motor results. Quality of live of 27 patients for the unified Parkinson's disease rating scale (UPDRS), Parkinson's disease Questionnaire 39 (PDQ39) and Short Form 36 health survey questionnaire (SF36) were compared before surgery and after 12 months of bilateral STN–DBS. Ventriculography and MRI were performed to target the STN. Surgery was done under local anesthesia to perform clinical assessment.

Results. Dyskinesias were reduced (-72% compared to preop score), preop UPDRS was 73 off dopa and was 22 on dopa. Postop UPDRS was 68 off dopa and off stim, 19 off stim and on dopa, 24 off dopa and on stim and 7 on stim and on dopa after 1 year. Morbidity included: 7 device infections (10.2%), 2 intracerebral haematoma, 2 skin erosions over implanted hardware (1.0%), 2 hypophonias. Comparing off-dopa conditions before versus 12 months after surgery, both UPDRS parts II and III significantly improved: 32.6% and 52%, respectively. UPDRS part I scores did not change significantly at 12 months. As for PDQ39, the global score significantly improved after surgery (21.1%) as did four subscores: mobility (25.6%), activity of daily living (34.5%), stigma (40.1%) and bodily discomfort (30%). Three PDQ39 subscores, however, showed no significant changes: emotional well-being (10.7%), social support (3.2%) and cognition (8.5%) and one item even worsened: communication (-7.7%). In SF36, only physical items significantly improved.

Conclusion. Physical quality of live improved after surgery but fear recognition was impaired and mood changes can occurred. Clinical assessment peroperatively can be a predictive marker to avoid non motor effect of STN stimulations.

F2C9. Parkinson disease management in Romania: past, present and future

J. Ciurea, G. Lugoji, and I. Simoca
Bucarest, Romania

The first lesions for Parkinson disease were performed in Romania in '60. They used ventriculogaphy for target coordinates and both radiofrequency and radioactive seeds.

We restarted radiofrequency lesioning – VIM and GPi – in selected cases since 1998. There are 35 lesioned patients. All exhausted drug therapy or did not respond or tolerate it. They were assessed sequentially, pre and postoperative monthly, using united Parkinsonian disease rating scale, Schwalb and England Scale and Hohen and Yahr score. There were 20 men and 15 women, with an age ranging from 26 to 72 and a mean of 58 years. There were performed 21 pallidotomies and 14 thalamotomies. Small repeated lesions versus ''regular'' lesions strategies were used in certain cases.

DBS proved to be an efficient method, but the small number of cases (two bilateral subthalamic nucleus implants in our hospital) are inducing discussions beyond medical aspects of the problem.

The pre and postoperative levodopa equivalent daily dose (LEDD), anti-parkinsonian medication costs and quality of life self assessment were analyzed. An improvement was recorded in all patients. No major complications were encountered. The DBS group presented the most significant reduction in LEDD, more then half ($p = 0.043$) The medication costs ranged from 30 Euro to 625 Euro per month in pre-op cases. There were a reduction of medication in all early postoperative phase, but with no statistical significance in ablative surgery group. Reduced amount of medication lowered the amount of money for DBS group medication too, but failed to show a statistical significance.

An overall tendency of life quality self assessment postoperative improvement was recorded.

Due to the necessity to understand the real situation, we performed sampled epidemiological prevalence studies and compared them with official governmental and international statistics. Exhaustion of conservative management and referral to neurosurgeon present interesting detailes.

An attempt to compare the situation in other country presenting similar condition with Romania is performed.

Future perspective are optimistic concerning DBS implants, but lesioning must be considered in certain selected cases.

F2C10. Simultaneous targeting and stimulation of STN and VIM in tremor predominant PD patients. Pro's and cons

S. J. Kwiek and G. Klodowska-Duda, T. Wójcikiewicz, W. Slusarczyk, W. Kukier, P. Bazowski, A. Zymon-Zagórska, H. Buszta, M. Konopka, A. Kieltyka, and G. Opala
Katowice, Poland

The introduction of stereotactic stimulation as a treatment of movement disorders is the important tool for the therapy of Parkinson's disease, dyskinesias and fluctuations associated with pharmacologic therapy for PD, essential tremor, primary dystonia etc. In some cases of tremor predominant PD patients the question if stimulation of STN is more efficient than VIM stimulation is still taken into consideration.

Between December 2000 and April 2006, 170 stereotactic procedures were performed in the Department of Neurosurgery at the Medical University of Silesia in Katowice, Poland. The procedures were carried out in local anaesthesia with a Brain-Lab stereotactic positioning and treatment system and PatXfer, Target 1.19 and Automatic Image Fusion software. After the stereotactic frame placement, a computed tomography was performed by a Hi Speed NX/iPROBE GE device, with the scan width of 2–3 mm. The images were sent to the stereotactic planning station. Then, the images were converted, and they were superimposed on the previously made MR images (SIGNA MR/iEchospeed 1.5 T GE). Among them were 23 functional stereotactic operations for PD, essential tremor or dystonia (11 STN or VIM DBS and 12 ablations of GPi or VIM). In cases of stereotactic DBS micro- and macro-monitoring of STN and/or VIM using 4–5 electrodes was carried intraoperativelly.

In 3 out of 23 cases who underwent procedure of DBS electrode implantation or target ablation we defined trajectory reaching STN and passing VIM (or VIM area). In every mentioned above case clinically observed, so called positive ''lesionigng effect'', which was observed intraoperativelly persisted for many weeks. Monopolar or bipolar stimulation of STN and/or VIM was started when tremor and other PD signs recurred.

In this paper defining of the target and trajectory, positioning of the DBS electrode, clinical answer on stimulation of STN and/or VIM regarding both effect and side effects are discussed.

Imaging, planning, measuring of neuronal activity intraoperativelly, early and late outcome of such procedure including failures are discussed.

F2C11. Facial pulling during intraoperative stimulation for subthalamic nucleus (STN) deep brain stimulator (DBS) implant

A. Gorgulho, D. Shields, D. Malkasian, E. Behnke, S. Krahl, and A. De Salles
Los Angeles, USA

Introduction. STN intraoperative high frequency stimulation (HFS) may trigger multiple side effects and they are as important as motor symptoms improvement to define electrode final position. One of the most common side effects is facial pulling (FP). We determined the most common location triggering FP and its relationship with(in) STN and surrounding structures.

Materials and methods. From September 1999 to January 2004, there were 53 STN implants for PD at UCLA using the Medtronic 7789 model. Facial pulling was observed in 49 (47.11%) leads on 19 (35.85%) patients. Precise location of the contacts triggering FP was calculated based on the coordinates of the electrode tip at the immediate postoperative MRI scan, accounting MRI artifacts.

Coordinates were compiled to locate the stimulated structure leading to FP.

Results. The mean X and Z coordinates responsible for FP were located 11.5 ± 1.4, 1.15 ± 3.3 mm laterally and inferiorly to the anterior-posterior commissure line respectively. Y laid 1.2 ± 1.52 mm posterior to midcommissural point. FP point was plotted at the anterior–superior border of the STN, at the transition between H2 Forel Field and Internal Capsule. Voltages leading to FP ranged from 1.6 to 5.7 V, mean amplitude of 3.6 V. There were 2 patients with FP above 5 V and 7 below 2.5 V.

Conclusions. These results are best explained by electrical current spread to nearby axons representing the face area coursing

lateral to the STN, within the internal capsule. According to the usually planned electrode trajectory in order to place more leads inside the STN, superior leads are more likely to trigger FP.

F2C12. Unilateral deep brain stimulation in contralateral subthalamic nucleus for Parkinson's disease after prior pallidotomy: long term follow-up

T.-K. Lee, S.-H. Yang, K.-S. Lee, and S.-S. Jeun
Seoul, Korea

Objectives. Pallidotomy was an effective treatment for unilateral parkinsonism (PD) and dyskinesia, yet symptoms progress in many patients. Little is known about whether such patients obtain a useful response to bilateral subthalamic nucleus deep brain stimulation (STN–DBS). The aim in long term follow up study was to assess the safety and efficacy of unilateral STN stimulation to parkinsonian patients with progression of symtoms after pallidotomy.

Methods. Four patients with PD underwent unilateral DBS of the STN and were followed up for 22–51 months. Patients were assessed at baseline and at each visit by analyzing the unified PD rating scale (UPDRS), ambulation speed, motor and activities of daily living (ADL) scores, medication requirements, and dyskinesias were measured.

Results. Contralateral STN–DBS after prior pallidotomy resulted in a significant reduction in UPDRS motor scores (48%). Levodopa-off/stimulation-on UPDRS motor scores were improved by 28.8% ($p = 0.05$, mean standard deviation [SD]) compared with the baseline levodopa-off score; there was a 50% improvement in contralateral features, a 17% improvement ipsilaterally, and a 24% improvement in axial features. The mean ambulation speed increased by 80–25% ($p = 0.01$, mean SD). The medication-on time with dyskinesias was significantly reduced ($p = 0.01$) and the daily levodopa dose was reduced by 29–16% ($p = 0.05$, mean SD). There were no clinically significant side effects.

Conclusions. Unilateral STN–DBS is safe and efficacious in improving motor symptoms in patients with prior pallidotomy. Unilateral DBS of the STN is safe and well tolerated, and may provide sufficient benefit so that additional surgery is not required.

F2C13. Subthalamic nucleus stimulation for essential tremor: critical target area and short- and long-term results

G. Lind, G. Schechtmann, Ch. Lind, J. L. (R. N.) Winter, B. A. Meyerson, and B. Linderoth
Stockholm, Sweden

Background. VIM-stimulation is a well-established treatment for essential tremor (ET), but the effect may diminish over time. In a pilot study in 1997, STN was explored as an alternative target. Six patients with ET were tested intraoperatively with VIM and STN stimulation, and in three the STN target yielded the best tremor control. (First reported at the ESSFN meeting in Freiburg; Acta Neurochir 1998).

Methods. The first ET patients with STN-electrodes have been now been re-evaluated and subjected to MRI. For comparison, a group of ten ET patients treated with VIM stimulation in 1997–98 was reviewed.

A second cohort of nine ET patients with STN stimulation from 2004–05 was examined with follow-ups ranging from 6 to 24 months.

Results. The three initial ET patients with nine years of STN-stimulation still enjoy excellent (75–90%) tremor control. The outcome in the VIM-group from the same period was variable and in several patients the tremor suppression was unsatisfactory. The ET patients recently implanted in the STN experienced good tremor control, but one elderly patient has dyskinetic side-effects and is scheduled for re-implantation in VIM. Examinations of locations of the effective cathodes indicate that they are located within the STN proper.

Conclusions. STN may constitute an alternative target for treatment of ET, and the choice of target can be based on intra-operative testing. In this small group, STN stimulation for ET appeared to provide a more long-lasting effect at lower stimulation intensities than those required for VIM stimulation.

F2C14. Health-related quality of life in segmental dystonia is improved by bilateral pallidal chronic deep brain stimulation

H. H. Capelle, C. Blahak, K. Kekelia, H. Baezner, R. Weigel, E. Grips, J. C. Woehrle, and J. K. Krauss
Hannover, Germany

Objective. To evaluate the effect of pallidal deep brain stimulation (DBS) on the quality of life in patients with segmental dystonia.

Background. Deep brain stimulation (DBS) of the globus pallidus internus (GPi) has been shown to be an effective treatment for idiopathic medically-refractory dystonia. In patients with segmental dystonia reports on the effect of pallidal DBS on quality of life are lacking. Here, we prospectively evaluated the effect of pallidal DBS on quality of life using the SF-36 questionnaire.

Methods. Ten patients (mean age 57.4 years) suffering from idiopathic segmental dystonia were treated with CT-guided stereotactic bilateral GPi–DBS. In all patients the indication for DBS was insufficient control of dystonic symptoms by oral medication including anticholinergics and BTX injections. The prospective protocol included MMSE, Hamilton depression scale, BFM and the SF-36. Postoperative follow-ups were available at a mean of 7.5 months (FU I) and 17 months (FU II). The Wilcoxon signed-rank test was applied for descriptive statistics.

Results. All 10 patients experienced sustained benefit from pallidal GPi as indicated by a 60% decrease of BFM scores. Out of the eight dimensions of the SF-36, role limitations due to physical problems, social functioning and general perception of health subscores showed the most improvement, whereas role limitaions due to emotional problems and bodily pain subscores were not significantly changed. There was a significant increase of the total SF-36 score by 40% at FU I and 51% by FU II.

Conclusion. The improvement of quality of life by pallidal stimulation underlines the role of chronic DBS as an effective treatment option in patients with primary segmental dystonia.

Tumor

F3A1. Modern multimodal neuroimaging image-guided neurosurgery: the example of PET scan integration

M. Levivier, D. Wikler, B. Pirotte, N. Massager, Ph. David, S. Goldman, and J. Brotchi
Brussels, Belgium

Introduction. Stereotaxy relies critically on medical imaging modalities. In tumor neurosurgery, targeting is limited by the heterogeneity and infiltrating nature of the lesions. The advent of new imaging modalities opens new avenues for planning strategies of

brain tumors. As such, the integration of stereotactic positron emission tomography (PET) represents an example of modern multimodality imaging in neurosurgery.

Methods. We review our experience with the clinical development and routine use of stereotactic PET for neurosurgical guidance in stereotactic biopsy, neuronavigation and radiosurgery. Since 1992, accumulated experience withPET-guided stereotactic procedures include over 200 stereotactic biopsies, 100 neuronavigation procedures, and 100 cases treated with LGK radiosurgery.

Results. When combining PET and MR information, specific target volumes were prospectively defined, depending on the respective information provided by these 2 imaging modalities. In the majority of cases, abnormal PET uptake was found, and this information altered significantly the MR-defined tumor and the surgical planning. Based on these data a classification of multimodality images information was proposed (J Nucl Med 2004; 45: 1146–1154). Examples with stereotactic biopsies, neuronavigation, and radiosurgery for brain tumors will illustrate this concept.

Conclusion. Integration of PET in stereotactic procedures provides additional information opening new perspectives for the treatment of brain tumors. The use of a standardized classification allows to assess the relative role of PET. A similar approach could be useful and may serve as a template for the evaluation of the integration of other new imaging modalities in neurosurgery.

F3A2. Stereotactic versus endoscopic surgery in periventricular lesions

T. M. Kinfe, H.-H. Capelle, J. Mirzayan, J. Boschert, R. Weigel, and J. K. Krauss
Hannover, Germany

Objective. Endoscopic and stereotactic surgery both have gained wide-spread acceptance as minimally invasive tools for the diagnosis of intracerebral pathologies. Here, we investigated the specific advantages of each technique in the assessment of periventricular lesions.

Methods. This study includes a series of 70 patients with periventricular or intraventricular lesions. Endoscopic surgery was performed in 17 patients (mean age: 37 years, range: 4 months; 78 years) and stereotactic biopsy in 55 patients (mean age: 63 years, range: 23; 80 years), including two patients who underwent both procedures.

Results. Hydrocephalus was present in 13/17 patients in the endoscopic (76.5%) and in 11/15 patients in the stereotactic surgery group (20%). Histological diagnosis was achieved in all patients of the endoscopic group, and in all but one patients of the stereotactic group. In the latter patient histological diagnosis was obtained by endoscopic biopsy during a second operation. In the endoscopy group other procedures performed in the same operative session included ventriculostomy (2/17), cyst fenestration (3/17), endoscopic shunt revision (3/17), and placement of Rickham reservoirs or external CSF drains (6/17). Adverse events occurred in one patient after endoscopy (chronic subdural hematoma) and in two patients after stereotaxy (one mild hemiparesis, one transitory paresis of the contralateral leg).

Conclusion. Periventricular lesions can be approached by both, endoscopic and stereotactic surgery with minimal morbidity in experienced hands. The advantages of endoscopy encompass the possibility to perform additional surgical procedures during the same session (e.g. tumor-reduction, third ventriculostomy, fenestration of a cyst). The direct visual control reduces the hazard of injury to anatomical structures and allows for a better control of bleeding although there is a considerable blind-out in such situations.

Advantages of stereotaxy include a smaller approach and precise planning of the trajectory. It is usually performed under local anaesthesia. Finally, both methods can be combined if necessary.

F3A3. Stereotactic biopsies of intrinsic brain stem lesions

G. Touzet, N. Reyns, S. Derrey, C. Haegelen, S. Caron, R. Assaker, M. Vinchon, and S. Blond
Lille, France

Intinsic brain stem lesions represent a major diagnostic and therapeutic challenge, specially in children. The management of theese lesions remains problematic and the role of stereotactic biopsies contorversial. For some authors modern MRI or metabolic imaging (Functional MRI or PET) seem sufficient for diagnostic purposes. For some others, biopsies may not be reliable due to sampling error. But sometimes antomical or metabolic images alone may lead to inaccurate diagnosis and treatment. We reviewed more than 120 consecutive patients, adults and children, undergoing stereotactic biospies as they presented intrinsic brain stem lesions. Stereotactic technique is descibed and histopathological findings and derived treatments are exposed. Morbidity is discussed as well. All the data are presented separately in adults and in children. We believe that stereotactic biopsies of intrinsic brain stem lesions remain a well tolerated and accurate procedure, providing adequate diagnostic and prognostic information, allowing a better tailored therapeutical management in adults and in most children, as in the pediatric group a less variety of lesions encourtered allows, in characteristic cases, a treatment exclusively based on anatomical and/or metabolical images.

F3A4. Convection – enhanced intratumoral application of hycamthin (topotecan®) in the treatment of recurrent glioblastoma, a clinical pilot study

F. Hertel, M. Kiefer, W. Feiden, and M. Bettag
Trier, Germany

Objective. Despite the development of different multimodal therapy concepts for the treatment of malignant gliomas within the recent years, the overall prognosis still remains fatal. Especially the treatment of tumor relapse remains difficult. Though several drugs, such as nitrosoureas, temozolomide® or topotecan® have an implicite potential for the treatment of brain tumors, a systemic therapy may be difficult, if patients had prior chemotherapies.

Methods. Three male patients with recurrent glioblastomas were treated by intratumoral application of topothecan®. In each patient, 2 or 3 catheters were stereotactically implanted. The patients got at least 2×0.5, up to 2×1 mg intratumoral drug infusion via external infusion pumps.

The mean age of the patients was 52 y (36–66 y). At the time of topothecan application, two patients had a 3rd and one a 2nd tumor recurrency. All patients had prior operation, radio-, and chemotherapy. One patient had an additional stereotactic brachytherapy before, also.

Results. The patients tolerated the infusions well. We did not observe any side effects during the infusion times. Also, no patient got an infection. One patient at the moment is still alive, without tumor progression (7 months after intratumoral chemotherapy). Two other patients died (one due to a pulmonary embolism, one due to a new tumor at the contralateral brain hemisphere 2.5 months after intratumoral chemotherapy). We did not observe tumor progression at the treated tumor site.

Discussion. Intratumoral convection enhanced chemotherapy with topothecan® in the above mentioned dose schedule was tolerable for the patients without significant acute side effects.

Due to the fact, that we have not observed tumor progression at the treated tumor sites, intratumoral chemotherapy with topotecan® maybe a potential therapy modality for recurrent glioblastomas under certain conditions. However, so far neither any clinical data exist about the diffusion of the drug in the tumorous brain, nor do we have any data about longterm efficacy or long term side effects. Therefore a controlled prospective clinical trail seems to be necessary.

F3A5. Effect of cervical spinal cord stimulation in the microenvironment of malignat gliomas

F. Robaina, B. Clavo, M. A. Caramés, I. Jorge, B. Valcarcel, L. Catalá, R. Montz, F. Panero, and J. L. Carreras
Canary Island, Spain

Introduction. Generally, malignant gliomas (MG) have decreased blood flow (ischemia) that results in reduced delivery of chemotherapy and oxygen (hypoxia), with further increase in radiation-resistance. This work summarizes our studies about the effect of cervical spinal cord stimulation (cSCS) in the microenvironment of MG.

Materials and methods. Twenty-six patients with MG (15 grade-III, 11 grade-IV) and cSCS devices were enrolled. Pre- and post-cSCS, they underwent; 1) Middle cerebral artery velocity measurements (cm/s) using transcranial Doppler (TCD): 12 patients; 2) Common carotid blood flow quantification (ml/min) using color Doppler: 8 patients; 3) Single photon emission computed tomography (SPECT): 13 patients; 4) Tumor pO2 measurement (mmHg) using the polarographic probe technique (Eppendorf device): 5 patients; and 5) glucose metabolism assessment by positron emission tomography (PET): 13 patients.

Results. Pre-cSCS blood-flow was significantly lower ($p<0.001$) in tumor sites than peri-tumor sites (32%) and contra-lateral areas (41%). Post-cSCS results showed: 1) blood-flow increase in middle cerebral arteries >18% ($p<0.002$); 2) blood-flow increase in common carotid arteries >64% ($p<0.013$); 3) tumor blood-flow increased 15% ($p=0.033$); 4) tumor oxygenation increased ($p<0.022$) and hypoxic fraction decreased 50% ($p<0.007$); and 5) glucose metabolism increased 39% ($p=0.027$) in tumor and 37% ($p=0.001$) in peri-tumor areas.

Conclusions. Our data show that cSCS can modify loco-regional blood flow, oxygen and glucose-metabolism in MG. These modifications in the microenvironment of MG could be useful to increase chemotherapy delivery and the effect of chemo-radiotherapy. Further researches are in progress.

F3A6. Experience with the mini-invasive supraorbital subfrontal key-hole approach in the treatment of epileptogenic anterior fossa meningiomas

M. Iacoangeli, A. Di Rienzo, M. Dobran, F. Formica, A. M. Mauro, and M. Scerrati
Ancona, Italy

Background. Anterior cranial fossa meningiomas represent 40% of all meningiomas and the most epileptogenic ones. Surgical removal of the tumor is the best choice for epilepsy control, but the operation itself can increase the incidence of seizures at least in the immediate post-operative period.

Aim of this work was to evaluate if the minimally invasive key-hole supraorbital approach (KHSA), avoiding the unnecessary wide exposure of the cerebral surface, with minimal brain retraction, could reduce the incidence of post-operative epilepsy allowing at the same time the complete control of the meningioma.

Methods. Twenty-one patients have been treated by KHSA (age 41–73 yrs; 13 women). Oxcarbazepine was used in all patients. This group was compared with a similar group of patients (no. 20) operated on by the standard microsurgical unilateral fronto-temporal or bicoronal approaches. The surgical technique of KHSA consists of an eyebrow skin incision with a limited supraorbital craniotomy (max 25×15 mm).

Results. The completeness of resection was the same in both group (19\21 vs 18\20). In the KHSA group no patients experienced seizures in the first week after surgery, in the long term only one patient had seizures. The hospital stay was shorter as well as the patients discomfort. In the control group 3\20 patients had peri-operative seizures, and in the long term 2 other patients experienced seizures. One patient had infection.

Conclusion. In our experience, the KHSA offers equal surgical possibilities with less approach-related morbidity, especially epilepsy in a high risk group.

Oral posters IV

F3C1. Long term results and quality of life in children after epilepsy surgery

D. Larysz, P. Skorupka, and M. Mandera
Medykawe, Poland

The aim of the study was evaluation of surgical treatment of epilepsy measured by a turn in QOL and in seizure frequency and severity. The examined group consists of 21 boys and 7 girls. We performed corpus callosotomy, lesionectomy, VNS, temporal lobectomy and MST. Age at surgery was 0–17 years with mean follow-up 14.57 months. QOL was evaluated on the basis of the questionnaire created by us, in which parents were asked to assess the following variables before and after the surgical procedure: communication, socialization, daily living skills, movement abilities and behavioral problems.

The seizure frequency was assessed with the modified Engel's scale. Clinical state of all patients was evaluated as well. There were no patients with stable and worsening QOL status. In the group treated with callosotomy the considerable improvement in QOL concerned approximately 50% of cases. More than 95% of cases the reduction of seizures frequency is greater than 75%. The 100% reduction of seizures frequency concerns over 43% of cases. Surgical treatment of pediatric refractory epilepsy seems to be an effective therapeutic method. Upturn in QOL as equivalent to seizure reduction rate may influence further differentiation of methods of qualification and surgical procedures of epilepsy. The improvement in QOL is accompanied by a decrease in frequency and severity of seizures. Further studies on major group of patients will lead us to better understanding of this clinical problem.

F3C2. Neuronavigation assisted subdural strip electrode positioning – a simple method to increase the accuracy of strip localization in epilepsy surgery

L. Eross, A. Bago, I. Fedorcsák, A. Balogh, and P. Halasz
Budapest, Hungary

Objective and importance. Localizing the epileptogenic zone in cases of focal epilepsies clinical, imaging and different

electrophysiological methods are in use. In some cases intracranial electrodes are necessary. Proper positioning of subdural electrodes is always challenging for the neurosurgeon. CT and MR techniques are gold standard to localize the real postoperative position of the electrode contacts over the gyri. However, the exact localization of the electrodes on the patient's brain remained uncertain for the surgeon during insertion. Intraoperative visualization of the electrodes during positioning through a burr hole with the combination of navigation systems and fluoroscopy was not found in the literature.

We introduce the real time paralel use of intraoperative neuronavigation and X-ray for co-localizing subdural strips and the cortical gyri during operation to increase the accuracy of subdural strip electrode placement.

In cases of grid implantation we position the electrodes by visual control after opening a large are of interest. In cases of stereotactically implanted intracerebral electrodes carefull preoperative planning procedure lead us to the target points. In cases of FO electrodes implantation the insertion technique itself determine the rout of the electrodes. Fluoroscopy help us or neuronavigation (Cikk Bale!!!).

Methods. For describing the proper electro-clinical seizure pattern and localising the epileptogenic zone of patients with drug resistant epilepsy subdural strip electrodes were implanted before long-term video EEG monitoring. We demonstrate our method with 3 cases of focal drug resistant epilepsies. Brain Lab Vector Vision neuronavigation system were used in the operating room (OR) to select our entry point and visualise our region of interest and target point on the cortical surface. The radiopaque navigation probe was placed on the skin, over the target point under the control of C-arm (Siemens, Siremobil 2000). The stainless steel, radiopaque strip (DIXI Medical) was introduced through the burr hole to the target point. The target point was visualized by the radiopaque navigation probe what were kept in place during strip insertion.

Results. Though we were able to visualize the target point, which was the the region of interest on the convolutions of the patient's cortex with neuronavigation and localize the the strips during insertion with the C-arm.

With the help of the radiopaque neuronavigation probe the two modality could be fused during the procedure. We controlled our accuracy intraoperatively with the navigation system and postoperative MR (1.5 Tesla GE) and less then 1 mm registration error was found.

Conclusion. Combining neuronavigation and intraoperative X-ray is a simple and feasible method to get precise intraoperative localization of subdural strips for long term video EEG monitoring of patients with drug resistant epilepsy.

F3C3. SEEG of insular cortex with occipito-insular electrodes in temporal plus or fronto opercular epilepsy

S. Gil Robles, A. Crespel, P. Gelisse, H. El Fertit, and P. Coubes

Montpellier, France

The purpose of this presentation is to report about the stereotactic thecnic and the EEG results in the presurgical exploration of insular cortex, in temporal lobe epilesy patients, with occipito-insular electrodes.

Methods and results. Nine patients in presurgical evaluation of severe partial complex seizures were implanted with intracerebral electrodes and SEEG recordings on the basis of ictal symptoms or scalp ictal video EEG recordings suggesting early spread of seizures to the insular cortex, 6 with temporal plus seizures (partial complex epilepsy with laringeal constriction, hypersalivation or gustatoty ilusions) and 3 with tipical TLE and early spread to the suprasylvian opercular cortex such us lip and face paresthesiae or tonic clonic movements of the face.

One to three insular elctrodes were implanted per patient, 1 or 2 in the suspected side and 1 contro lateral. In total 12 insular electrodes of 14 and 15 contacts were introduced using an MRI based anatomical targetting with Leksell stereotactic frame, with intraoperatoty profile radioscopic control, targeting the superior or inferior insular sulcus with an entry point at the parieto-occipital junction. All patients had a control MRI to check the exact position of each contact before EEG recordings. Apart from insular cortex all the patients had amygdalo hypocampal electrodes.

There was not any intracranial bleeding or infection and the electrodes were kept maximum 15 days.

Fifteen insular seizures were recorded in the Video SEEG, in all of them clinical symptoms of insular propagation correlated to spiking recordings in insular electrodes.

F3C4. Surgical results of corpus callosotomy in patients with intractable epilepsy

J. K. Lee, S. H. Hong, J. Koo Kang, S. Am, Lee, and T. S. Ko

Seoul, Korea

The purpose of this study is to evaluate the effect of the corpus callosotomy and to elucidate possible prognostic factors.

The cases of 39 patients who underwent corpus callosotomy were reviewed retrospectively. Clinical outcomes were analyzed using Engel's classification with consideration of various presurgical conditions and the extent of the callosal resection during follow up more than one year.

Satisfactory outcome was obtained in 20 patients (51%) in the total of 39 patients. In 36 cases with drop attack seizures, the outcomes were evaluated to be satisfactory in 22 patients (61%). When the patients were grouped according to the extent of callosal resection, the outcomes were satisfactory in 50% of the patients with anterior $1/2$ or $2/3$, 50% of those with anterior $4/5$ callosotomy, and 57% of those with total callosotomy, respectively. The mean follow-up period was 34 months (24–58 months).

Although it was not statistically significant, the patients who had underwent total callosotomy showed better outcomes than those with partial callosotomy.

Corpus callosotomy was efficacious in controlling medically intractable epilepsy in appropriately selected patients.

F3C5. Frameless stereotactic robot-guided depth electrode placement for invasive EEG-monitoring in children with drug-resistant partial epilepsy

G. Dorfmüller, C. Bulteau, M. Fohlen, S. de Ribaupierre, C. Jalin, and O. Delalande

Paris, France

Purpose. To present our technique of depth electrode placement for chronic EEG-recording in children with medically intractable focal epilepsy.

Methods. Seven hundred and thirty-eight multilead electrodes were placed with a robot-guided MRI-based stereotactic system (Neuromate, Schaerer-Mayfield®) in 81 children (mean age 9.4 years). Monitoring consisted of 6 to 14 electrodes over a mean period of 6 days.

Results. Invasive recording included sampling from 2 cerebral lobes in 43 children, from 3 lobes in 26, from a single lobe in 12,

and from 4 lobes in two children; six had bilateral exploration. MRI was negative in 8 patients (10%). Other investigations included PET- or SPECT-scan, functional MRI, WADA testing, and foramen ovale recording in several cases. We performed electrode stimulation for motor and/or language cortex mapping and for ictal discharge provocation. Beside 3 electrode breaks during removal, there were no other surgery-related complications.

Having identified the epileptogenic zone, we proposed tailored resection in 69 cases, one child had a hemispherotomy instead. In 11 children (14%), S-EEG results precluded resective surgery.

Histo-pathology from 57 children who underwent resective surgery up until now revealed: cortical developmental malformation (29), glioneural tumor (13), hippocampal sclerosis (7, associated with neocortical dysplasia in 5), postischemic sequels (3), no abnormality (5).

Conclusions. Depth EEG-recording helps to identify the epileptogenic zone more precisely in surgical candidates. In children, frameless stereotactic robot-guided electrode placement of multiple intracerebral electrodes is a safe and reliable technique.

F3C6. Reversal of the epileptic encephalopathy epilepsy in hypothalamic hamartomas: a prospective trial of Gamma knife surgery in 65 patients

M. Nagai, M. Tamura, N. Villeneuve, F. Bartolomei, T. Brue, D. DaFonseca, P. Chauvel, and J. Régis
Marseille, France

Objective. Drug resistant epilepsy associated with hypothalamic hamartoma (HH) can be cured by microsurgical resection of the lesion. Morbidity and mortality risks of microsurgery in this area are significant. Gamma knife surgery's (GKS) reduced invasivity seems to be well adapted. In view of the severity of the disease and risks of surgical resection it is crucial to evaluate GKS for this indication.

Methods. Sixty-five patients have been included prospectively since October 1999 including 31 operated by GK more than 3 years ago. The median age was 17.25 years (range: 3–50; mean 19.27) at the time of GKS. Range of maximum diameter was from 7.5 to 23 mm with only 3 larger than 18 mm. The median marginal dose was 17 gy (14–20).

Results. A satisfactory follow up is available for 27 patients. Among those 59.2% have an excellent result with a dramatic behavioural and cognitive improvement and are completely seizure free (37%) or have only rare non disabling seizures (22.2%). No permanent neurological complication have been observed so far; 3 patients have presented a transient poîkilothermia. A microsurgical approach have been performed in 4 patients (14.8%) with quite large HH and poor efficacy of radiosurgery (2 cured and 2 failures). The radiosurgical treatement have been carried out twice in 9 patients. From the radiological point of view the majority (28/31) of our patients did not have any obvious MR change (slight de crease in 2 and a asymptomatic local high T2 signal in 1). No patient till now has presented permanent complication. No cognitive worsening (specially no short term memory deficit), no appetite stimulation or weight gain, no thyroxyne blood level lowering, no hypernatremia, no visual field or acuity deficit were observed.

Conclusion. Our first results indicate that GKS is as effective as microsurgical resection and very much safer in small types I, II and III. GKS also allows to avoid the vascular risk related to radiofrequency lesioning or stimulation. The disadvantage of radiosurgery is its delayed action. Longer follow-up is mandatory for a serious evaluation of the role of GKS.

F3C7. Surgery for intractable focal epilepsy: what is the current need for invasive seizure monitoring? Insights from a four-decade experience

B. Devaux, F. Chassoux, B. Turak, and E. Landré
Paris, France

Identification of homogeneous groups of surgical candidates, improved imaging modalities, surgical techniques and patient selection, have reduced the need for invasive seizure monitoring prior to surgical resection for intractable partial epilepsy.

In our institution, all candidates for epilepsy surgery underwent a SEEG – i.e. multiple depth electrode implantation and extra-operative recordings – in the 1960–1980 period, while they were 95% in the 1980–1991 period, 66% in the 1992–2000 period and 33% since then.

SEEG has provided indispensable information about epileptogenicity and EZ patterns in different epileptogenic lesions. Current indications for invasive monitoring depends on proven or suspected etiology of epilepsy: in mesial temporal lobe epilepsy, indication for invasive monitoring is limited to patients in whom clinical and video-EEG suggest an involvement of insula, suprasylvian or extratemporal regions, in patients with bilateral hippocampal abnormalities and patients with bitemporal epilepsy but lateralized seizure onset.

In patients with a tumor-associated epilepsy, invasive monitoring is indicated in patients with diffuse or megagyric forms of DNT, in patients with a tumor adjacent to eloquent cortex when a large resection is anticipated, and in patients with a neocortical temporal tumor when mesial structures are involved in seizure origin. In patients with suspected focal cortical dysplasia, invasive monitoring is indicated to identify the dysplasia when not detected on MRI, to identify the lesion limits when poorly delineated on imaging, and when a limited resection in a functional area is anticipated. In other etiologies as well as in cryptogenic epilepsy, invasive monitoring may help to confirm a focal origin of seizures when suspected on non-invasive investigations and then to suggest resection margins, or may help to reject surgery if bilateral or multifocal EZ is demonstrated.

SEEG has helped to validate non-invasive investigations, and still improves the delineation of surgical resection margins in selected candidates for epilepsy surgery.

F3C8. Deep brain stimulation (DBS) in progressive Myoclonic epilepsy

J. Vesper, B. J. Steinhoff, S. Rona, G. Nikkhah, and C. B. Ostertag
Freiburg, Germany

The surgical treatment of cases with therapy refractory epilepsy, which are not applicable for resection, took place so far predominantly by means of Vagus nerve stimulation. Based on the extensive experiences with the treatment of movement disorders, the question arises whether chronic high frequency deep brain stimulation is effective in these patients. The approach based on the connections of the subthalamic nucleus (STN) to colliculus superior (dorsal midbrain anticonvulsant zone). Individual reports of successful treatment for different types of epilepsy are present already.

A case of a 39-year-old male with progressive Myoclonus epilepsy is reported, which remained further heavily impaired despite VNS and combined antiepileptic therapy attempts. The patient was operated in the context of a study. Deep brain stimulation electrodes (Medtronic 3389) were stereotactically implanted into the STN bilateral under general anesthesia, followed by the implantation neurostimulation system (Kinetra^{TM}) after 4 days of external

stimulation and EEG recording. No complications occurred. The coordinates for the active contacts in the STN/Snr range were related to the midcommisural point: $x = \pm 11$ mm, $y = -4$ mm, $z = -6$ mm. The medication of the patient remained unchanged before and after stimulation. The VNS equipment has been switched off. Under deep brain stimulation with bilateral 3.5 V, 120 μs, 130 Hz bilateral monopolar, myoclonic seizures could be reduced so far in intensity and frequency by approx. 50%. The follow-up at present is 12 months. Since the effect are retarded, the adjustment and testing of the remaining contacts take place in the course of the next months. Positive influence of DBS in progressive Myoclonic epilepsy in an adult is reported for the first time. In the context of the following study it will have to be clarified whether the STN or other targets are applicable for DBS and which long-term results can be obtained.

F3C9. Vertical gaze palsy after thalamic deep brain stimulation for intractable tourette syndrome

L. Ackermans, Y. Temel, D. Cath, M. Kleijer, C. van der Linden, P. Nederveen, K. Schruers, M. A. J. Tijssen, and V. Visser-Vandewalle

Maastrich, Netherlands

Background. We report on a patient with tourette syndrome (TS), who developed vertical gaze palsy following the implantation of deep brain stimulation (DBS) electrodes in the medial part of the thalamus. The rostral interstitial nucleus of the medial longitudinal fasciculus (riMLF) plays an important area role in vertical gaze saccades and is located at the junction of the midbrain and the thalamus.

Case description. A 39-year-old man with intractable TS underwent bilateral thalamic DBS. Post-operatively, he complained of diplopia and dizziness. The neurological examination revealed vertical gaze palsy. The vertical oculocephalic movements were preserved, which was suggestive of a supranuclear lesion. Post-operative computed tomography (CT) scan showed that both electrodes were placed symmetrically in the medio-caudal part of the thalamus. A discrete high-density lesion was suggestive of a small hemorrhage across the midline at the distal end of the left electrode corresponding to the pretecal area including the riMLF, with sparing of the oculomotoric and the rubral nuclei. After two weeks the up- and downward gaze deficits were remarkably reduced spontaneously. Six months after the operation a maximum of up- and downward smooth pursuit eye-movement was achieved, while upward saccadic velocities were still reduced by 20–25°.

Conclusion. Vertical gaze palsy can occur as a complication after thalamic DBS for intractable TS. It should be kept in mind during the trajectory planning and electrode positioning of thalamic DBS for TS that the nucleus responsible for vertical gaze is located near the target.

F3C10. Effect of bilatéral subthalamic nucleus stimulation on postural control in advanced Parkinson's disease

S. Colnat-Coulbois, G. Gauchard, L. Maillard, G. Barroche, H. Vespignani, J. Auque, and P. Perrin

Nancy, France

Objectives. The effects of bilateral stimulation of subthalamic nucleus on postural control are still the subject of much debate. The aim of this study was to assess the impact STN stimulation on balance control in PD and to determine how basal ganglia-related sensorimotor modifications act on neurosensorial organisation of balance and motor postural programming.

Methods. Twelve subjects aged from 45 to 70 years underwent unified Parkinson's disease rating scale (UPDRS) motor (part III) clinical tests, static and dynamic posturography, shortly before and six months after bilateral implantation of electrodes into the STN.

Results. Post-operative static test showed an improvement in postural control precision both in eyes open and eyes closed conditions. Dynamic test highlighted the decrease in the number of falls and the ability of the patients to develop more appropriate sensorimotor strategies when stimulated. Sensory organization test showed an improvement of equilibrium score and thus, a better resolution of sensorial conflicts.

Conclusions. STN stimulation allowed an improvement in the ability to reacquire of the possibility to use muscular proprioception as reliable information, resulting in vestibulo-proprioceptive conflict suppression. STN stimulation has a synergistic effect with levodopa (L-Dopa) for postural control. Accordingly, non-dopaminergic pathways could be involved in postural regulation and STN stimulation may influence the functioning of these pathways.

F3C11. Pallidal deep brain stimulation (DBS) in a patient with progressive dystonia due to tyrosine hydroxylase deficiency

A. Stibal, J. A. Isa, and A. Kaelin-Lang

Bern, Switzerland

We report a 26-year-old female patient with severe generalized dystonia due to tyrosine-hydroxylase (TH) deficiency. The patient had a normal psychomotor development up to the age of three years. She then developed a slow progressive disease initially with dystonia involving oral and facial muscles. In the further course of the disease, she had a progressive generalized dystonia with painful spasms, dysarthria and ataxia without major cognitive impairment. She was in need of a wheelchair by the age of 13. All metabolic and genetic testing performed at that time could not reveal the cause of the disease. Due to the progression of the disease with the occurrence of respiratory distress and swallowing difficulties, we performed further investigation by the age of 25. A brain MRI did not show any structural change whereas a CSF investigation revealed pathological dopaminergic metabolism with a strong evidence for TH deficiency. None of the drug treatment including intrathecal baclofen injection could relieve the painful spasms. We also started a high dose L-Dopa therapy over several weeks with only a slight improvement of the spasms. In this situation, we decided to perform a DBS targeting the GPI on both sides. After surgery the dystonic component improved remarkably, the painful dystonic spasms disappeared whereas the other symptoms, including ataxia and dysarthria did not improve. The pain caused by the dystonia was declining rapidly.

In conclusion, this report further confirms that not all metabolic dopaminergic deficiencies respond to L-Dopa therapy and suggests that DBS-implantation could be an efficient treatment for therapy resistant TH deficiency. DBS seems to improve the dystonic component of the disease but not other associated symptoms.

F3C12. A simple method for frameless micro-electrode recording in movement disorders surgery

M. S. Eljamel, K. Spillane, M. Latimer, and M. Tulley

Dundee, UK

Micro-electrode recording (MER) in movement disorders surgery was found to be useful by many authors. However, some surgeons

don't use it routinely because of the perceived added risk and the added time required to map the anatomical target. We designed a simple method of staging the operation so that MER can be performed quickly and without the frame. This method involves implanting a stereotactic cube with 5 parallel trajectories at the entry point using conventional stereotactic frame under GA. At a second sitting the surface of the cube is exposed under LA and a frameless micro-drive is fitted to the cube and MER is performed. Using this method in 80 consecutive procedures we managed to reduce the number of simultaneous MER tracks to 3 per procedure (240 MER tracks). This technique of MER altered the final position of the DBS from central in 37.6% and the final depth by more than 2 mm in 33%. The average duration of MER including DBS implantation was 90 min per side with a risk of haemorrhage of 1.13% per track. This method is of MER is simple, quick, safe, reliable and altered the final position of the DBS in about a third of patients by more than 2 mm.

F3C13. Short term follow up results of GPi–DBS for dystonia

T. Ochiai, T. Taira, S. Goto, M. Hayashi, and T. Hori
Tokyo, Japan

Purpose. There are many reports that GPi-HFS for Generalized and Segmental dystonia is effective. We show our experience of GPi–HFS for dystonia.

Material and methods. Thirty-three (F:M = 9:24, mean age 43) generalized and segmental dystonia cases were treated with GPi–DBS. 31 cased were DYT1 negative and 2 cases were not examined.

Our protocol was that 4 electrodes (2 electrodes in one side) were inserted temporarily in postventral pallidum (PVP) and 3 mm anterior from PVP. After stimulation test in three weeks, optimal electrodes were selected.

Evaluation was performed with BFM scale in pre- and discharge (2 months) and >6 months follow up.

Results. Total BFM scale was improved in 60.35% (pre: 37.7 and discharge: 15.0). In last follow up (>6 months), BFM scales was 9.0, which was 77.13% improvement. Concerning with a duration, an effect is low in cases more than five years. Concerning with a sex, men is 53.4% improvement and women 44.3% improvement.

Conclusion. GPi–DBS was effective not only DYT1 but also non-DYT1 cases. Further improvement more than 15% was seen more than a half year. Men is more effective than women.

Psychiatry

S1A1. Limbic leukotomy – like stereotactic procedure for treatment of impulsive-aggressive disorder

F. Jiménez, J. Soto, L. Ramírez, E. Guerrero, F. Velasco, G. Castro, J. D. Carrillo-Ruiz, and E. García
Mexico City, Mexico

Sterotactic neurosurgical procedures have been used for the treatment of major depression, obsessive-compulsive disorder, anxiety disorder, substance addiction and in impulsivity/aggressively disorder. Few prospective studies utilizing a valid tool for determining a statistically significant change exist. Aggressiveness is a frequent and disabling symptom in psychiatric patients amenable to neurosurgery which was evaluated by means of a pilot prospective study in 12 patients with aggressiveness/impulsivity disorder besides other psychiatric disorders. Patients refractory to conventional treatment where selected, after obtaining written consent from their family Bilateral anterior capsulotomy and cingulotomy where performed by means of a stereotactic radiofrequency procedure. The patients where evaluated at 3 and 6 months postoperative by means of the Portland Adaptability Scale and the Global Functioning Scale of the DSM–IVR.

Results show a statistically significant decrease in aggressive behavior and an improved social function according to the Wilcoxon test ($p < 0.002$). Collateral effects where hyperphagia, somnolence, disinhibition and hyper sexuality during the first month only. This is the first attempt of a prospective study of a group of techniques that could benefit this group of patients.

S1A2. Cingulotomy for refractory obsessive-compulsive disorder. Over one-year follow-up of five patients

M. Birski, M. Harat, M. Rudas, A. Borkowska, and J. Rybakowski
Bydgoszcz, Poland

Objective. The purpose of this study was to assess effectiveness and safety in patients who received stereotactic bilateral anterior cingulotomy as a treatment for intractable obsessive-compulsive disorder (OCD).

Method. Five patients with refractory OCD was carefully selected and evaluated for neurosurgical treatment by committee which consist of psychiatrists, neuropsychologists and neurosurgeons. Therefore these patients were operated between December 2002 and August 2005 in the Department of Neurosurgery of Military Clinical Hospital in Bydgoszcz. All patients undergone stereotactic bilateral anterior cingulotomy using BrainLab frame and software with automatic CT/MRI image fusion and Elekta Neuro Generator for electro coagulation. Preoperative and at least one year follow-up assessment was conducted by using Yale-Brown Obsessive Compulsive Scale (Y-BOCS) and other neuropsychological tests (WCST, N-back, TMT A, B, Stroop A, B).

Results (Till now. It will be modified). Two patients improved significantly and they met criteria for treatment responders (40%). Two others were partial responders (40%). One patient didn't improved (20%). Cognitive and other significant adverse effects were not reported.

Conclusion. Cingulotomy is the safe method for treatment of intractable OCD which allows to achieve significant improvement in part of patients who previously were treatment-refractory.

S1A3. Capsulotomy for OCD – long-term efficacy and side-effects

C. Rück, A. Karlsson, P. Svanborg, B. A. Meyerson, and M. Åsberg
Stockholm, Sweden

Context. Neurosurgical procedures such as capsulotomy are sometimes used in severe and treatment refractory cases of obsessive-compulsive disorder as a treatment of last resort.

Objective. To evaluate the efficacy and safety of capsulotomy in OCD.

Design. Non-controlled before–after trial. Long-term follow-up.

Setting. University hospital referral center.

Patients. A referred sample of 25 consecutive OCD patients having undergone capsulotomy since 1988.

Intervention. Uni- or bilateral capsulotomy.

Main outcome measure. Yale-brown obsessive-compulsive rating scale (Y-BOCS).

Results. Mean Y-BOCS was 34 preoperatively and dropped to 18 at long-term follow-up ($p < 0.0001$). Two neurosurgical complications related to radiosurgery were reported. A mean weight gain of 6 kg was reported in the first postoperative year. Two patients were severely disinhibited postoperatively. Ten patients were considered to sufferer from significant problems in the area of executive functioning, apathy or disinhibition. Only 2 patients achieved remission from OCD without substantial side effects.

Conclusions. Capsulotomy is effective in reducing OCD symptoms but carries a significant risk of substantial side effects.

S1A4. Gamma knife capsulotomy for intractable obsessive compulsive disorder

M. Goldman, G. Norén, S. A. Rasmussen, R. Marsland, B. Greenberg, and C. Lindquist
Providence, USA

Introduction. Obsessive compulsive disorder (OCD) is a major cause of disability worldwide. Most patients demonstrate adequate response to pharmacological and behavioral therapy. However, 10–20% of OCD patients fail to respond. The anterior limb of the internal capsule has been used as a stereotactic target since the 1950s. The safety and efficacy of gamma capsulotomy was prospectively analyzed.

Methods. A total of 37 patients were treated and followed for at least two years after having met strict inclusion criteria followed by thorough pre-treatment evaluation. In the first 15 patients (group 1), bilateral 4 mm shots to a maximum dose of 180 Gy were placed in the middle third of the capsule in the coronal plane. Bilateral shots ventral to the existing were added in 13 of these patients. In the subsequent 22 patients (group 2) double bilateral shots were placed upfront, covering the ventral 1/3–1/2 of the capsule 8–10 mm anterior to the anterior commissure. Extensive test batteries including YBOCS and GAF were used to evaluate the patients.

Results. In group 1, one of 15 patients demonstrated full response to single shot treatment. After a second shot, a total of 5 of the 15 patients were full responders and 2 partial responders. In group 2, 15 (68%) of the 22 were full responders and 5 (22%) partial responders. One patient developed apathy secondary to frontal lobe edema.

Conclusions. Gamma ventral capsulotomy seems to be highly effective and safe for treatment of severely ill OCD patients refractory to conventional therapy.

S1A5. Deep brain stimulation for obsessive compulsive disorder

P. R. Schuurman, D. J. A. P. Denys, and D. A. Bosch
Amsterdam, Netherlands

Objective of a controlled study is to test the hypothesis that bilateral DBS in the nucleus accumbens of patients with severe treatment-refractory OCD can lead to long-term improvement of OCD symptoms and functioning, without unacceptable side-effects. The study design is a double-blind cross-over trial in which sixteen patients are to be included. Selected patients are reviewed by an independent approval-board. After electrode implantation an optimisation period is used to test stimulation parameter settings and check for side-effects of stimulation. In the ensuing cross-over period of three months without and three months with stimulation, the order being determined by randomization, patients are followed closely on an outpatient-basis. Thereafter the study continues with stimulation on in all patients.

S1A6. Thermal anterior capsulotomy for chronic, severe, treatment-refractory major depression

K. Matthews, D. M. Christmas, and M. S. Eljamel
Dundee, UK

Major depression (MD) represents the fourth largest cause of morbidity and disability worldwide. Although we have advanced our understanding of the mediating pathophysiology, our knowledge of how best to manage such illnesses, and in particular, chronic and 'treatment-refractory' forms (TRD), is severely limited. For a small number of such patients, ablative neurosurgery may offer valuable symptomatic improvements.

Anterior capsulotomy (ACAPS) appears to be an effective neurosurgical treatment for obsessive compulsive disorder and for some other chronic, severe, anxiety states. However, the adverse effect burden, particularly at long-term follow-up, has raised concerns about the overall risk/benefit ratio.

Here, we report on the long-term clinical outcomes (range 12–152 months) for 20 patients with chronic, severe TRD who were treated within our national specialist service by thermal ACAPS.

At long-term follow-up (median = 88.6 months), 10 patients (50%) met strict criteria for 'response' [<50% reduction in baseline Hamilton (HAMD-17) or Montgomery-Asberg Depression Rating Scale (MADRS) scores], whilst 8 of these (40%) met full criteria for 'remission' [HAMD-17 score; 7 or MADRS score; 10). Seven patients went on to have further neurosurgery (Anterior Cingulotomy: $n = 6$; extended Anterior Capsulotomy: $n = 1$), of whom 3 (43%) subsequently met criteria for remission at long-term follow-up (median = 53.2 months).

ACAPS was associated with a favourable outcome in 50% of our patients with chronic, severe TRD. These data are, to our knowledge, the first systematically collected outcome data for the use of ACAPS to treat TRD in over 40 years.

S1A7. Deep brain stimulation of the right nucleus accumbens in a patient with tourette's syndrome. Case report

M. Zabek, M. Sobstyl, H. Koziara, and A. Friedman
Warsaw, Poland

Introduction. The aim of his study is to present a patient with tourette's syndrome (TS) treated by unilateral right nucleus accumbens stimulation.

Case report. We present a case of 31-year-old man with intractable motor and vocal tics and also with self injurious behaviors. The pharmacotherapy completely failed to improve his tics and behavior. The patient was treated by unilateral right nucleus accumbens deep brain stimulation. Because of severe tics and unpredictable movements the operation including neuroimaging was performed in general anesthesia. The coordinates of nucleus accumbens were calculated according to the anterior commissure. The stereotactic target was also directly visualized by MRI T1 weighted images. The MRI images were merged with stereotactic CT images and the best trajectory to the target was planned using Treon 3 Medtronic. The quadripolar electrode (3389) was inserted to the right nucleus accumbens, and connected to stimulator (Itrel 3). In the postoperative period (20 months) the stimulation dramatically improved patients behavior. The self injurious movements completely disappeared. The severity and frequency of vocal and

motor tics were decreased by 80% during stimulation when compared to preoperative condition. Side effects were associated only with inserted equipment and included malfunction of pulse generator, which was reimplanted.

Conclusions. Nucleus accumbens stimulation effectively alleviates motor and vocal tics. This approach is also highly effective in complete disappearance of self injurious behavior.

S1A8. Deep brain stimulation for the treatment of resistant Gilles de la tourette syndrome. Intermediate and long term follow-up results of a consecutive surgical series of 18 patients

D. Servello, M. Porta, M. Sassi, and A. Brambilla
Milan, Italy

Few case reports of deep brain stimulation (DBS) for the treatment of severe Gilles de la tourette syndrome (GTS) have been documented in the literature to date. Protocols varied widely, with different areas of the brain being stimulated. Authors hereby present their surgical series of 18 cases treated from November 2004, with GTS (17–46 years; 14 = male) treated at the centro-median parafascicular complex and ventralis oralis nucleus of the thalamus, bilaterally. Patients were resistant to at least six months of treatment with standard medications, including typical and atypical neuroleptics, dopamine depleters (tetrabenazine), clonidine, guanfacine, benzodiazepine derivatives, botulinum toxin, levetiracetum, and selective serotonin reuptake inhibitors (in all 18 cases). Though satisfying the inclusion criteria for our surgical series, one patient was treated bilaterally in the internal glubus pallidum due to her dystonic-type tics, and was excluded from the statistical analysis. This patients is however showing results similar to those of the reported surgical series at each of the follow-up endpoints. Patients with cognitive impairment, pseudo-tics and psychosis were excluded. Prior to DBS, all patients had marked to severe social impairment, as measured by standardised schedules assessing the patients, as well as a caregiver interview. Local ethical permission and written informed consent were obtained in all cases. Intra-operative micro-recording during DBS was obtained for all the patients. DBS surgery was performed under general anaesthesia in 7 patients whose tics were very severe, while in the remaining cases the procedure was undertaken using local anaesthesia and sedation, allowing intraoperative macro-stimulation. Results will be presented and discussed. We suggest that DBS should be undertaken only in centres, which are well acquainted both with the technique and with the assessment and treatment of GTS patients. Rigorous internationally accepted protocols should ideally be constructed, based on evidence from studies such as ours.

S1A9. Cyberknife radiosurgery for psychiatric disorders

M.-C. Kim, T.-K. Lee, B.-O. Choi, I.-B. Choi, and Y.-N. Kang, and J.-S. Jang
Seoul, Korea

Objective. Stereotactic psychosurgery is known as one of effective means of treating in some medically intractable psychiatric disorders. The authors report cyberknife radiosurgery for patient with refractory major depression and obsessive-compulsive disorder (OCD).

Methods and materials. Eleven patients underwent stereotatic psychosurgery for medically intractable psychiatric disorders. All were referred from psychiatrist of these disorders. Three was major depression and eight were obsessive-compulsive disorder (OCD)s. Subcaudate tractomy was done for patient with major depression and ant cingulotomy was done for patients with OCD. Hamilton depression scale (HAMD) was used for clinical improvement of depression and the results of OCD were evaluated with YBOCS (Yale Brown Obsessive Compulsive Scale) and VAS (Visual Analogue Scale). Computed tomography (CT) was used in patient for localization of target. A thin-section CT scan (240 slices, thickness 1.0 mm) was made through the entire head, showing the anatomy of ventricle and corpus callosum. The CT images were networked to the cyberknife workstation, where anterior portion of cingulum and subcaudate portion of white matter was outlined. The 80% isodose line was prescribed in a conformal fashion to an 7-mm diameter of the target. The lesions were made with cyberknife radiosurgery with LINAC.

Results. In two patient with depression, The average HAMD declined from 30 to 8. Patient returned to previous social life. An signal changes in target area was seen in T2-weighed images in MRI performed from 3 months after the treatment. The significant lesions were made with the volume of 1.94 cm^3 and the surrounding margin of low attenuation at 6 months. With follow up in eight patients with OCDs, average YBOCS of six patient during 3 months decline from 34 to 24 and clinical improvement was evaluated in two patients. T2-weighed images in MRI showed the signal changes in target areas at 3 months after the treatment. There was no operative mortality and no significant morbidity except one case of fatigue and malaise.

Conclusion. With these results authors assumed that cyberknife psychosurgery could be one of safe and effective therapeutic methods in several medically intractable psychiatric disorders.

S1A10. Neurosurgical treatments for depression: a comparison of anterior cingulotomy, anterior capsulotomy and vagus nerve stimulation

M. S. Eljamel, K. Matthews, and D. M. Christmas
Dundee, UK

Ablative neurosurgical procedures are offered by a number of treatment centres internationally as one component of the management of patients with the most chronic, severe, and treatment refractory forms of affective illness – particularly depression and OCD. There have been very few studies of the comparative efficacy of different procedures.

Within our national specialist service, we have prospectively studied the 12-month clinical outcomes for 15 patients with comparable severity of illness and dysfunction who have been treated for depression by ablative anterior capsulotomy (ACAPS, $n = 5$), ablative anterior cingulotomy (ACING, $n = 5$), or vagus nerve stimulation (VNS, $n = 5$). Primary outcome measures were collected at baseline and at 12 months post-surgery. Clinical ratings included self-rated instruments and objective assessments conducted by independent observers who rated videotaped clinical interviews.

In this presentation, we shall present these outcome data according to different definitions of response and recovery. Even within this modestly sized sample, employing strict definitions for 'response' and 'recovery', the outcomes for ACING appeared superior at 12 months follow-up compared with those for either ACAPS or VNS. However, both ACAPS and VNS did appear to confer some therapeutic effect for some patients.

These data, although limited by small sample size and by the absence of a non-operated group, represent a unique, contemporary comparison of neurosurgical interventions for chronic, severe

and treatment-refractory depression. Anterior cingulotomy may represent a superior treatment for such patients than either anterior capsulotomy or VNS.

S1A11. Neurosurgery for obsessive-compulsive disorder, other anxiety disorders and depressive disorders – Cochrane review

D. Christmas, K. Matthews, and M. S. Eljamel
Dundee, UK

Historically, neurosurgery for mental disorder (NMD) has been advocated as a treatment for only the most severe and chronic psychiatric illnesses, and in the Western World is currently used for only three disorders: major depression, obsessive-compulsive disorder; and severe anxiety disorders. However, doubts still remain about the efficacy of NMD among both the general public and clinicians. One of the main criticisms of NMD has been the absence of randomised controlled trials (RCTs) of its outcome, and the absence of a systematic review of the outcomes of ablative NMD makes assessment of the effectiveness of such treatments difficult.

There have been a small number of controlled trials, but as yet, no RCTs of ablative neurosurgery have been reported, despite protocols being published as early as 1977. Nerve treatments such as vagus nerve stimulation (VNS) and deep brain stimulation (DBS) potentially allow for controlled trials to be performed.

We will summarise some of the historical difficulties in assessing NMD and provide an overview of the existing literature. We will describe the development of a protocol for a systematic review and meta-analysis (currently published by the Cochrane Collaboration) and highlight some of the challenges involved in such a process. We will also present an update of the review. Finally, we will propose some guidelines for the reporting of trials of NMD which will make comparisons across centres more valid. These guidelines will include proposals regarding: subject characteristics and treatment history; surgical procedure; imaging; assessment of symptomatic outcome; and assessment of adverse effects.

Movement disorders III

S1B1. In vivo modulation of midbrain serotonin neurones by the subthalamic nucleus

Y. Temel, V. Visser-Vandewalle, L. Boothman, P. Magill, H. W. M. Steinbusch, and T. Sharp
Maastrich, Netherlands

Modulation of the function of the subthalamic nucleus (STN) by stimulation of surgically implanted electrodes relieves motor dysfunction in animal models of Parkinson's disease and has striking and long-lasting therapeutic effects in patients. Although many thousands of patients have benefited from this procedure, substantial amount of patients can experience debilitating non-motor (psychiatric) side effects. The neural basis of these non-motor side effects is not known. There is little evidence of direct connections between the STN and midbrain 5-HT (serotonin) neurones but it is notable that many of the psychiatric effects of STN stimulation, such as depression, suicidality and increased impulsivity, can be triggered by low 5-HT function. Our unique expertise in both the clinical application of STN stimulation and the basic physiology 5-HT and the basal ganglia, led us to investigate the effects of STN stimulation on the firing of midbrain 5-HT neurones as well as depressive-like behaviour in the rat.

Bilateral electrical stimulation of the STN at stimulation parameters used clinically (130 Hz, 100 μA), both inhibited the firing rate (by 40–50%) and disrupted the firing pattern of the vast majority of raphe 5-HT neurones tested but did not influence neighbouring non-5-HT neurones This striking effect was frequency- and current-dependent, was not elicited by electrodes located in either neighbouring or remote structures, and was still present after dopamine depletion. The effect of STN stimulation on 5-HT neuronal firing was mimicked by STN injection of the inhibitory chemical agent muscimol (GABAA agonist), indicating that high frequency STN stimulation produces the observed effects by a net inhibition of STN output.

In additional experiments utilising a widely used and validated behavioural model of depression, the forced swim test, STN stimulation caused a marked increase in immobility and reduced swim time, indicative of profound behavioural depression. This behavioural effect was completely reversed by a course of treatment with the selective 5-HT reuptake inhibitor, citalopram (10 mg/kg s.c. for 14 days).

Collectively, these data provide the first evidence that electrical stimulation of the STN, at parameters used to relieve the motor deficits of Parkinson's disease, causes a striking inhibition of 5-HT neuronal activity which is directly linked to the induction of depressive-like behaviour. This effect may contribute to the psychiatric disturbances observed in patients subject to STN stimulation and provide an experimental basis for their clinical management. The powerful link between the STN and the 5-HT system constitutes evidence for the existence of a novel 'limbic-motor interface' for the integration and processing of sensorimotor, associative and emotional information.

S1B2. Combined implantation of PPN and STN improve gait akinesia and freezing in severe Parkinsonian patients

P. Mazzone, A. M. Lozano, A. Peppe, P. Stanzione, S. Galati, A. Insola, E. Scarnati, and A. Stefani
Rome, Italy

Background. It has been suggested that modulation of the activity of the pedunculopontine nucleus (PPN) may be beneficial in the treatment of the motor and gait disturbance in Parkinson's disease. Here, we report the clinical effects in severe PD patients treated with PPN DBS examined during a 6 months follow-up after surgery.

Methods. Patients underwent simultaneous microelectrode recording guided bilateral implantation of DBS electrodes in the STN and PPN. Clinical effects were evaluated 1 day and 1, 3 and 6 months after surgery. Patients were assessed, in the on and off medication state and with both STN or PPN stimulators on or off or with one target being stimulated and the other not.

Findings. Bilateral PPN–DBS at 25 Hz in the off medication state produced an immediate 42% clinical amelioration declining around 31% improvement (at 3 and 6 months) in the motor UPDRS subscale. Bilateral STN–DBS at 130–185 Hz led to a 59% reduction. PPN–DBS, per se, was peculiarly effective against freezing of gait instability. In addition, four weeks after the steady-state reintroduction of drug therapy (mean 425 mg/die L-Dopa), the association of STN and PPN–DBS provided a slight but significant further improvement while STN–DBS alone did not.

Interpretation. These finding highlight the possibility that, in advanced PD patients with severe axial signs, PPN–DBS could be useful in improving gait and in optimizing dopamine-mediated on-state.

S1B3. Does a limbic subthalamic nucleus exist on humans? Effect of deep brain stimulation on fear recognition in Parkinson's disease

S. Raoul, I. Biseul, P. Sauleau, C. Haegelen, D. Drapier, S. Drapier, F. Lallement, I. Rivier, Y. Lajat, and M. Verin
Nantes, France

Behavioural disturbances such as disorders of mood, apathy or indifference are often observed in Parkinson's disease (PD) patients with chronic high frequency deep brain stimulation of subthalamic nucleus (DBS–STN). Neuropsychological modifications causing these adverse events induced by STN–DBS remain unknown, even if limbic disturbances are hypothesised. The limbic system supports neural circuits processing emotional information. The aim of this work is to evaluate changes of emotional recognition in PD patients induced by STN–DBS. Thirty PD patients were assessed using a computerised paradigm of recognition of emotional facial expressions [Ekman, P., and Friesen, W. V. (1976). Pictures of facial affect. Palo Alto, CA: Consulting Psychologists Press], 15 before STN–DBS and 15 after. The two patients groups were compared to a group of 15 healthy control subjects. One series of 55 pictures of emotional facial expressions was presented to each patient. Patients had to classify the pictures according to seven basic emotions (happiness, sadness, fear, surprise, disgust, anger and no emotion). The intact ability to percept faces was firstly assured using the Benton recognition test. Recognition of fear expressions was significantly and selectively reduced in the post-operative group in comparison to both pre-operative and control groups. Our results demonstrate for the first time a selective reduction of recognition of facial expressions of fear by STN–DBS. This impairment could be the first neuropsychological marker of a more general limbic dysfunction, thought to be responsible for the behavioural disorders reported after STN–DBS.

S1B4. Hardware related complications in subthalamic nucleus deep brain stimulation: long term follow-up of 78 patients

J. González, J. Rumià, Dra. G. Villalba, S. Candela, J. Poblete, C. García-Amorena, F. Valldeoriola, and E. Ferrer
Barcelona, Spain

Objective. To describe and to analyse complications derived from implanted prothesis in our series of advanced Parkinson disease (APD) patients who underwent subthalamic nucleus deep brain stimulation (STN–DBS) and long-term follow-up.

Material and methods. Retrospective study of 78 consecutive patients undergoing 89 STN–DBS procedures (=164 electrodes) and 41 generator replacements at our institution from 11/1997 through 04/2005. Minimum follow-up: 12 months.

The authors undertook an statistical analysis of: 1) Frequency and kind of hardware-related complications. 2) Patient variables (age, vascular risk factors (VRF), immunosupression, cerebral MRI), prothesis variables (type of electrode and pulse generator) and surgical technique parameters (antibiotherapy, number of tracks, time of surgery, number of procedures or replacements, generator position) and their statistical association with STN–DBS hardware-related problems.

Results. 12.35% of adverse events were registered: 3 generator migrations (3.3%), 3 cases of generator failure (3.3%), 2 brain electrode displacements (2.2%), 2 skin erosions over implanted hardware (2.2%) and 1 electrode breakage (1.1%). Procedure duration ($p = 0.047$), immunosuppression ($p = 0.02$), number of generator replacements ($p = 0.01$) and generator positioning ($p = 0.045$) tend to increase complication risk in the follow-up.

Conclusion. Although there were no fatalities or permanent severe disabilities, the authors found non worthless number of deferred adverse events in relation with implanted device. Implant exteriorization was considered the most important complication since implied system removement and treatment interruption in all the cases. Identified statistically significant variables were considered primary target for avoidance of hardware-related complications.

S1B5. Complications, side effects and failures of deep brain stimulation

A. Franzini, C. Marras, G. Tringali, and G. Broggi
Milano, Italy

Introduction. In the last decade the number of implanted deep brain electrodes rised as far as the search for novel therapeutic fields. The main advantage of DBS is the reversibility of the induced effects and this feature induced many neurologists to indicate DBS to a wider patient population. Nevertheless DBS, although minivasive, is a surgical procedure and it has a certain amount of complications, side effects, and failures. This paper would answer to the question "How benign DBS is?".

Patients and methods. We analyzed 450 consecutive implants of deep brain electrodes performed in 270 patients treated between 1995 and 2005. Homogeneous series of operated patients includes advanced Parkinson disease (109 cases), Dystonia (37 patients), Tremor (27 patients), chronic cluster headache (21 patients). The remnant number of patients underwent surgery for rare orphan disease like SUNCT, Meige syndrome, atypical facial pain, mayor behavioural disorders and refractory epilepsy.

Results and conclusions. The incidence of haemorrhages, infections and hardware failures have been calculated and the risk factors has been carefully analyzed in the whole series. The side effects of DBS have been recorded and related to the stimulated targets (STN, GPi, VIM, VOA, VOP, ZI, CMPf, pHyp). Failures of DBS have been analyzed only in the larger series of patients (STN and GPi). In the cumulative series of patients a significative improvement of a previously refractory disease has been obtained in more than 70% of patients. These results confirm DBS as a safe and promising procedure to treat otherwise refractory neurological disease in spite of the incidence of complications, side effects and failures.

S1B6. Subthalamotomy through chronic deep brain stimulation electrode in Parkinson disease

J. Molet, R. Rodríguez, J. Kuliseusky, A. Gironell, B. Pascual, E. Guardia, A. Gil de Bernabé, and F. Bartumeus
Barcelona, Spain

Infection rate in patients treated with deep brain stimulation in Parkinson disease is as high as 4%. Very often the infection are secondary a skin ulcers on the electrodes or the extension wires of the stimulation device. Superficial infections are well managed with surgical cleaning of the wound and reposition the wires; but, in few cases, to withdrawal of the brain electrodes is mandatory in order to cure the infection, wait 6 months and reimplant the electrodes. Patients with a very thin skin can be troublesome to reimplant the DBS device.

In these cases a subthalamotomy can be an alternative. These procedure can be performed at the moment to withdrawal the electrodes in order to avoid a second surgery.

Since 1995 till 2004 150 patients with Parkinson disease have been treated wit DBS, palidal stimulation until 1997 and subthalamic nucleus since then. Skin ulcers and infection were present in four patients of the last group, in two out of them staged removal the electrodes was performed.

A staged bilateral subthalamotomy was performed in these patients. Three subthalamic lesions were performed through the chronic electrode (Medtronic 3389).

The lesion was centred at the most effective contacts. Patient was under local anesthesia and anesthesiologist survillance. Stimulation at 130 Hz, 90 μsec amplitude was increased until to disclose side effects at the different contacts. The lesion was performed by a Radionics model C-Plus, the intensity of electrical current was progressively increased until improvement of the rigidity. No adverse side effects were observed.

S1B7. Subthalamic stimulation is more cost-effective than best medical management in advanced Parkinson's disease

J. Rumià, S. Candela, F. Valldeoriola, E. Ferrer, and E. Tolosa

Barcelona, Spain

Background. Deep brain stimulation of the subthalamic nucleus (STN–DBS) is a safe and effective although so-considered expensive treatment for advanced Parkinson's disease (APD).

Objective. To compare the cost-effectiveness (C/E) of STN–DBS versus the best medical management (BMM) in APD.

Methods. We conducted over 12 months a prospective comparative study between two groups of 15 APD patients each: A group with consecutive patients with bilateral STN–DBS, and a group of STN–DBS candidates receiving BMM while waiting for STN–DBS. Motor scales and quality of life were double-blind assessed at 3, 6 and 12 months. Costs attributable to PD were estimated by recording all medical and non-medical health care expenses in 2004 euros. Quality-adjusted life year (QALY) was the effectiveness measure.

Results. At 12-month follow up, the unified Parkinson's Disease Rating Scale (UPDRS) total score was a 58.58% of the baseline score in STN–DBS patients, while increased to 123.34% in the BMM group. UPDRS IV lowered to 23.50% in the STN–DBS group and rose to 110.03% in the BBM group. The mobility section of the PD Quality of Life Questionnaire (PDQL-39) score in the STN–DBS group decreased to a 47.45% while reached 109.67% of the baseline score during the study among BMM patients. At 12 months, the mean QALY scores for STN–DBS patients were 43% higher than those of BMM patients. The incremental C/E ratio of STN–DBS with respect to BMM was □34.319/QALY. Incremental C/E ratios above □100.000/QALY are not usually considered cost effective.

Conclusions. STN–DBS may be more cost-effective than BMM in treating APD patients.

S1B8. Different psychosocial subtypes of Parkinsonian patients undergoing bilateral subthalamic stimulation

K. Kalteis, H. Standhardt, I. Kryspin-Exner, T. Brücke, D. Volc, and F. Alesch

Vienna, Austria

Background. Bilateral subthalamic deep brain stimulation (STN–DBS) is an effective treatment to improve motor function in patients with advanced Parkinson's disease (PD). The effects of STN–DBS on mood are not clear. Some studies reported positive changes in mood, others an adverse influence. Therefore we have performed a prospective study to examine the effects of STN–DBS on mood and quality of life.

Methods. We examined the influence of the STN–DBS on psychosocial functions. The assessment consists of self rating questionnaires: Profile of Mood States, Beck Depressions Inventory, State Trait Anxiety Inventory, Symptom Checklist 90-R, and Sickness Impact Profile. The assessment was carried out on thirty three PD patients before STN–DBS (six weeks, four and two weeks) to establish a baseline level in mood state and three, six and twelve months after chronic bilateral deep brain stimulation of the STN. To identify different patient types we calculated a cluster analysis and confirmed this result with a discriminant function analysis. At twelve months postoperatively we repeated the discriminant function analysis to see the time course of the subtypes.

Results. At baseline the patients mean age was 60.15 (7.88), the disease duration was 13.52 (4.82) years. We assessed 22 men and 11 women. A cluster analysis of the baseline data identified four patient subtypes. Patients in cluster 1 described their well being as very low and suffered from a moderate sickness impact. In Cluster 2 the patients had a low well being and a high sickness impact. The two other subtypes presented a better mood state compared to the others. Patients in cluster 3 suffered only from a slight decreased well being and a low sickness impact. The subtype 4 presented a good well being and a little sickness impact. The subtypes did not differed in age, education years and disease duration. A trend toward significant were seen in cognitive screening (Cluster 2 showed the lowest MMSE score, $p = 0.018$). The discriminant function analyses confirmed the four subtypes ((Wilks' $\lambda = 0.000$, $\chi^2 = 161.34$, $p = 0.000$). The classification result predicted the group membership in the four clusters with 100%. One year postoperatively the psychosocial functions improved in all patients, but the four subtypes differed significantly from each other. The group membership could be again correct classified. Subtypes 1 and 2 also improved their mean scores, but they still exhibited an impaired psychosocial pattern compared to the other groups.

Conclusion. We identified preoperatively four different psychosocial patterns in Parkinsonian patients. The subthalamic stimulation improved the psychosocial functions up to one year postoperatively, but the four subtypes showed again different patterns of psychosocial functioning. Clusters 1 and 2 presented an impaired pattern compared with the other two groups. They should receive psychosocial support before and after subthalamic stimulation to enhance their ability to cope with disease and treatment burden.

Posters

P1. Role of local inductive cues on striatum precursor cell immunophenotype

P. Gallina, M. Paganini, M. Marini, C. Crescioli, and G. B. Vannelli

Firenze, Italy

Patients with Huntington's disease have recently benefited from intracerebral cell therapy, which aims to substitute damaged striatal neurons by striatal neuroblasts obtained from fetuses after elective abortion. Striatal metabolic heterogeneity has been reported after

striatal neural transplantation in Huntington's disease (Lancet Neurol 2006, 5: 303). The causes of such heterogeneity are unknown. Integration of a transplant relies not only on patient-related characteristics but also on transplanted neural graft features. Indeed, although restricted gene expression patterns regulate distinct compartments of developing brain, inductive signals from adjacent tissues might regulate regional development patterning as well (Development 2002, 129: 233). To study the mechanisms underlying locally inductive cues in human developing brain, we established cell cultures isolated from fetal cortex, ganglionic eminence and midbrain/hindbrain, from fetal tissues (gestational age 7–12 weeks). We analyzed both tissues and derived primary cell culture by immunocytochemistry and FACS for neural stem and differentiation markers (Biomaterials 2005, 26: 687). Tissues and cells were positive for CD133, CD90, CD44, CD147 and CD71, immature neural cell surface markers, and positive for nestin, sox-2 and pax-6, cytoplasm neural stem marker. Although these markers were all widely expressed, the percentage was different depending on gestational age and anatomical compartment. The vast majority of neurons expressed GAD 65/67 (GABA-synthesizing enzymes). Cells from fetal striatum changed their immunophenotype when cocultured with cells derived from fetal cortex or midbrain/hindbrain. In fact, they were capable of multi-differentiation into mature neurons, astrocytes and oligodendrocytes. Thus, local inductive cues seem to participate in commissioning the regional identity during brain development.

P2. Experience with neuronavigation assisted surgery for cerebral metastases

I. Aksiks, R. Sverzickis, E. Valeinis, E. Pukitis, R. Putnins, and A. Ribenis
Riga, Latvia

Objective. This study retrospectively summarizes our experience of neuronavigation (NN) guided surgery for cerebral metastases (MTS).

Methods. Since November 2000 we have broadly applied NN in cranial surgery. Our first NN system was Zeiss surgical microscope navigator (SMN), from November 2002 – Medtronic StealthStation Treon, and from November 2005 – Medtronic StealthStation Plus. All NN systems were combined with Carl Zeiss OPMI 200 NC4 microscope.

Results. During a 65-month period we have used NN assistance totally in 232 patients with 249 planned trajectories. Twenty-seven patients (11.64%) had cerebral MTS. Age range was 32–74 years (mean – 56.4). Fourteen were male, 13 – female. Eight patients (29.63%) of MTS cases had multiple MTS (2–3) which were extirpated during one surgery session. Twenty-seven patients had totally 37 lesions. For 35 lesions NN targeting was applied, supratentorially – 34 lesions, infratentorially – 1 lesion. Twenty-one patient (77.78%) had various types of carcinoma MTS, 5 patients (18.52%) had melanoma MTS, and 1 patient (3.7%) – lymphoma MTS. As a primary tumour most often was lung cancer, followed by separate cases of breast cancer, renal cancer, prostate cancer and colon cancer. In 11 patients (40.74%) no exact primary tumour was found.

Three patients were reoperated during a 6-month period due to recurrence. Two patients died in a month period after surgery. For the rest 19 deceased patients the median survival time was 5.8 months, with the longest survival time – 15 months.

Conclusions. NN provides reliable surgery for cerebral MTS and is indispensable neurosurgical tool especially in cases with multiple lesions.

P3. Frameless stereotactic brain biopsy

A. Dario, E. Cartini, F. Pessina, M. Soldati, C. Scamoni, and G. Tomei
Varese, Italy

Aim. To evaluate the effectiveness and safety of the frameless stereotactic brain biopsy.

Clinical material and method. In the last two year we have performed frameless stereotactic brain biopsy in 35 patients with supratentorial lesions using the Stealth Station (Medtronic, USA) as neuronavigation system with Navigus system (Medtronic, USA) to carry out the specimen. In all patients but two the preoperative imaging was obtained with post contrast MRI immediately prior to surgery. We used always 10 fiducials markers. The specimens has been examinated intraoperatively by neuropathologist. The duration of the procedure is calculated. The method of anaesthesia as well as the surgical complications are recorded. The postoperative CT was performed by one hour.

Results. All patient but two with cerebral abscess had neoplasms. In one patient (2.8%) the biopsy should be repeated since in the first operation only necrotic material was achieved. The local anaesthesia was used in 86% of the patients. The mean operation time of the entire procedure was 120 minutes. The postoperative CT demonstrated small asymptomatic haemorrhage in 8 patients (22.8%) and a symtomatic haemorrhage in one patient (2.8%) that presented contralateral haemiparesis. In two patients (5.7%) we observed a temporaneous neurological impairment.

Discussion. Frameless stereotactic biopsy is a reliable and safe method to obtain brain specimen. The possibility to discharge the patient within 24 hours after surgery is not prevented by frameless procedure.

P4. Pure endoscopic endonasal approach aided by neuronavigation for treatment of pituitary macroadenomas

M. Iacoangeli, L. Fasanella, C. Carlucci, A. Ciabattoni, A. Di Rienzo, and M. Scerrati
Ancona, Italy

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Discussion. Frameless stereotactic biopsy is a reliable and safe method to obtain brain specimen. The possibility to discharge the

patient within 24 hours after surgery is not prevented by frameless procedure.

P5. Electrical stimulation of the supplementary motor area (ESSMA) in a patient with intractable epilepsy

A. L. Velasco, J. M. Núñez, F. Velasco, M. Velasco, and F. Jiménez
Mexico City, Mexico

Purpose. To evaluate the possible anticonvulsive effect of stimulating an epileptic focus located in the SMA in a patient with intractable epilepsy.

Methods. A 17-year-old male was studied. He started seizing at 14 years old. The seizures were characteristic supplementary motor ones, that is, brief, with abrupt posturing of left arm and sudden version of the head to the left, occasionally secondary tonic clonic seizures. Consciousness was preserved. Conduct abnormalities with perseverance and verbal aggressiveness were present. EEG showed frontal parasagittal epileptic activity. MRI was normal. Bilateral 20 contact grids were implanted in right and left SMA. Daily depth recording was performed without AEDs and ictal EEG activity showed a mesial focus located in the right SMA. Patient reinitiated AEDs. Grids were explanted and replaced by a 4 contact electrode for chronic stimulation (Resume, Medtronic Inc.) connected to a DBS system. Stimulation was started with the following parameters: bipolar continuous stimulation of 130 Hz, 3.0 V.

Results. Six-month follow up showed progressive decrease in seizure occurrence to become seizure free in the last month. No adverse effects have been reported up to now. QOL scales were evaluated.

Conclusion. ESSMA provides a non lesional alternative method when compared to conventional ablative surgery that could improve seizure outcome without deterioration of motor function in patients with SMA intractable seizures.

P6. Focal cortical dysplasia in the elderly developing progressive epilepsia partialis continua

N. Foroglou, D. Karakostas, O. Koutoula, P. Selviaridis, G. Karkavelas, N. Taskos, and I. Milonas
Thessaloniki, Greece

Epilepsia partialis continua (EPC) is rare in the adult, usually related to vascular disease, tumor, inflammatory lesions or of idiopathic origin. Migration disorders is also a rare cause of epilepsy in the adult. We present a case of progressing EPC in the elderly, due to cortical dysplasia.

History. Sixty-nine-year old female with progressively deteriorating EPC of the left side (neck, trunk, lower and upper extremities) lasting for 3 months before admission, refractory to AED and disabling for daily life activities. MRI of the brain revealed a non-enhancing cortical-subcortical lesion of the right paramedian premotor area, 2 cm of diameter, low signal on T1WI, high signal on T2WI and proton density. Ictal EEG revealed slow rythmic spiking activity of 3–5 c/s frequency on the right central and temporal region.

Surgical management – outcome. Under stereotactic guidance a complete lesionectomy (as documented from the postoperative MRI) has been performed with the assistance of intraoperative mapping under general anesthesia (phase reversal for central sulcus identification and direct cortical stimulation for motor function). Pathology examination reported a non Taylor cortical dysplasia.

Outcome was partially satisfied, with persistence of seizures in the upper extremity and shoulder. A second operation has been performed for non-lesional cortectomy adjacent to the previous dysplastic area with electrocorticographical guidance and direct cortical stimulation. Pathology was normal in the second specimen. Outcome after the second operation was characterized from immediate cease of epilepsy and transient slight hemiparesis that resolved after 2 weeks. Six months later there was no sign of involuntary movement, pathological electrical activity on EEG and the patient was back to her activities.

Conclusions. EPC is rare in the adult and rarely caused by a focal cortical dysplasia previously clinically silent. Surgical excision should be extended beyond the edges of the MR abnormality according to clinical and EcoG data.

P7. Image-guidance in epilepsy surgery. Where have we been? Where are we going? One surgeon's 14 year perspective

C. R. Mascott
Toulouse, France

The impact of imaging modalities on epilepsy surgery in the past 20 years is obvious, yet the importance of using imaging to correlate surgical strategies to newer imaging modalities remains subject to debate.

The utility of image-guidance in epilepsy surgery can be divided into 3 phases: The preoperative analysis and correlation phase: An image-guidance workstation can be a very useful platform to correlate presurgical imaging and physiology data from MRI, fMRI, SPECT, PET, MEG and high-resolution EEG for quantitative analysis and volumetric studies even in patients that end up not going to surgery.

The intra-operative guidance phase: Here, the accuracy of correlating a planned intervention to the actual procedure becomes relevant. In the author's experience, optimized image-guidance using skull-implanted fiducial registration has application accuracy of 1.7–2.4 mm. This was more favorable than similar accuracy studies when using a frame. This accuracy is necessary for depth-electrode implantation and for very small resective targets, but probably not for routine craniotomies. For common temporal lobe cases, for example, image-guidance is useful in finding the ventricular temporal horn and defining the supero-mesial extent on the amygdala but little else. There are special advantages of image-guidance for functional hemispherectomies and other procedures, however. These shall be discussed on the basis of the 100 most recent surgical cases.

The post-operative analysis and correlation phase: Post-operative studies can be imported into an image-guidance workstation in order to assess whether the planned operation matches the post-operative results. This is a major tool in epilepsy surgery research to assess how further improvements in results of seizure control and cognitive outcome can be achieved.

P8. Chronic bilateral subthalamic stimulation in two cases of drug-resistant epilepsy: clinical and functional outcome after a 24 months follow-up

R. A. Ricciuti, M. Capecci, A. Paggi, A. Ortenzi, V. Durazzi, V. Cardinali, L. Diletti, V. G. Bombace, M. Iacoangeli, L. Provinciali, M. G. Ceravolo, and M. Scerrati
Ancona, Italy

Background. The therapy for epilepsy is still problematic since around 30% patients never become seizure-free with severe drug

side effects. Deep brain stimulation (DBS) has gained a significant therapeutic role in the treatment of various neurological disorders, however its efficacy for managing intractable epilepsy has not yet been proven.

We report our experience on bilateral subthalamic stimulation in 2 drug-resistant epilepsy patients.

Case 1. Male, 36 years-old, epilepsy since the age of 8 years. Submitted to callosotomy in 1999 without benefit. In February 2004 DBS. There was a significant clinical improvement of partial motor tonic seizures with related falls and no more tonic-clonic generalized attacks. However, ataxia worsened and the patient required a wheelchair. Drug therapy remained unchanged. Dysartria, abulia with word fluency impairment and ataxia were stimulus-related symptoms.

Case 2. Female, 31 years-old, epilepsy from 11. Callosotomy in 1994 with partial benefit. DBS in May 2004. After an initial improvement in partial motor and generalized seizures, there was an increase of fall attacks and a recrudescence of partial motor fits. Moreover, she presented a stimulation-related dramatic increase of absence rate. Only tonic-clonic convulsions decreased permanently. Dysartria, anaedonia and apathy were stimulus-related side effects.

Conclusions. Chronic bilateral subthalamic stimulation may exert a therapeutic influence on both generalised and focal motor seizures, whereas it does not affect fall attacks. Clinical heterogeneity and previous callosotomy in both cases may introduce a significant bias. However, the safe procedure and the potential gain obtainable from DBS build up the basis for future investigation aimed at discovering the best targets.

P9. The role of cortico-thalamic coupling in human temporal lobe epilepsy

J. Régis, M. Guye, M. Tamura, F. Wendling,
A. Mc Gonigal, P. Chauvel, and F. Bartolomei
Marseille, France

The purpose of this work was to study the synchronization between signals recorded from cortical structures and thalamus (TH) during temporal lobe epilepsy seizures (TLEs) and to study correlations with clinical features and post-surgical outcome.

The EEG activity of the TH and the temporal lobe structures (hippocampus, entorhinal cortex and neocortex) was obtained using intracerebral recordings (stereoelectroencephalography, SEEG) performed in patients with TLEs undergoing presurgical evaluation. Synchrony was studied using a statistical measure of SEEG signal interdependencies (non linear correlation).

The results demonstrated an overall increase of synchrony between TH and temporal lobe structures during seizures. Moreover, although there was great inter-individual variability, we found that values from seizure onset period were significantly higher than values from the background period ($p = 0.001$). Values at the end of seizure were significantly higher than values from the seizure onset ($p < 0.0001$).

Several indices were also defined in order to correlate some clinical features to the degree of coupling between cortical structures and TH. In patients with mesial TLEs, a correlation was found between the degree of thalamo-cortical synchrony and the presence of an early loss of consciousness but not with other clinical parameters. In addition, surgical prognosis seemed better in patients with low values of thalamo-cortical couplings at the seizure onset.

This report demonstrates that the TH and remote cortical structures synchronize their activity during TLE seizures and suggest that the extension of the epileptogenic network to the TH is a potential important factor determining surgical prognosis.

P10. Long term results and quality of life in children after epilepsy surgery

D. Larysz, P. Skorupka, S. Blamek, and M. Mandera
Katowice, Poland

The aim of the study was evaluation of surgical treatment of epilepsy measured by a turn in QOL and in seizure frequency and severity. The examined group consists of 24 boys and 9 girls. We performed corpus callosotomy, lesionectomy, VNS, temporal lobectomy and MST. Age at surgery ranged from 5 months to 19 years with mean follow-up 11.9 months. QOL was evaluated on the basis of the questionnaire created by us, in which parents were asked to assess the following variables before and after the surgical procedure: communication, socialization, daily living skills, movement abilities and behavioral problems. The seizure frequency was assessed with the modified Engel's scale. Clinical state of all the patients was evaluated as well. There were no patients with stable and worsening QOL status. In the group treated with callosotomy, the considerable improvement in QOL concerned approximately 50% of cases. In more than 95% of cases, the reduction of seizures frequency is greater than 75%. In over 43% of patients there are no seizures after surgery. Our results indicate the improvement in QOL of all operated patients. The improvement in QOL was accompanied by decrease in frequency and changes in morphology of seizures. Improvement in QOL, as equivalent to seizure reduction rate, may influence further differentiation of qualification methods and surgical procedures of epilepsy.

P11. Robotic stereotactic biopsies in the management of brain stem lesions: about a first series of 15 patients

C. Haegelen, G. Touzet, N. Reyns, D. Lisii,
C. A. Maurage, M. Ayachi, and S. Blond
Lille, France

Stereotactic biopsies are useful for histopathological analysis and appropriate treatments of brain stem tumors. We evaluated the safety and accuracy of frameless ISS Neuromate robot-guided biopsies in 15 consecutive patients with brain stem tumors. Five children (mean: 9 y.o.) and 10 adults (mean: 45.3 y.o.) underwent 17 procedures. Targeting was defined from the robot-guided cerebral MRI. Trajectories were calculated using MRI-guided robot software respecting anatomophysiological structures. We performed 12 transcerebellar and 5 transfrontal approaches for tumors located in the mesencephalon in 2 cases, in 7 cases in the pons, in 5 cases in the pons and medulla oblongata and, once in the whole midbrain. In children, diagnoses were 3 high-grade gliomas, one ganglioglioma and one unspecific gliosis. In adults, diagnoses were 4 low-grade and 3 high-grade gliomas, one metastasis, one lymphoma, 2 cases of unspecific inflammatory tissue and one case of unspecific gliosis. We observed no mortality, 3 cases of transient and one case of permanent morbidity. All the patients but three were alive at a mean follow-up of 18.5 months (range 1–72) in children and 9.3 months (range 1–18) in adults. Robot-guided-biopsies is an accurate procedure allowing easier transcerebellar approach than framebased stereotactic biopsies. Further studies including more patients are necessary to compare these techniques in terms of complications.

P12. An attempt to assess the pleiotropic role of FAS and its ligand (FAS-L) in gliomas of different grades of histological malignancy, sampled by means of stereotactic biopsy

G. Bierzynska-Macyszyn, U. Mazurek, T. Stepien, A. Lech, P. Wlaszczuk, J. Gola, M. Kapral, A. Owczarek, H. Majchrzak
Katowice, Poland

The CNS tumours arise as a result of a complicated process. In this process, the proliferation is disturbed and the glia cells avoid apoptosis. The death receptors of TNF superfamily (TNFSF), especially receptor FAS (TNFRSF6) and theirs ligands (TNFSF6) have major impact on cell biologic activity. The aim of this study was to assess the number of mRNA molecules of FAS receptor and level of FAS and FAS-L proteins in gliomas of various malignancy grades; and to estimate a correlation between FAS and FAS-L expression and course of the disease.

The material consisted of stereotactic biopsy specimens obtained from 285 patients, who have undergone stereotactic biopsy in last 7 years in Department of Neurosurgery in Sosnowiec. Morphologic and molecular analysis were performed on 103 cases of gliomas (30 diffuse gliomas of low malignancy G2 WHO, 55 anaplastic astrocytomas G3 WHO and 18 glioblastomas G4 WHO).

The clinical data analysis, cytology, routine histological examination, immunohistochemical responses against FAS and FAS-L proteins were performed. The number of mRNA molecules of FAS receptor was determined with QRT-PCR method.

We found that transcriptional activity of FAS-receptor encoding genes correlates better with the course of the disease than intensity of immunohistochemical responses against FAS and FAS-L proteins. The activity suggests the dominancy of its proapoptotic effect. Our findings enable us to claim that assessment of genes expression may be a valuable additional marker in the prognosis of diffuse astrocytomas of various grades of histological malignancy.

P13. Preliminary analysis of quality of life of patients treated with stereotactic radiosurgery for residual/recurrent pituitary tumors

S. Blamek, D. Larysz, E. Wolny, and A. Rudnik
Gliwice, Poland

Background and purpose. The results of stereotactic treatment of pituitary tumors are quite different to assess because of relatively long time period needed from treatment to objective response detection. Moreover, most of investigations focus on hormonal and radiological improvement, without assaying the health related quality of life (HR-QOL) of the patients. The aim of our study was to evaluate the HR-QOL of patients treated with linac-based stereotactic radiosurgery for recurrent or residual pituitary tumors.

Material. A group of 40 consecutive patients irradiated between September 2001 and December 2004 was enrolled into the analysis. All patients were treated with linac-based radiosurgery.

Methods. All the patients filled the HR-QOL questionnaire – University of Toronto Instrument, which is specific for brain tumor patients. We expanded our investigations with the questionnaire specific for pituitary tumors patients which allows the assessment of hormonal disturbances-related symptoms as well as side effects of conducted treatment.

Conclusions. Linac-based stereotactic radiosurgery for recurrent or residual pituitary tumors is an effective method of treatment in terms of HR-QOL.

P14. Gamma knife radiosurgery for benign meningiomas

A. Kollová, R. Liscák, J. Novotný Jr, V. Vladyka, G. Šimonová, and L. Janoušková
Prague, Czech Republic

Meningioma is the most frequent benign tumor treated by gamma knife radiosurgery, however the assessment of its efficacy and safety in slow growing tumors is an ongoing process, requiring analysis of long term results.

Methods. Three hundred and sixty eight patients (400 meningiomas) treated from 1992 to 1999 at Na Homolce Hospital were analyzed. The median age was 57 years (range, 18–84 years). The median volume was 4.4 cm^3 (range, 0.11–44.9 cm^3). The median marginal dose to 50% isodose was 12.55 Gy (range, 6.5–24 Gy). Follow up longer then 24 months (of median 60 months) was available in 331 (90%) patients. Volume of treated tumors decreased in 248 (69.8%), 99 (27.8%) remained unchanged, increased in 9 (2.5%) tumors. Actuarial tumor control rate was 97.9% at 5 years. The perilesional edema after radiosurgery was radiologically confirmed in 51 (15.4%) patients. Temporary and permanent morbidity after radiosurgery was 10.2 and 5.7% respectively.

A significantly higher incidence of tumor volume increase was observed in men compared to women and in tumors treated with marginal dose lower than 12 Gy. Significant risk factors for edema occurence was age above 60 years, no previous surgery, perilesional edema before radiosurgery, tumor volume bigger than 10 cm^3, tumor location in anterior fossa and marginal dose higher than 16 Gy.

Conclusion. Stereotactic radiosurgery is a safe method of treatment for meningiomas. Minimal marginal dose of 12–16 Gy seems to represent therapeutic window for the treatment of benign meningioma with high tumor control rate in a mid-term follow up period.

P15. Radiosurgery for cavernous malformations: an experience of 5 years

L. Garcia-Muñoz, F. Velasco-Campos, J. P. Lujan-Castilla, M. Enriquez-Barrera, L. Villaseñor-Navarro, C. Molero-Milo, and C. Marquez-Diaz
Mexico City, Mexico

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Conclusion. Stereotactic radiosurgery is a safe method of treatment for meningiomas. Minimal marginal dose of 12–16 Gy seems to represent therapeutic window for the treatment of benign meningioma with high tumor control rate in a mid-term follow up period.

P16. Intraventricular stimulation for targets close to the midline: periaqueductal Gray, posterior hypothalamus, anterior hypothalamus, subcommissural structures

A. L. Benabid, S. Chabardes, E. Seigneuret, and N. Torres
Grenoble, France

The walls of the third ventricle (V3) are close to structures involved in several functions from pain to behaviour, and in which implantation of electrodes is potentially dangerous.

This close vicinity of subependymal targets suggests that they might be stimulated by intraventricular electrodes, in contact with the brain parenchyma.

On this basis, in 1981, we stimulated the PAG of 15 patients with electrodes into the aqueduct of Sylvius. Recently, we placed an electrode onto the floor of V3 above the posterior hypothalamic target for cluster headaches. The results of the aqueductal stimulation were comparable to the stimulation into the PAG, with similar benefits, similar side effects (oscillopsia, vertigo). Delayed tolerance led to abandon this minimally invasive method. Uneventful positioning under fluoroscopy of an electrode allowed stimulation of the floor of V3, in a 27 year old patient suffering since seven years from intractable cluster headaches. A local infection of the stimulator resolved under long-term antibiotics. The cluster headaches disappeared under stimulation at high-frequency [130 Hz, 60 µs, 1–3 V] for periods of several weeks. In five months, the patient had two recurrences which required a progressive increase of the voltage of stimulation, allowed by an increasing threshold of the visual side effects. The medical treatment has not been stopped, but the administration of sumatriptan was limited to the recurrences.

This study proves that subependymal structures can be successfully stimulated using an intraventricular electrode this approach.

P17. Microrecording in the subthalamic nucleus using deep brain stimulation electrodes

D. Debatisse, C. Pollo, J. G. Villemure, and E. Pralong
Lausanne, Switzerland

Aim. We have tested if signal recording through deep brain stimulation (DBS) electrodes contacts before internalization could confirm their correct location in the subthalamic nucleus (STN).

Methods. Data acquisition was performed on 7 patients (4 males/3 females, 72 ± 8 year-old). Recordings were performed using the DBS electrode contacts and scalp electrodes. Signal was recorded using a Micromed 32 channels system at 512 Hz, low passed filtered at 128 Hz and high passed filtered at 1 Hz and visualized using a monopolar montage or an averaged reference. Somatosensory potentials (SEP) were performed on the controlateral median nerve during DBS electrode lowering to the STN. Off line analysis was performed using linear and temporal techniques (wavelet and FFT) with EEimagine software from ANT.

Results. EEG data analysis (phases, frequencies and synchronization) revealed statistically significant differences ($p < 0.05$) between intracerebral (IN) and scalp electrodes (OUT) in all cases. SEP (4 cases) analysis demonstrated phase opposition between the upper (1–2) and the lower (0–1) electrode contacts on both sides.

Discussion and conclusions. This study confirms 1) the possibility to record electrophysiological signal from DBS electrode contacts during surgery. 2) The presence of signal variations between DBS contacts and between DBS and scalp derivations. 3) The possibility to record SEP responses through the DBS electrodes. In conclusion, we believe that on line signal acquisition/analysis during DBS electrode placement can help to optimize STN localization. Such encouraging results should be confirmed by prospective studies comparing radiological and clinical outcomes.

P18. The peduncolopontine nucleus (PPN) targeting restore normal prepulse acoustic inibition in auditory blink reflex of PD patients

A. Insola, V. Di Lazzaro, G. D. Marca, and P. Mazzone
Rome, Italy

We studied three parkinsonian patients, who underwent functional stereotactic surgery which peduncolopontine nucleus (PPN) implantation for deep brain stimulation for relief of intractable symptoms like gait akinesia. The PPN target was selected because this nucleus, who display a prominent role in the basal ganglia circuitry, modulates locomotor activity and his degeneration cause gait impairment, a major disturbance in PD patients. Electromyographic responses were simultaneously recorded from the orbicularis oculi muscles of both sides and were elicited by electrical stimulation of supraorbital nerve; the electrical stimulus was preceded by a brief loud click (auditory prepulse) at an interstimulus interval of 110 ms.

In normal subjects, the auditory prepulse induces a significant inhibition of both R2 electromyographic responses simultaneously recorded from the orbicularis oculi muscles and facilitation of R1 response; in parkinsonian patients the inhibition of R2 after auditory prepulse is absent.

In our three parkinsonian patients, studied before and after stereotactic surgery the lead implantation within peduncolopontine nucleus, restored normal prepulse acustic inhibition.

The change in prepulse inhibition response was observed in all patients studied and was apparently not due to PPN stimulation but just to mechanical insertion of lead in the nucleus.

This neurophysiological phenomenon is probably linked to a short-term modification of basal ganglia-cortical circuits; it is possible that microlesions in the target nucleus lead to an attenuation of the pallidal inhibition on thalamocortical transmission.

P19. Feasibility of continuous monitoring of the cortico-spinal tract (CST) during surgery around the motor area

B. Cioni, G. Colicchio, L. Di Muro, M. Meglio, V. Perotti, D. Policicchio, and T. Tufo
Rome, Italy

Surgery around motor areas carries a risk of damaging the CST. The identification of the central sulcus is of great help, but injuries

to the CST may occur subcortically; therefore continuous monitoring of motor evoked responses is advisable. The Penfield technique is used to map the motor cortex, but it has a 20% rate of seizures and it doesn't allow continuous monitoring. We describe our experience in 86 cases undergoing surgery in the motor area (46 tumoral lesion, 20 movement disorders, 15 neuropathic pain, 5 non-tumoral epilepsy) in order to demonstrate the feasibility and safety of continuous monitoring of CST under general anesthesia.

The central sulcus was identified using the somatosensory phase reversal technique The motor cortex was mapped and the CST continuously monitored. Motor potentials were evoked by direct cortical stimulation (trains of 3–5 stimuli, 0.5 ms, ISI 4 ms, up to 20 mA, 2 trains/s). The muscle responses were recorded from contralateral extremities.

In all the patients, central sulcus identification was possible (flattening or phase reversal of the N20 component). A slight difference in the localization of the motor cortex was observed when comparing neurophysiological and neuroradiological (fMRI) findings. Continuous monitoring was performed in 51 patients. No change in muscle responses was detected in 47 cases, and no motor deficit was present postoperatively. In 2 cases a sudden loss of MEPs occurred and the patients presented a permanent hemiplegia. In 2 other cases a decrease of muscle responses correlated with a temporary paresis. No complications were observed, particularly seizures.

Our technique is feasible under general anesthesia, is reliable and safe.

P20. Efficiency of deep cerebellar stimulation in spasticity in cases of CP

M. Rudas, M. Harat, and M. Galanda
Bydgoszcz, Poland

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P21. Motor cortex stimulation can improve motor strength in spinal cord injury: case report

A. Dario, F. Pessina, S. Sangiorgi, C. Scamoni, and G. Tomei
Varese, Italy

Aim. To evaluate the effects of the extradural motor cortex stimulation in patients suffering from post traumatic tetraparesis of spinal origin.

Clinical material and method. This 25-year-old man in 2000 had a motor-cycle accident with myelic trauma at C7-D1 level. He presented paraplegia, paresis of the right arm, and retention of urine. Two years later the patient developed a perineal burning pain with allodynia during uretheral cateterization. The drugs administration was ineffective to treat the pain so a bilateral motor cortex stimulator was implanted over the somatotopic cortical area of the perineum. In the attempt to improve the muscle strength of the hand further four electrode were bilaterally implanted over the motor cortex of the hand. The stimulation parameters were amplitude 3 mAmp, frequency 200 Hz, pulse width 250 ms, cycle 1 hour ON and 4 hours OFF. The patient was evaluated before and after implantation by visual analogic scale (VAS) = 9 and by muscle strength grading = 3.

Results. The perineal pain improved on VAS from 9 to 5 with reduction of 70% of the allodynia. The muscle strength grading of the right hand revealed an improvement from 3 to 4+. The legs remained unchanged.

Discussion. In this case the bilateral motor cortex stimulation has improved the muscle strength impairment due to spinal cord damage.

P22. Chronic epidural stimulation of the lumbal level of the spinal cord in treatment of CP-patients with spasticity

A. V. Dekopov, V. A. Shabalov, and E. M. Troshina
Moscow, Russia

Traditionally the surgical treatment of spastic cerebral palsy includes selective dorsal rhizotomy and chronic intrathecal baclofen infusion. A few papers describe the effectiveness of chronic spinal cord stimulation (SCS).

Objective. To estimate the efficiency of SCS for the treatment of CP spasticity.

Material. Eight patients (middle age 7 years) with spastic CP have been operated. Spastic low paraparesis was diagnosed in five cases, spastic tetraparesis – in three cases. The motor assessment of patients included the Ashworth scale, GMFM-66 and videotaping.

Methods. Two quadripolar electrodes were implanted in the posterior epidural space on the lumbar level by a standard procedure. High frequency SCS (Mattrix, Medtronic) was started after the operation with rate 1–2 times per day. The duration of one-time stimulation was 10–15 minutes. All patients were examined with EMG before operation, after 1 week of SCS and in follow-up. The H-reflex and M-response were estimated.

Results. Preoperatively in all patients the muscle tone was increased till 3–4 points in legs and till 2–3 points in arms. The relief of the spasticity in legs and hands was observed in all cases during several days of SCS. The muscle contractures were reduced during the first postoperative week. The clinical effect was establish in follow-up (6 month–4 years). One-time stimulation per day was sufficient to support the muscle tone on the almost normal level. These data have correlated with the dynamics of EMG (H – reflex, M – response).

Conclusion. SCS is an effective method of choice in treatment of cerebral spasticity.

P23. 3 Tesla MRI of the thalamic and subthalamic nuclei in an anatomic preparation

S. Marbacher, H. Slotboom, T. Lönnfors-Weitzel, and A. Stibal

Bern, Switzerland

Objective. Deep brain stimulation depends in its therapeutic effect on an exact localisation of the electrodes in minuscule anatomic structures. Anatomic mapping is progressively replaced by high resolution multiplanar magnetic resonance imaging. A correlation of anatomic preparations and MR-images in optimised sequences allows future stereotactic neurosurgical navigation without the bias of the transformation from anatomic coordinates, e.g. ''Schaltenbrand and Wahren atlas'' (Thieme, Stuttgart, 1977).

Methods. Two post mortem formaldehyde fixated specimens were examined in a 3 Tesla Trio (Siemens Medical Solutions, Erlangen, Germany). The selected specimens had no history of neuropathological disease. The specimens were examined in vacuumised standard body bags after meticulous washing out of air. Duration of formaldehyde fixation was 4–5 years. Several, mainly T2 weighted sequences were performed with systematic variation of TE values between 12 and 110. TR varied between 600 and 6000. Optimum anatomical differentiation was achieved between TR 2000 and 6000 with TE relaxometry between 24 and 96. Schaltenbrand and Wahren atlas and Salamon's Neuroanatomy and Neurovasculature Web-Atlas Resource were used as anatomic reference. We used the nomenclature of Jones and Van Buren and Borkes.

Results. Substantia nigra, subthalamic nucleus (STN), nucleus ruber, putamen, Globus pallidus internus and externus (GPI, GPE) were identified. A segmentation of thalamic nuclei, e.g. VIM was possible with a resolution of 15 different thalamic nuclei. Three hypothalamic structures and nucleus accumbens could be identified.

Conclusion. 3 Tesla imaging opens new potentials to stereotactic interventions with immediate implementation into patient management and a hitherto unreached quality of morphological imaging.

P24. Imaging and volumetry of the subthalamic nucleus in healthy subjects at 3 Tesla MRI

T. Lönnfors-Weitzel, S. Marbacher, H. Slotboom, and A. Stibal

Bern, Switzerland

Objective. Deep brain stimulation (DBS) of the subthalamic nucleus (STN) is an established therapy in Parkinson's disease. High-field magnetic resonance imaging (MRI) improve the identification of STN. The discrimination of STN borders allows for a 3 dimensional description of the target for DBS. Our aim of this pilotstudy is to optimise the MRI of STN and to collect normal controls.

Methods. Up to now 15 healthy subjects in different age groups (10 men, 5 women, age range 23–57, average 37.2) were examined at 3 Tesla Trio (Siemens Medical Solutions, Erlangen, Germany) without neurologic diseases. STN was identified and measured in a 3D T2 weighted sequence with TR 2500 or 3000, TE 354 in an 8 channel head coil. The segmentation was conducted with Brain-voyager and the resulting voxelcount was statistically processed. Additionally to manual marking of STN, an automated ROI-analysis on gray-scale basis was performed. Schaltenbrand and Wahren Anatomic Atlas (Thieme, Stuttgart, 1977) and Salamon's Neuroanatomy and Neurovasculature Web-Atlas Resource were used as anatomic reference.

Results. Both STN could be identified in all subjects. The volume of STN was 0.6 ml in average, median 0.56, range 0.45–0.7. Several covariates were calculated.

Conclusion. The applied sequences allow a reliable identification of the STN and improve the preoperative DBS management. The interindividual STN variability of volume was negligible in healthy subjects. The improved imaging opens possibilities of morphological and pathophysiological studies, better planning for DBS with STN as a therapeutic target.

P25. Stereotactic head ring to MRI fixation device

J. M. Nazzaro and S. Daniluk

Boston, USA

Advances in MRI scanning have progressively improved visualization of basal ganglia structures targeted in movement disorders surgery. Most stereotactic movement disorders neurosurgeons presently routinely rely in large part upon high definition fine-cut MRI brain studies for operative planning. It is not unusual for such scans however to require that patients remain without any head movement for 20 to 30 minutes for single-plane scan sets. Attempts to secure the head with tape or straps often fail to alleviate motion.

In this report we describe a fixation device which secures MRI compatible Cosman-Roberts-Wells (CRW) and universal compact head ring (UCHR) stereotactic head rings and fiducial localizers (Integra Radionics, Burlington, MA) to MRI (Phillips Gyroscan Intera 1.5T and related) couches (Phillips, Amsterdam, Netherlands). The fixation device is made of MRI compatible materials and secures the head ring and localizer to the MRI table. By this method, there is no motion of the head or neck during scanning. The fixation device has been utilized for surgical planning in 52 consecutive movement disorder operations. The device has helped optimized image quality (scans without motion artifact) and has significantly decreasing total scan session time as the variable of patient motion involving the head and neck is controlled. The fixation device does not produced image artifact.

P26. Long-term lead failure in spinal cord stimulation

S. Akmal and M. S. Eljamel

Dundee, UK

To evaluate the long term lead failure in spinal cord stimulation leading to malfunction.

Methods. The study population consisted of 16 patients out of a total of 106 patients with permanently implanted therapeutic spinal cord stimulators. All the 16 patients required lead replacement and their SCS was working perfectly well before the malfunction and following lead replacement.

Results. The total lead failure for this series was 15.1% and the incidence of a second lead failure after replacement was 25% (4/16). Three of the primary failures were due to lead fracture 1.9% (18.8% of the lead failures and 25% of secondary lead failures). The fractures were more common in the cervical region with 3 of all the four (primary $3+1$ secondary lead failure) occurred in the neck. More than 75% of the lead failures occurred within the first 5 years. (Mean follow up of the series is 7 years).

Conclusion. The incidence of primary lead failure remains low at 15.1% in the long run. Secondary lead failure is more likely to happen (25%) unless the cause of the primary failure could be identified and corrected. Leads in the neck more likely to fracture due to the hyper mobility and a better lead design may be required.

P27. Peripheral neurostimulation for the treatment of intractable facial pain

S. Goto, T. Taira, T. Ochiai, T. Sasaki, and T. Hori
Tokyo, Japan

Objective. The authors present a series of patients with continuous burning facial neuropathic pain treated with peripheral neurostimulation (PNS) by subcutaneously implanted quadripolar electrodes. In all cases, pain control had been difficult with conservative treatment such as anticonvulsants, opioids or nerve blocks, and the activities of daily living were markedly disturbed.

Patients and methods. Four patients were selected for surgery, of which two were post traumatic pain, one post-surgical treatment of maxillary sinusitis pain and one post stroke pain. Stimulation electrodes were inserted subcutaneously under general anaesthesia to the painful area of the face by a percutaneous approach with the fluoroscopic guidance. All patient underwent a test trial for about a week after the insertion of electrodes. In cases of successful trial, pulse generator system were internalized.

Results. Average operative time was 41 minutes and perioperative complication was not observed. In all four cases, stimulation was effective and the mean pain score decreased from 8.8/10 to 5.4/10 after the stimulation. In all the cases, pulse generator was implanted.

Discussion. PNS is indicated to provide a pain relief for the treatment of intractable facial neuropathic pain. Compared with motor cortex stimulation, Gasserian ganglion stimulation or deep brain stimulation, the maneuvers of PNS are simple and safe. PNS is thought to become one of effective modalities for the treatment of the atypical facial neuralgia.

Conclusion. Facial intractable neuropathic pain was controlled by PNS with the subcutaneously implanted electrodes in all four patients.

P28. Anatomical targets in gamma knife treatment for intractable pain

D. Urgosik, R. Liscak, J. Vymazal, J. Novotny Jr, and V. Vladyka
Prague, Czech Republic

Introduction. Various pain syndromes require various therapeutic approaches. That was the reason, we used the different targets for gamma knife surgery (GKS) in different cases.

Material and methods. Since the end of 1995 we have used these targets for our pain patients: 1) The root entry zone (REZ) of trigeminal nerve, 2) trigeminal ganglion for trigeminal neuralgia (TN), 3) ganglion sphenopalatinnum for sphenopalatine neuralgia, 4) ganglion inferior of the ninth cranial nerve for glossofaryngeal neuralgia, 5) ganglion ciliare for vegetative orbital pain, 6) medial parts of thalamus for thalamic pain and unilateral pain of other origin, 7) rostral parts of gyrus ciguli mainly for pain of malignant origin, 8) pituitary gland for pain caused by skeletal metastasis of different types of cancer. All targets were irradiated by Leksell gamma knife. A maximal dose has ranged from 70 to 80 Gy in the case of cranial nerves irradiation, 150 Gy in the thalamic target, from 160 to 200 Gy in hypophysectomy and 150 Gy has been applied during cingulotomy.

Results. The best initial pain relief (successful rate to 96%) was reached after GKS in REZ area for essential TN. Also hypophysectomy for cancer pain was successful (rate to 75%). Only partially satisfactory results were achieved after thalamotomy and cingulotomy (successful rate to 50%).

Conclusion. Versatility and accuracy of GKS allow us to treat the patients with various types of pain. GKS is the method of the first choice in TN patients and appropriate complementary method in other pain syndromes.

P29. Chronic motor cortical stimulation in refractory neuropathic and central pain

R. Rodriguez, J. Molet, F. Muñoz, A. Gironell, E. Guardia, P. Tresserras, P. Clavel, S. De Teresa, J. Solivera, and F. Bartumeus
Barcelona, Spain

Introduction. Ablative techniques to treat neuropathic pain have been introduced since the end of nineteen century and some of them are still useful. In 1991 Tsubokawa first described chronic motor cortical stimulation for treatment of central thalamic pain.

Material and methods. Between 1996 and 2006 ten patients with refractory central and neuropathic pain underwent surgery for the implantation of an epidural electrode for chronic motor cortex stimulation. Six were women and 4 were men; mean age 61 years. The cause of pain was central ischemic, 3 cases; post-surgical, 3 cases; atypical facial pain, 3 cases and spinal cord trauma, 1 case.

Most of patients were studied by preoperative fMRI and intraoperative epidural somatosensory evoked potentials and motor cortex stimulation with electromyographic recording. A navigation system was used intraoperatively. Finally we placed two quadripolar electrodes to maintain the stimulation with external stimulator during 10–15 days. Parameters were the next: Frequency 25–60 Hz, Pulse width 60–200 useg, Intensity 1–4 V. If pain improves we place inside the definitive stimulator (Synergy).

Results. One patient showed excellent improvement of pain, (>80% improvement of VAS), 3 good outcome (60–80% improvement of VAS), 1 average (40–60% improvement of VAS), 5 poor (<40% improvement of VAS). The best results were found in spinal cord injury patient, post-surgical facial pain and one of patients with thalamic pain. Atypical facial pain and post-surgical cervical pain showed poor improvement. The introduction of intraoperative neurophysiology and fMRI integrated with neuronavigation improved the results.

Conclusions. Chronic motor cortical stimulation for treatment of neuropathic and central pain is a useful technique with low risk of complications. Functional MRI, neuro-navigation system and intraoperative neurophysiology are tools to improve results.

P30. Sacral nerve stimulation and spinal cord stimulation for intractable pain caused by spinal cord infarction

S. H. Kim, S. H. Jang, S. H. Ahn, S. W. Kim, C. H. Chang, and O. L. Kim
Daegu, Korea

Intractable pain which is caused by spinal cord lesion is very hard to treat with drugs and even operation. We report the case of persistent pelvic and lower extremity pain caused by spinal cord infarction in spite of conservative treatment, as we have treated the pain by combination of sacral nerve stimulation and spinal cord stimulation.

Method. A 63-year-old woman had spinal cord infarction 5 years ago, that she had medical treatment, rehabilitation and injection treatment to relieve the pelvic and lower extremity pain. As there was no improvement that she had spinal cord stimulation 4 years ago to relieve both lower extremity pain. But according to the persistent and severe pelvic pain and voiding and defecation

difficulties, she had sacral nerve stimulation 6 months ago to relieve such kinds of pain.

Result. Both lower extremity pain was improved about 80% by spinal cord stimulation and voiding and defecation difficulties including pelvic pain were improved about 70% by sacral nerve stimulation that daily life was possible. We kept most appropriate condition for her by some stimulus parameters changing. There was no surgical complication.

Conclusion. We think that the combination therapy of spinal cord stimulation and sacral nerve stimulation for intractable pelvic pain with lower extremity pain caused by spinal cord lesion may be good treatment modality. And by sacral nerve stimulation, we can treat voiding and/or defecation difficulties as well as pelvic pain.

P31. Successful treatment of a patient with severe chronic cluster headache by chronic high frequency stimulation of the ipsilateral hypothalamus

F. Hertel, T. Ulrich, M. Bettag, M. Zuechner, and P. Gemmar

Trier, Germany

Introduction. Cluster headache (CH) is a certain form of so-called vascular headache, which seems to be caused by a hypothalamic dysregulation according to recent findings in functional image analysis. The symptoms include a unilateral severe recurrent headache as well as ipsilateral swelling of the eye and nose. The treatment of CH is predominantly a domain of medical therapy.

However, a small percentage of patients remain resistant against any kind of drug treatment or oxygen therapy, respectively. Recently a small number of patients have been reported with a successful treatment of severe chronic CH by ipsilateral hypothalamic DBS.

Patient and method. A 43 years old male patient was suffering from severe CH. Within the last 15 months, he had at least one, sometimes several attacks per day. The attacks reached values of 9–10 according to the visual analogous scale (VAS). No prior medical therapy, including verapamil, lithium, oxygene therapy, and a lot more of analgetic medications, could reduce the attacks sufficiently. The patient reported thinking about suicide.

Under local anaesthesia, a DBS electrode (Medtronic 3389®, Medtronic, MA, USA) was implanted using CT/MRI matching and intraoperative microrecording. Consecutively, a impulse generator (Medtronic Soletra®) was implanted. As target we used the posterior hypothalamus.

Results. Intraoperatively, neuronal activity could be detected by microrecording in the target region. During test stimulation, the patient got transient double vision and a certain kind of nausea. The postoperative course of the patient was without any complications. Under chronic stimulation, he had a clear reduction of the severity of his attacks down to a level of VAS 1–2.

After transient withdrawal of the stimulation without the knowledge of the patient, the attacks went fully back. Three days after the operation, the stimulation was put off and a new attack was provoked by the application of Nitro spray. This attack could be immediately blocked by putting the stimulation on again.

Discussion. Chronic high frequency stimulation of the hypothalamus seems to be an efficacious treatment method in certain kinds of chronic severe CH, when conventional conservative treatments fail. With this case, we could confirm the results of 2 other groups reporting about a similar treatment in a total of not more than 20 patients. However, a prospective randomized controlled multicenter trial for a further sufficient evaluation of this treatment is required.

P32. Glycerol rhizolysis in trigeminal neuralgia

M. Rattaj and T. Jankovic

Nitra, Slovakia

Introduction. Trigeminal neuralgia seems to be serious medical and social problem. Treatment of this disorder present a problem in choosing a proper method in satisfying a patient. We tried glycerol rhizolysis (GR) in abolition of trigeminal pain. An anhydrous form of glycerol is used as mildly neurotoxic producing demyelination in small fibres.

Method. During last two years 8 patients with recurrent trigeminal neuralgia were treated with GR – application of glycerol through foramen ovale into cavum Meckeli. 0.3 ml of glycerol was applying in sitting position under local anaesthesia. Radiografic confirmation of proper targeting of cavum Meckeli had been performed before application of glycerol by means of contrast medium. All patient underwent any other procedure, in 5 cases percutaneous nerve block, in 2 cases radiofrequency thermocoagulation, in 1 radiosurgical irradiation of trigeminal entry zone.

Results. The complete relief or more than 80% of pain has lasted in 3 patients, the pain relief in 80 up to 50% in 3 patients. Two patient underwent radiosurgical irradiation of trigeminal entry zone at gamma knife 13 and 20 months after procedure because of recurrence of pain. Complications as anaesthesia dolorosa, keratitis or cranial nerve palsy has not been occurred in any patient.

Summary. This procedure does not solve the cause of neuralgia. It is concerning for patients they want pain relief regardless of cause, for patients they do not want to undergo the open neurosurgery. The procedure itself is simple, easy feasible in local anaesthesia, without need of sophisticated tools. Later recurrences must be taken into account during the process of indication and good informed consent should be prepared.

P33. Spinal cord stimulation (SCS) in the failed back surgery syndrome (FBSS): a 28 years

B. Cioni, S. Daini, F. Doglietto, L. Di Muro, C. Sturiale, and M. Meglio

Rome, Italy

Since August 1978, 182 patients complaining of FBSS were submitted to a test of SCS at our institution. 112 patients underwent chronic stimulation. The mean follow up of these patients is more than 6 years (min 6, max 240 months). We report the results on leg and back pain, the adverse events, and the analysis of prognostic factors. Pain was evaluated utilizing the visual analog scale and the global impression of change. A 40% pain relief was considered the cut-off between success and failure of SCS. Functional and psychological evaluations were carried out in most of the patients. At 5 years, 56% of the patients can still be regarded as a success. SCS must evoke paraesthesiae in an area corresponding to the painful zone to have the possibility to be successful; this may be obtained either by multiple electrodes with multiple contacts or by an accurate placement of a single quadripolare percutaneous electrode, as in the majority of our cases. Only minor complications and side effects were encountered, nevertheless the need for multiple surgical revisions of the hardware should be taken into account.

On the basis of our experience, SCS should be considered a clinical useful and cost-effective procedure in the treatment of FBSS.

P34. DBS more effective than MCS in atypical trigeminal neuralgia – a case report

P. Sokal, M. Harat, and J. Gryz
Bydgoszcz, Poland

65-years-old female suffering on atypical trigeminal neuralgia for 7 years, after ineffective farmacotherapy, several MVD's and gasserotomies was operated on – MCS (one electrode perpendicular to precentral gyrus and Itrel3 stimulator). Presurgical VAS = 8–9 cm. Postsurgical transient 2 days improvement. For the next 12 months poor analgesic effect – VAS = 9 cm. Stimulation paresthesias covering pain area. Then after one year – implantation of electrode to CM-Pf was performed and connected to the same stimulator. Stimulation paresthesias covering pain area of the half of the face and a very good analgesic effect VAS = 3 cm with improvement of mood. Is DBS more effective than MCS in neuropathic facial pain?

P35. Spinal cord stimulation for refractory angina pectoris

P. Sokal, M. Harat, T. Piekarz, and A. Cuprych
Bydgoszcz, Poland

SCS is a proven mode of treatment of patients with refractory angina pectoris. Co-operation of cardiologists, cardiosurgeons and neurosurgeons in proper qualification of patients is essential. This method is becoming more popular in Poland. Our centre is one of the leading in which procedures of implantation are performed. For two last years we have implanted 4 stimulators in angina pectoris with excellent results.

All the patients have been qualified for SCS due to ineffective farmacotherapy and when all revascularisation procedures had been completed.

Four patients, all males (aged 49, 55, 50, 51y) after implantation achieved alleviation of pain, reduction of incidence of anginal attacks, and improvement of physical capacity. Standard exercise tests and scintigraphy tests revealed improved myocardial perfusion. Comparison of costs of treatment before and after surgery revealed reduction of costs after implantation. The way of qualification, effects of treatment and achieved results will be presented.

P36. Motor cortex stimulation in the case of trigeminal neuralgia refractory to previous pharmacological and neurosurgical treatment

M. Sobstyl, M. Zabek, and H. Koziara
Warsaw, Poland

Introduction. The aim of his study is to present the results of motor cortex stimulation in a case of trigeminal neuralgia refractory to pharmacological and neurosurgical treatment.

Case report. We present a case of 46 year-old women with 13 years history of trigeminal neuralgia refractory to previous pharmacological and neurosurgical treatment. The pharmacological therapy has completely failed to reduce her facial pain. In the past the patient underwent two suboccipital craniotomies /first surgery for decompression of trigeminal nerve from vessel, and the second operation consisted of cutting of sensory roots of trigeminal nerve/.

The other procedures included cutting of supraorbital nerve, and several Gasser ganglion termolesions. The neurosurgical treatment was also ineffective. Some improvement in pain sensations was achieved by subcutaneous morphine in the dose of 50 mg every four hours. The patient was a good candidate for epidural motor cortex stimulation. The operation was performed in general anesthesia.

The 3D T1 weighed MRI images with the aim of neuronavigation Treon 3 Medtronic allowed very precise three dimensional reconstruction of patient's brain surface. The four-contact electrode was sutured to the dura over facial representation of the precentral gyrus. Thereafter pulse generator (Itrel 3) was placed in a subcutaneous pocket in the chest wall. Six months postoperatively the patient's facial pain was greatly reduced and the dose of subcutaneous morphine was dropped to 12 mg every four hours.

Conclusions. Motor cortex stimulation is an effective method in facial pain suppression in cases of trigeminal neuralgia.

P37. Cyberknife radiosurgery in management of recurrent trigeminal neuralgia

T.-K. Lee
Seoul, Korea

Objective. There are many treatments in management of recurrent trigeminal neuralgia (TN). In the recurrent trigeminal neuralgia, there has been only sporadic reports of the management. Authors reports the treatment result of recurrent trigeminal neuralgia with Cyberknife Radiosurgery.

Methods. During this year, 30 trigeminal neuralgias were treated by Cyberknife Radiosurgery by authors. Among them, Twelve patients were recurrent trigeminal neuralgias. These patients used radiofrequency (RF) thermocoagulation, alcohol rhizotomy or pheripheral neurectomy for the primary surgical treatment and then pain recurred after the mean interval of pain relief (18 months). There were not the offending lesions. Cyberknife radiosurgery was offered to patient who used the primary surgical treatment for medically refractory TN or were not suitable candidates for invasive intervention. A CT cisternography was performed by injecting 5 ml of ISOVIST into the thecal sac and keeping the patient in Trendelenburg's position for about 30 min. A thin-section CT scan (240 slices, thickness 1.0 mm) was made through the entire head, showing the anatomy of the basal cisterns. The CT images were networked to the Cyberknife workstation, where the trigeminal nerve was outlined. The 80% isodose line was prescribed in a conformal fashion to an 6-mm length of the nerve, sparing the proximal 3 mm. The mean age was 57.8 years and the mean duration of follow up was 16.2 months. The right V2, 3 distribution was most prevalent area of pain.

Result. The early result was satisfactory. Results of 12 patients undergoing Cyberknife radiosurgery for recurrent TN showed that pain relief was achieved in 10 patients within the first 72 h after the treatment. The average dose delivered at the 80% isodose line was 62.4 Gy. Four patients reported overnight onset of pain relief and maximal effect within 24 h. Two patient had onset of pain relief after 24 h with complete relief within 72 h, and Six patients had onset of pain relief after 72 h and complete relief within 7 days after the treatment. Ten of these patients are now pain free and medication free after a 12-month follow-up period. The overall pain control was 83.3%. There was no mortality or morbidity for initial Cyberknife Radiosurgery. During follow-up, two patients showed aggrevation of pain temporarily (VAS2 → 3). Two patients were controlled with medical management and became free of pain.

Conclusion. These results indicate that cyberknife radiosurgery effective means of pain control for recurrent trigeminal neuralgiais. Cyberknife radiosurgery in management of recurrent trigeminal neuralgiais can relieve early pain in patients with trigeminal

neuralgia. A combination of conformal irradiation and CT cisternography lead to increase accuracy of targeting. With these results authors assumed that cyberknife radiosurgery could be one of safe and effective therapeutic methods in recurrent trigerminal neuralgia. Even with recurrence, however, cyberknife radiosurgery seems to be effective method of control of pain in these cases.

P38. Transforamenal SNS in intractable isolated pelvic pain syndromes

M. De Rose, A. Lavano, M. Grassi, F. Abbate, G. Volpentesta, and C. D. Signorelli
Catanzaro, Italy

Objectives. The aim of the study is to test effectiveness of sacral nerve stimulation performed with transforamenal approach in patients with isolated chronic intractable pelvic pain.

Materials. Nine patients were implanted with self-anchoring leads by way of dorsal S3 foramen in 6 cases and of dorsal S4 foramen in 3 cases. Patients with pain improvement >50% underwent neuroprothesic device implantation. SNS therapy efficacy was measured with VAS and its effects on QoL with the SF-36 scale.

Results. During test stimulation 7 patients had significant and permanent pain relief and were definitively implanted. VAS score improvement was evident in these patients and remained unchanged at 3, 6, 12 and 18 months (median 10 months); SF-36 QoL questionnaire also revealed significant improvement in all domains. There were 3 complications: 1 lead fracture, 1 lead displacement in presacral space and 1 pain at IPG site.

Conclusions. Transforamenal SNS is effective in isolated pelvic pain relief but high complication rate was found.

P39. Therapy resistant complex regional pain syndrome in adolescents may respond to spinal cord stimulation

B. A. Meyerson, B. Linderoth, and G. Olsson
Stockholm, Sweden

Aim. Complex Regional Pain Syndrome type I (CRPS-1) is relatively common in children, particularly in girls around the age of 12–14 years. In some cases none of the conventional treatment modalities is effective and Spinal Cord Stimulation (SCS) may then be a therapeutic option.

Material. Seven girls 11–14 years of age presenting with severe and treatment resistant CRPS-1 were subjected to SCS.

Results. As a rule, a pain relieving effect was not reported until 1–2 weeks of stimulation. After another 2–6 weeks of treatment pain alleviation was complete in six of the patients. In one patient pain relief was not reported until after numerous reprogramming trials produced adequate paresthesia coverage. The treatment was continued for between 3 and 48 months, but in one it was discontinued after three weeks due to a local infection. In three of the cases it was possible to remove the stimulator equipment after 8 months to 4 years when the original symptoms and complains gradually had subsided. At follow-up (12 yrs-8months) all patients were able to take part in sports and were free of medication.

Conclusion. SCS in adults has proven to be a very effective treatment for certain forms of neuropathic pain, including CRPS. To the best of our knowledge SCS has hitherto not been tried in children but in our experience it can be a useful treatment also for paediatric cases of otherwise therapy resistant CRPS-1 where it also may have a curative effect.

P40. Relation between territory of trigeminal neuralgia (TN) and location of the vascular compression (VC)

J. Leston and M. Sindou
Lyon, France

Introduction. Topographie of the TN, variable from one patient to another, has not been clearly explained and documented until the present. It is recognised that there are a somatotopy of trigeminal fibers in the level of the root.

We know that fibers of V1 are supero-median, fibers of V3 are infero-laterals and fibers of V2 between precedent both fibers. That is why we are interested in the study of relation between the territory of trigeminal neuralgia (TN) in the face and the origin of the vascular conflict (VC) responsible of the neuralgia.

Material and methods. The VC has been classified according to their origin around the root in: supero-median (SM), supero-lateral (SL) and the inferior (INF).

Clinical presentations have been regrouped in: Group I: TN affecting all territories V1, Group II: TN affecting only V2 territory, Group III: TN affecting territory V3 and V2–V3. Correlations between territory of the TN and the location of VC were studied in a population of 350 patients treated with Microvascular Decompression (MVD).

Results. In Group I: location of VC was SM: 73.1%, SL: 19.3%, INF: 5%; in Group II: SM: 61%, SL: 28.6%, INF: 9.1%; and Group III: SM: 48.2%, SL: 31.9%, INF: 15%. Results were statistically significant $p = 0.002$.

Conclusion. VCs were localised principally in:

– SM for neuralgias of V1,
– SL for neuralgias of V2
– INF for neuralgias of V3

These findings are concordant with knowledge about sensory somatotopy of the trigeminal root.

P41. Gamma knife radiosurgery to the pituitary for thalamic pain syndrome: clinical evaluation of our recent institutional series

M. Hayashi, T. Taira, T. Ochiai, M. Chernov, S. Goto, K. Nakaya, M. Izawa, T. Hori, and K. Takakura
Tokyo, Japan

Rationale. Thalamic pain syndrome is one of represented intractable central pain. One clinical report, however, suggests that it can be controlled by chemical hypophysectomy with the development of transiently diabetes insipidus. We performed Gamma knife radiosurgery (GKR) to the normal pituitary gland-stalk aiming to control this kind of intractable pain.

Material and method. Our treatment indications are: 1) the pain is typical thalamic pain syndrome, 2) no any other effective treatment prior to GKR, 3) patients cannot be treated under general anesthesia, 4) main complaint is ''pain'', not ''numbness''. We have treated 27 patients with thalamic pain syndrome. The onset was cerebral infarction/hemorrhage in 26, malignant lymphoma in one. We targeted only the pituitary gland involving a part of the pituitary stalk with 8 mm collimator. Prescribed maximum dose was 140–180 Gy. Twenty-four patients were followed more than 12 months.

Results. Initial significant pain reduction was observed in 70.8% (17/24). All effective cases experienced significant pain reduction within 4 days. Long-term effectiveness (>1 year) was

observed in 25.0% (5/20). No other postoperative complications were observed except in two patients who developed transiently diabetes insipidus.

Conclusions. Thalamic pain syndrome is still too difficult to be cured with any treatment protocol. However, we achieved significant pain reduction for the majority of the patients by GKR. We should clinically explore the reason why the GKR is an effective treatment to the pituitary gland for this type of pain. We suppose that GKR to the pituitary has a huge potential in managing intractable pain.

P42. A new "arch – less" stereotactic device

M. Paolo
Rome, Italy

Introduction. The possibility to implant intraoperative or definitive leads for DBS in different pathologies with a ''arch–less'' device is a possible advantage to obtain, with the same surgical precision, a major degree of freedom for the surgeon and patients. The more recent devices applied to the bone are complex and with high profile; and the other hand, the ''burr hole devices are not ever precise''.

Material and method. The instrumentation consist in a simple cylindric tube of 4 cm × 4 mm, internal Ø 1.6 mm, initially fixed to bone with stereotactic arch; after the fixation, the stereotactic arch is removed and the surgeon have the possibility to made the surgical procedure through the cylinder. The system is conceived for one or more trajectories. Now we have the system only for ''static'' implantation, applicable to all stereotactic devices not only to Maranello system, but a robotic system in the next future is under made. Instrumentation is build by CLS Titanium Forli', Italy.

Discussion. The system is based on the necessity to: 1) made surgical procedure free from arch or emiarch, made free the patients and the surgeon, with the same stereotactic precision, 2) have the possibility to targeting simultaneously more targets, and finally, 3) obtain the same electrophysiological and dyalithic recordings through low profile instrumentation and 4) (a new possibility) have the choice in clinical evaluation with the patient in orthostatic position or during the gait, important evaluation especially in new targets, like the PPN.

P43. Bilateral stimulation of the subthalamic nucleus using Fisher stereotactic frame, MRI-CT fusion guidance and preoperative orthogonal radiographs

D. Fontaine, D. Von Langsdorff, M. Borg, C. Bayreuther, M. N. Magnié-Mauro, M. Duval, and P. Paquis
Nice, France

We present the method and results of an original technique to implant electrodes in the subthalamic nucleus (STN) to treat Parkinson's disease, based on adaptations of the Fisher ZD stereotactic frame.

Targets coordinates were calculated after fusion of stereotactic CT-scan and MRI images. STN was localized by its theoretical coordinates according to AC–PC and by its direct visualization on T2 images. Bilateral electrodes were implanted after local anaesthesia, using preoperative multicanal microrecordings and test stimulation. Electrodes location was checked by preoperative perpendicular radiographs. To avoid projection of the frame arm on the area of interest on antero-posterior and lateral radiographs, the arm was fixed at 45° from the usual 90° position. This original fixation needed a trigonometric transformation of the X and Y stereotactic coordinates. Radiopaque markers, fixed on the frame, were identified on the radiographs, allowing the calculation of the stereotactic coordinates of the electrode tip, which were then entered in the stereotactic MRI, to check its location from the defined target.

No problem due to adaptations of the frame occurred in the 57 patients. In all cases, preoperative radiographs allowed to confirm the correct location of micro and definitive electrodes. Six months after operation, UPDRS IV items 32, 33 and 39 scores were decreased by 79.7, 83.5 and 73.4%. UPDRS III scores without medication were 47.4 and 21.9 with stimulation ''off'' and ''on''. Pre and postoperative Dopa-equivalent doses were 1470 and 425 mg/d (reduction 71%).

One asymptomatic thalamic hematoma and 2 wound infections occurred.

P44. The influence of CSF-filled cavities on radiofrequency lesions – a simulation study

J. D. Johansson, D. Loyd, K. Wårdell, and J. Wren
Linköping, Sweden

Enlarged perivascular Virchow-Robin (VR) spaces are a common finding in the basal ganglia, especially among elderly. These CSF-filled cavities have different thermal and electrical characteristics compared to the surrounding tissue and may thus affect the outcome of heat- and electricity-based techniques such as radiofrequency (RF) lesioning and deep brain stimulation (DBS). We have used finite element method computer models in order to simulate the impact of VR-spaces of different size, shape and location on RF-lesioning.

CSF was found to spread heat very effectively due to circulation caused by the heating. This caused major changes in size and shape of the simulated lesions when the VR-space had contact with the electrode tip but very little change if the VR-space was just 1 mm away from the tip. However, the presence of VR-spaces or other CSF-filled cavities adjacent to the electrode tip should generally be possible to detect, since CSF is a much better electric conductor than other brain tissues and will thus cause a large drop in electric impedance. In conclusion enlarged VR-spaces may greatly alter the lesion size and shape and thus possibly affect the treatment result. However, since the electric impedance can be measured before lesioning it should in most cases be possible to detect potentially complicating VR-spaces.

P45. Somatotopy in the GPi: analysis of motor side effects during intraoperative assessment in a Parkinsonian

J. Coste, S. Hemm, M. Ulla, P. Derost, F. Caire, F. Durif, and J. J. Lemaire
Clermont Ferrand, France

Objective. A somatotopy inside the human globus pallidus (GP), based on intraoperative microelectrode-recordings during passive or active movement, and on clinical results of deep brain stimulation (DBS) in movement disorders, has been reported. We aimed to report a GP somatotopy, observed in one parkinsonian patient based on dystonic motor side effect assessment during acute stimulation, and related to MRI anatomy.

Methods. A 68 year old parkinsonian (female, 16-year history; suffering mainly from limb and trunk dyskinesia) underwent bilateral stereotactic DBS surgery in internal GP (GPi) based on

direct MRI targeting. We identified the different GP parts on T2-weighted coronal slices: external GP (GPe) and lateral and medial subdivisions of GPi (GPil, GPim). Controlateral dystonic movements were noted during acute intraoperative stimulation under local anaesthesia (1 or 2 mm step; mean current = 0.97 ± 0.14 mA) along the distal 10 mm on 3 parallel tracts (2 mm distant; left hemisphere: central, lateral and medial; right hemisphere: central, anterior and lateral). On the 6 tracts (45 GP checkpoints), the involved body parts (face, upper and lower limbs) were matched with the anatomic structures. Postoperatively, chronic DBS dramatically improved dyskinesia (electrodes implanted on the central tracks).

Results. GPe, GPil and GPim seemed to be characterized by a segregated body map. We found inside each structure a rostro-caudal organisation: face, superior part; upper limb, intermediate part; lower limb, inferior part.

Conclusions. Motor side effect analysis is an interesting tool for somatotopic investigations. The GP somatotopy related to these clinical conditions has to be confirmed.

P46. Anatomic and physiologic target for DBS in Parkinson disease and dystonia. Our experience on 75 patients

C. Conti, R. Eleopra, G. Rizzo, C. Lettieri, M. Brollo, R. Quatrale, C. Cavallo, and G. Trincia

Venezia, Italy

Deep brain stimulation (DBS) is an effective treatment for Parkinson Disease (PD) and Dystonia. Although procedural details are well established, targeting STN and GPi remain problematic. A combination of anatomical imaging, atlas coordinates and intraoperative neurophysiology is considered the most reliable approach. In 75 patients we inserted intracerebral electrodes (148 procedures) for PD (58 pts) and Dystonia (17 pts). The anatomic targets were calculated on stereotactic MRI (first 65 patients in Ferrara) or using the fusion of preoperative MRI and stereotactic CT (last 10 patients in Mestre). All cases had intraoperative Microelectrode recording (MER) with single (ST) or multiple tracks (MT). In 39 patients (52%) we had correspondency between anatomic and physiologic targets. In 36 patients (48%) one or both targets were modified on the base of neurophysiologic recording and the result seems to be more significant in patients with Dystonia (70%). The approach, in the last 10 patients, with MT recording has allowed a better accuracy of the final target with reduction of the time of surgical procedure without any complication.

P47. Dbs in Parkinson's disease with intraoperative multitraces neurophysiological monitoring: no increase of intraparenchimal complications

R. Donati, B. Ferraro, C. Foresti, O. Manara, A. Crocco, and F. Biroli

Bergamo, Italy

Objectives. We emphasise our surgical complications to match with other series without use of intraoperative multitraces neurophysiological monitoring.

Methods. Since May 2002 we have implanted 67 electrodes in 35 patients with PD; in all cases the target was STN. In all cases the pre-operatory planning was performed with IRM.

Intra-operatory neurophysiological monitoring was performed with multichannel microrecording (3–5) of spontaneous nuclear activity. When the neurophysiological target was performed, microstimulation was carried out through the same electrode to assessed effectiveness of the stimulation and to avoid collateral effects.

Results. In our series we haven't sintomatic intraparenchimal hematoma. We have 1 case of cortical localized ESA and 1 case of limited cortical hematoma: both without clinical consequences.

Conclusions. In our experience the intraoperative multitraces neurophysiological monitoring is important to identify the correct position of the electrode to DBS in PD and there isn't increase of surgical complications.

P48. Comparison between atlas based diagrams used for indirect STN targeting and STN templates determined directly on stereotactic MRI

F. Caire, L. Ouchchane, J. Coste, P. Derost, and J. J. Lemaire

Clermont Ferrand, France

Objective. Stereotactic determination of the subthalamic nucleus (STN) target is based on diagrams (indirect statistical coordinates relatively to anterior and posterior commissures AC, PC) or on direct MRI visualization. We aimed to compare both methods.

Methods. We studied 30 STN in 15 parkinsonian patients operated on for bilateral electrode placement. STN, AC and PC were identified on stereotactic 1.5-Tesla MRI slices (stereotactic frame in place; T2 weighted). We outlined STN boundaries on coronal slices. We defined a lateral template (hexagonal shape; on the sagittal slice where STN was widest) then 3 frontal templates (quadrilateral shape) located on the anterior, the intermediate and the posterior borders of lateral STN template. We built Guiot's (modified by Benabid *et al.*) and Talairach's STN diagrams. We tested discordance, using paired means comparisons, on locations of centres between STN diagrams and templates, for both frontal and lateral views.

Results. There were significant differences ($p < 0.05$) between diagrams and templates in laterality, in ACPC direction and in dorso-ventral direction, except for the anterior frontal template in the dorso-ventral direction.

Schematically the lateral template was in a more posterior and ventral position and the frontal templates were in a more medial position. Considering only the indirect method, the locations of centres on frontal and on lateral diagrams, in the dorso-ventral direction, were significantly different.

Conclusions. A slight translation of diagrams on lateral view would probably allow a better correspondence with STN directly defined on MRI. The shape of diagram used on frontal view could also be modified.

P49. Accuracy of stereotactic electrode placement in deep brain stimulation

T. Fiegele, F. Sohm, R. Bauer, J. V. Anton, K. Twerdy, and W. Eisner

Innsbruck, Austria

A high degree of accuracy is necessary for correct localising intracranial targets and position surgical tools in stereotactic neurosurgery.

In a prospective study 24 patients out of about 200 patients with movement disorders (M. Parkinson (7), Tremor (10), Dystonia (7)) treated by deep brain stimulation (DBS) were investigated. The

location of the stimulation electrode was examined in relation to the target point of the planning. All patients were treaded bilaterally and therefore we got 48 cases. The position of the electrode was examined by an intraoperative stereotactic helical computed tomography (CT) which is used routinely to control the correct position and exclude operative complications. The postoperative CT can be image fused easily with the stereotactic planning according to same ring location as the stereotactic frame is still on the patient. The position of the four electrode contacts (Medtronic 3387 or 3389, Minneapolis) was examined according to the Talairach space (AC–PC line) and compared with the coordinates of the planned target point. Our implantation strategy is to include the best stimulation site as contact 1.

Therefore the lowest contact has to be lower than our planned target. Thus we took for calculation the nearest point perpendicular to the electrode. The mean spatial distance of planned target perpendicular to the electrode was 1.38 mm (SD = 0.85 mm). These results show the high accuracy of stereotactic implantation of DBS electrodes.

P50. Subthalamic stimulation for Parkinson

D. Lisii, G. Touzet, N. Reyns, M. Tyr, F. Cassim, D. Devos, P. Krystkowiak, L. Defebvre, and A. Destée
Lille, France

Subthalamic nucleus became the most effective target in the deep brain stimulation for Parkinson disease treatment. Its major effects accounts for alleviation in the motor signs either tremor and rigidity or dyskinesia as dopamine treatment complication. It was previously reported the importance of precise target location and refinement by intraoperative microrecordings and microstimulation. In the same reports it remains uncertain which area of the subthalamic nucleus should be stimulated to enhance better results and still there is no evidence of a good relationship between lead location and clinical effects. Our report is based on a group of 82 consecutively treated patients suffering from dopamine sensible Parkinson disease. A target area is determined on orthogonal X-ray film after performing a ventriculography in a Leksell stereotactic frame, then the posterior-ventral parts of nucleus is targeted and five microelectrodes are descended under the control of microrecording and microstimulation. Retrospectively, coordinates of active lead in each patient were retrieved from intraoperative plans and correlated to clinical outcomes including separate parameters of the unified Parkinson's disease rating scale score (UPDRS) part 3, dysarthria and UPDRS part 2 score. Our results suggest that according the technique previously described the area of stimulation is well defined and rather limited but there is no precise relation between the lead location within the area and the motor clinical signs. However, low level of stimulation intensity and minor differences in the left and right coordinates are predictable of better results, perhaps suggesting an accuracy of the lead placement.

P51. Matching of microelectrode recording and MRI data for 3D target visualization in STN–DBS surgery

P. Gemmar, O. Gronz, F. Hertel, and C. Decker
Trier, Germany

Objectives. In surgical procedures for deep brain stimulation (DBS) differences between the image based targeting and the intraoperative electrophysiological recordings sometimes exist. For the determination of the optimal site for the DBS electrode, the surgeon has to combine intellectually clues from MRI and micro-electrode recording data (MER). This may be difficult.

Therefore, a method has been developed to determine the position of the MER electrodes within the subthalamicus nucleus (STN) and to provide a 3D visualization for the surgeon and the follow-up process, showing the 3D volume of the target structure, as well as the real positions of the electrodes within this structure.

Methods. Using an automatic approach for STN segmentation in MRI and an automatic classification of MER signals, a system has been developed that uses a set of voxels for target representation and straight lines for the electrodes. Marked line segments depict classified target sections. An efficient algorithm was developed to estimate the optimal geometric intersection between 3D target volume and 2D target sections. The algorithm produces a 3D visualization of the target and intersecting electrodes.

Results. The methods have been verified using STN segmentations of five patients. The algorithm showed stable results while using at least 4 electrodes per target. With 3 electrodes it was possible to extract their positions, but it did not show stable results at any time.

Conclusions. Estimation and visualization of the position of the microelectrodes within the target volume can facilitate the decision of the surgeon for the final placement of the DBS electrode. Further verification with a larger group of patients is necessary. Together with a comparison of the effects of macro-stimulation and the determination of the position of the DBS electrode by postoperative imaging, this algorithm may support the surgeon during the operation, as well as the neurologist during programming sessions in the follow-up.

P52. Deep brain stimulation of the subthalamic nucleus in patients with Parkinson's disease

A. A. Tomskiy, V. A. Shabalov, E. V. Bril, N. V. Fedorova, and S. B. Buklina
Moscow, Russia

Objectives. To present the results of the deep brain stimulation of the subthalamic nucleus (DBS STN) in 18 PD-patients.

Methods. Middle age was 54.8 ± 8.6 years, duration of disease 9.5 ± 3.5 years. Duration of L-DOPA therapy 6.8 ± 3.4 years, the daily doze 976.4 ± 534.8 mg. The degree of severity according to H&Y scale was 3 (5 cases), 4 (10 cases) and 5 (3 cases). The assessment of movement disorders was performed by UPDRS (II, III), daily living activity – scale and quality of life – PDQ-39. Patients were examined before surgery in OFF-med- and ON-medication conditions. The same examination was performed 6 months after surgery during the constant DBS. The dyskinesias and fluctuations were assessed by UPDRS-IV. DBS-electrodes were implanted bilaterally by the standard stereotactic technology. After test-period and MRI-control the electrodes were connected with pulse generator (KINETRA).

Results. DBS–STN have decreased the severity of main PD symptoms both in OFF-med- and in ON-med-conditions. Severity of movement disorders have decreased by 47.2% (OFF-med.) and by 28% (ON-med.), daily living activity has increased by 30.9% (OFF-med.) and by 11.2% (ON-med.). Daily doze of L-DOPA have reduced by 64.5% at the best control of movement disorders. Motor fluctuations and dyskinesias have decreased by 67.6%. Quality of life has improved at all patients.

Conclusion. The main influence of DBS–STN was displayed in decrease the severity of movement disorders in OFF-medication condition. It followed by the reducing of the daily doze of L-DOPA, the complications of pharmacotherapy and the improvement of quality of life.

P53. Impact of surgical treatment on tremor due to posterior fossa tumors

T. M. Kinfe, H.-H. Capelle, and J. K. Krauss
Hannover, Germany

Objective. To investigate the impact of surgical treatment on tremor caused by posterior fossa tumors the outcome of tremor in these patients thus far has not been documented.

Methods. This series included a retrospective evaluation of 6 patients with posterior fossa tumors. Patients with a family history of movement disorders or neuroleptic medication were excluded. All patients had postural or kinetic tremors. Tremor was mainly unilateral. There were five women and one man. Mean age at surgery was 59 years (range 45–80). Five patients underwent total or subtotal resection, one patient had a stereotactic biopsy. The histological diagnosis was epidermoid in two patients, metastasis in two other patients and acustic schwannoma and low-grade glioma in one, respectively.

Results. Two patients had no improvement of tremor, postoperatively. In both patients the tumor involved the dentate nucleus directly (one patient with low-grade glioma, and one patient with a metastasis). In the other patients in whom a compressive effect on the dentate nucleus or the dentatothalamic pathways was present without invading the cerebellar structures, gradual postoperative amelioration of the tremor was observed.

Conclusion. The prognosis of tremor due to posterior fossa tumors depends mainly on the involvement of the dentate nucleus or the dentatothalamic pathways. In general, in those patients with compression of tremor-generating structures the prognosis is favorable, while primary involvement of these structures has a poor prognosis.

P54. Targeting the subthalamic nucleus for deep brain stimulation: are intraoperative microrecordings necessary?

E. J. Boviatsis, M. S. Themistocleous, A. T. Kouyialis, P. Stathis, G. Tagaris, T. I. Bouras, and D. E. Sakas
Athens, Greece

Background. Subthalamic deep brain stimulation (DBS) has become the standard surgical therapy for medically refractory Parkinson disease (PD). An important controversy in DBS for PD is whether microelectrode recordings (MERs) are necessary for accurate DBS leads placement.

Objective. The aim of this study was to compare the accuracy of STN targeting by direct visualization on coronal T2-weighted MRI images, to the final DBS electrode placement based on microrecordings and macrostimulation.

Patients and methods. Between 2002–2005, 29 patients underwent surgery for the implantation of 57 STN–DBS leads (28 bilateral, 1 unilateral). We used an array of five microelectrodes separated by 2 mm for MERs. The final location was selected according to the results of MERs and macrostimulation.

Results. In a total of 57 DBS leads implantations the target was readjusted in 24 placements ($n = 42.2\%$). In 11 cases ($n = 19.29\%$) the target point was moved 2 mm posterior to the MRI defined target point, in 7 cases ($n = 12.28\%$) the medial track was used, in 4 cases ($n = 7.01\%$) the anterior track was selected and finally in 2 cases ($n = 3.5\%$) we used the lateral track.

Conclusions. These results indicate that a hybrid method of both direct STN visualization on MRI and intraoperative electrophysiology recordings are important for the optimal localization of the DBS leads.

P55. Intracerebral complication avoidance in microelectrode guided movement disorders surgery

J. M. Nazzaro, D. Slawomir, D. A. Bramble, P. Novak, and S. A. Ellias
Boston, USA

Intracerebral symptomatic hemorrhagic complications in 136 consecutive movement disorders operations directed to the subthalamic nucleus (STN) or globus pallidus internus (GPi) in an IRB-approved prospective consecutive series of parkinsonian surgical patients was studied.

There was no case of short- or long-term clinically significant intracerebral hemorrhage in this series. To help avoid brain hemorrhage several precautions have been followed. Microelectrodes are inspected following sterilization with microscope in the operating room to insure the tips are without bend or related defect. Also, each microelectrode is check prior to use and following sterilization to insure proper functioning including appropriate impedances along an electrode's entire length. Brain cannula are designed such that there is appropriate fit of guide tubes within the outer cannula sleeve and all cannula tips are rounded and inspected to insure no rough edges. Stereotactic trajectories avoid cortical sulci, the thalmostriate and related veins, and if possible the ventricles. Blood pressure is continuously monitored with arterial line and for patients without a history of hypertension and for patient anxiety a light propathol drip is used routinely. There are no passages within brain until the blood pressure is 90–100 systolic or lower. Microelectrode arrays are not used.

These data suggest that microelectrode recording and movement disorder surgery directed to the STN and GPi is not associated with symptomatic intracerebral hemorrhage provided several precautions are taken. Also, we view microelectrode recordings to be important in basal ganglia target localization since only one DBS lead has required revision due to suboptimal efficacy.

P56. Initial experience using DBS in Patras University Hospital in Greece

C. Constantoyannis, J. Ellul, and V. Salakou
Patras, Greece

Introduction. We describe our initial experience of Deep Brain Stimulation for patients with Parkinson's disease and dystonia.

Patients and method. Six patients (4 PD patients and 2 secondary dystonia pts) underwent DBS surgery between 2004 and 2005. Four patients (2 males, 2 females, mean age 63 yrs), were affected from advanced PD. Three of these patients presented with on–off fluctuations, severe rigidity and tremor. The symptoms were resistant to any medical treatment. The last PD patient presented with unilateral tremor. Two other patients (1 male, 1 female, mean age 38), affected from secondary dystonia were presented with hemidystonia. The patients affected from PD underwent bilateral subthalamic nucleus DBS (STN–DBS) in 3 cases and unilateral Ventral Intermediate Nucleus DBS (VIM DBS) in 1 case. The patients affected from dystonia were treated by Internal Globus Pallidum DBS (GPi–DBS) in 1 case and by thalamic nucleus Ventrooralis (Voa DBS) in 1 case. The operations were performed using preoperative MRI for target identification, intraoperative Microelectrode recordings (MER) for STN patients or macrostimulation for thalamic or pallidal targeting and Stealth Station neuronavigation for planning.

Results. All patients with PD in this report experienced improvement in their symptoms. The clinical improvement of UPDRS with DBS was from 42 to 79% in the STN surgery group. The tremor of

the patient with VIM DBS was totally abolished. On the other hand only one of the patients with secondary dystonia experienced clinical improvement. There were no complications or side effects intra- or postoperatively.

Conclusion. DBS surgery is an effective treatment in Parkinson's disease patients. It improves the quality of life of patients and their caregivers. In the secondary dystonia group the results were less impressive as that published by other teams.

P57. Stereotactic stimulation and ablative procedures for therapy of movement disorders. Own experience

S. J. Kwiek, G. Klodowska-Duda, T. Wójcikiewicz, W. Slusarczyk, W. Kukier, P. Bazowski, A. Zymon-Zagórska, H. Buszta, M. Konopka, A. Giec-Lorenz, and G. Opala
Katowice, Poland

The stereotactic procedures are carried out by means of the most modern equipment and planning system, these procedures are extremely low-invasive and relatively safe. The introduction of stereotactic stimulation as a treatment of movement disorders is the important tool for the therapy of Parkinson's disease, dyskinesias and fluctuations associated with pharmacologic therapy for PD, essential tremor, primary dystonia etc. Nevertheless, presently stereotactic deep brain stimulation or ablative procedures are performed relatively seldom in the cases of extrapyramidal diseases.

Between December 2000 and April 2006, 170 stereotactic procedures were performed in the Department of Neurosurgery at the Medical University of Silesia in Katowice, Poland. The procedures were carried out in local anaesthesia with a Brain-Lab stereotactic positioning and treatment system and PatXfer, Target 1.19 and Automatic Image Fusion software. After the stereotactic frame placement, a computed tomography was performed by a Hi Speed NX/iPROBE GE device, with the scan width of 2–3 mm. The images were sent to the stereotactic planning station. Then, the images were converted, and they were superimposed on the previously made MR images (SIGNA MR/iEchospeed 1.5 T GE).

Among them were 23 functional stereotactic operations (11 STN or VIM DBS and 12 ablations of GPi or VIM). In cases of stereotactic DBS micro- and macro monitoring of STN and/or VIM using 4–5 electrodes was carried intraoperativelly.

Appropriate patient selection for DBS or ablative procedures, imaging, planning, defining of the target and trajectory, positioning of the DBS electrode and lesion, stimulation for both effect and side effects and measuring of neuronal activity as well as early and late outcome including failures are discussed.

P58. Visual evoked potentials in Parkinson's disease: subthalamic stimulation vs. dopaminergic influence

R. A. Ricciuti, M. Capecci, V. Cardinali, F. Saltarelli, V. G. Bombace, L. Provinciali, M. G. Ceravolo, and M. Scerrati
Ancona, Italy

Study objective. To investigate the physiological effects of subthalamic stimulation (STNs) on visual evoked potentials (VEPs) through a controlled study versus L-DOPA in Parkinson's disease (PD) subjects.

Subjects and methods. Transient pattern-reversal VEPs were recorded in twenty-eight PD patients under bilateral subthalamic stimulation (age: 63.2 ± 5.3 years, mean disease duration: 14.1 years), 24 matched PD controls (subjects in advanced stage under medical treatment alone) and 15 age-matched healthy subjects. All patients were evaluated in ON medication condition (after 250 mg L-DOPA intake). The implanted patients were evaluated under four different conditions: OFF-stim, Right hemi-stim and Left hemi-stim, ON-stim.

Results. P100 latency and amplitude did not differ in implanted PD subjects in OFF-stim, with respect to PD controls and healthy subjects. P100 latency did not differ between hemi-stim (either right or left) or ON-stim with respect to OFF-stim condition. However, P100 was not appreciated in about 10% of ON-stim records. P100 amplitude was significantly reduced in both ON-stim and hemi-stim conditions with respect to OFF-stim state ($F = 12.5$; $p < 0.0001$). P100 latencies differed in response to four visual stimuli patterns of increasing complexity in all subjects, irrespective of group affiliation ($F = 126.6$, $p < 0.0001$). P100 amplitude was pattern-sensitive in healthy subjects, PD controls and in implanted patients assessed under OFF-stim and hemi-stim conditions. In ON-stim condition, subjects showed a significant P100 amplitude reduction, not influenced by the pattern type.

Discussion and conclusion. STNs does not influence P100 latency, although no conclusions can be definitive in the lack of an OFF-medication VEPs recording. Consequently, no direct STNs interference on the optic pathway can be argued. P100 amplitude reduction in ON-stim and hemi-stim conditions has been already described, leading to different hypotheses: 1) the phenomenon reflects STNs interference with pontine-mesencephalic pathways controlling calcarine cortex eccitability or, 2) it depends from the basal ganglia modulation of frontal, prefrontal and limbic cortex that provokes cognitive modifications able to affect VEPs.

P59. Human stereotaxis-MRI methodology for nonhuman primate research

A. A. F. De Salles, A. A. Gorgulho, G. Lacan, E. J. Behnke, S. Krahl, and W. P. Melega
Los Angeles, USA

Introduction. Novel therapies require previous evaluation in appropriate animal models to assure safety and efficacy. A human CRW stereotactic system was adapted for non-human primates.

Methods. Adult male vervet monkeys were used in over 50 procedures. Specially designed CT/MRI compatible frame was constructed to accommodate CRW instrumentation. Target localization was determined with a cryostat sectioned-atlas combined with MRI. Electrodes for the DBS were implanted into subthalamic nucleus (STN) or ventromedial hypothalamus (VMH). After MRI scan, stereotactic accuracy was verified on a CRW phantom, prior to surgery.

Radiosurgery procedures used a BrainLab stereotactic localizer with MRI (1 mm) fused to CT (1 mm) prior to delivery of 150 Gy to STN and substantia nigra (SN). Animals were assessed clinically, by MRI/ PET scans and immunohistochemistry.

Results. Methodologies were successfully applied to the following studies:

1) Stereotactic delivery of GDNF(200 µg/40 µl) into caudate and putamen unilaterally, which provided partial neuroprotection and accelerated recovery from methamphetamine-induced neurotoxicity.
2) Multiple sampling of CSF and intraventricular injections of GDNF: neuroprotective effects to MPTP-induced neurotoxicity were not observed; however weight loss was.
3) Stem cells harvesting from the walls of the lateral ventricle and their propagation in culture.

4) Accurate DBS placement in the STN/VMH with DBS activation in the conscious animal.
5) STN and SN precise lesions with a 3 mm collimator verified by MRI and post-mortem assessment.

Conclusion. Development of pre-clinical methodologies allows the development of the necessary expertise to optimize therapeutic strategies in animal models, expediting transfer time between experimental research and clinical trials.

P60. Bilateral Ventro-oralis internus (Voi) stimulation for post-traumatic cervical dystonia

T.-K. Lee, S.-H. Yang, K.-S. Lee, S.-S. Jeun, Y.-K. Hong, M.-C. Kim, and C.-K. Park
Seoul, Korea

A 32 year old man sustained a closed head injury in a car accident at the age of 31. Six months after the initial head injury, cervical dystonia developed, and this progressed in severity for six months. The cervical dystonia did not improve with medical treatment, which included clonazepam, L-DOPA, baclofen, and trihexyphenidyl. Two months later, he was treated with botulinum toxin injections to the neck, but there was only a transient ameliorating effect. There was no family history of movement disorders. The patient was referred to our institution for further evaluation and management.

Initial brain magnetic resonance imaging (MRI) done one months after the initial injury showed high signal around the right premotor cortex and both occipital area. A Leksell stereotactic frame was used to implant an electrode into the Voi. A tentative target was determined using customized software, which automatically calculated the target from the magnetic resonance image. The tentative target was set at 12 mm lateral to and 1 mm above the intercommissural line and 2 mm anterior to the midcommissural point. Microelectrode confirmation at the Voi target was undertaken Conventional single and multiunit extracellular recordings were made with platinum plated tungsten electrode insulated with Parylene-C. A local anaesthetic was given and a precoronal burr hole was made on the both side 2.5 cm lateral to the midline. A deep brain stimulation electrode (Medtronics, Minneapolis, Minnesota, USA) was then inserted into the target using a guiding cannula. Immediately after the operation, the patient was able to turn his head to the midline without any sensory tricks while lying on his back and his ability to turn his head to the midline while standing or sitting improved. Three days after implantation of the stimulating electrode, the initial improvement of head turning ceased.

The initial setting of the stimulation parameters was as follows: amplitude 2 V, pulse width 180 ms, frequency 160 Hz. There were no adverse effects associated with the operation.

We report the beneficial effect of bilateral Voi deep brain stimulation in a patient with post-traumatic cervical dystonia. The response to Voi stimulation suggests a common central pathogenic mechanism underlines the central importance of that structure in the generation and amelioration of cervical dystonia.

P61. Control of Post-stroke Rubral tremor with VIM deep brain stimulation with microelectrode recording – case report

T.-K. Lee, S.-H. Yang, K.-S. Lee, S.-S. Jeun, Y.-K. Hong, M.-C. Kim, and C.-K. Park
Seoul, Korea

This 56-year-old man had pontine hemorrhage on 26, Feb 2001 and gradually developed a disabling rubral tremor involving both distal and proximal part of upper arm. Since June he developed titubation and then he could not walk. On neurologic examination, he had no limitation of extraocular movement without nystagmus, ataxia of the both arm and generalized mixed tremor were noted. He had no control of tremor with medication as propranolol, primidon, clonazepam. His rubral tremor worsened and became untolerable. The authors performed stereotactic VIM–deep brain stimulation with MRI-guided and microelectrode recording. A Leksell stereotactic frame was used to implant an electrode into the Voi. A tentative target was determined using customized software, which automatically calculated the target from the magnetic resonance image. The tentative target was set at 11 mm lateral to and 2 mm above the intercommissural line and 6 mm anterior to the midcommissural point.

Microelectrode confirmation at the VIM target was undertaken extracellular recordings. Under the local anaesthesia, Two burr hole were made on the both side 2.5 cm lateral to the midline. There were no adverse effects associated with the operation. His resting, postural and action tremors were abolished in both proximal part of upper extremity. Authors consider that VIM deep brain stimulation could be an effective means of controlling rubral tremor involving proximal upper limb.

P62. Anterior lobe of cerebellum as a target for deep stereotactic high frequency stimulation

M. Galanda and S. Horvath
Bystrika, Slovakia

Objective. There is evidence the function of cerebellum in CNS extends beyond the control of motor performance. The results of stereotactic stimulation of anterior lobe of cerebellum can contribute to these observations.

Methods. Five patients suffered from a disabling spasticity and dyskinesias had unilateral (3) or bilateral (2) implants of quadripolar electrodes into the anterior lobe of cerebellum from suboccipital approach. Evaluation of the active electrode contacts relative to the target was defined by intraoperative high frequency makrostimulation. The therapeutic stimulation was individually set up according to clinical responses (usually 185–200 Hz, 0.5–2.5 V, ON 15–20 min, OFF 2–4 hours).

Results. The immediate improvement on spasticity, gradual reduction in athetoid movements, improvement in speech, respiration, ambulation, mood state and cooperation was combined with reduction of primitive reflexes. In our last quadruparetic patient, year after craniocerebral trauma, in coma vigil, with severe painful spasms in extremities was applied cerebellar stimulation. Her spasms were reduced, but also after two weeks of stimulation she began to communicate, her status is slowly but continuously improving.

Conclusion. Powerful connections of the anterior lobe of cerebellum to pontine, medullary reticular formation, vestibular and corrective movements circuits, also to limbic systems can predict its modulating effect not only on motor performance but also on consciousness and cognitive functions.

P63. STN bursting activity and application of acetylcholine in vitro

T. Heida, E. Tiemens, and E. Marani
Enschede, Netherlands

Parkinson's disease is characterized by an increased synchrony and bursting activity of STN (subthalamic nucleus) cells. The STN is a glutamatergic (excitatory) nucleus. It's neurons may switch from a single-spike mode to a burst firing pattern by the (voltage

dependent) generation of a 'plateau potential' after hyperpolarization. The underlying mechanism for this switch is unknown. STN cell cultures provide a useful instrument in investigating the STN membrane receptors involved in the generation of bursts without the in vivo projections to the STN. In this study (rat) STN cells were dissociated and cultured on a micro-electrode array and acetylcholine was applied. Under normal culturing conditions single spike activity with an average frequency of 5.5 Hz was recorded. Bursts, i.e. sequences of at least four spikes with an inter-spike interval less than or equal to 20 ms, were also recorded but no synchrony was found.

Acetylcholine was applied in 5 steps of 10 with a step interval of 1000 s. After application neuronal activity was significantly decreased for about 100 s, after which spiking activity was restored. The total measurement time was 2.25 hr (including preceding normal registration). Up to 1000 s after the last acetylcholine application a total reduction of 25% of the spike activity was measured ($p = 0.01$). The occurrence of bursts did not significantly change during and after the application of acetylcholine. In conclusion, two spike phenomena in STN cultures could be discerned: an acute diminishing effect of acetylcholine and an overall reduction or late acetylcholine effect.

P64 Pneumocephalus and its influence on the accuracy of deep brain stimulation in the region of subthalamic nucleus (STN)

D. Urgosik, R. Jech, J. Vymazal, and E. Ruzicka
Prague, Czech Republic

A patient suffering from advanced Parkinson's disease underwent deep brain stimulation (DBS). After the implantation the first quadripolar electrode in the STN, a sudden alteration of consciousness and homolateral hemiparesis developed. An urgent CT and MRI disclosed a large-scale pneumocephalus in the left frontal region. The pole of the frontal lobe was compressed posteriorly 40 mm, the left anterior horn of lateral ventricle was shifted towards the back 30 mm, the AC and PC were shifted posteriorly for 1 mm and to the right side by 1.5 mm. The coordinates of the quadripolar electrode contact introduced into the target changed from the original calculation only in the range 0.4–0.6 mm. The more we moved into intracerebral space, the smaller the deviation of brain structured was noticed. Regarding the level of subthalamus, the shift was on the border resolution of MRI and did not really influence the precision of surgery.

P65. The influence of subthalamic stimulation on acoustic analysis of speech in patients with Parkinson's disease

T. Stockinger, K. Kalteis, S. Moosmüller, I. Kryspin-Exner, A. W. Deutsch, and F. Alesch
Vienna, Austria

Background. Parkinson's disease is a progressive neurodegenerative disorder. Speech deficits and dysarthria occur in almost all patients in an advanced stage of the disease. Deep brain stimulation of the subthalamic nucleus is an established treatment to reduce the motor symptoms of Parkinson's disease. Previous studies indicate that this method may affect speech and intelligibility of the patients.

Methods. Sixteen patients with bilateral stimulation of the subthalamic nucleus were tested under four conditions: with bilateral stimulation, without bilateral stimulation, unilateral right stimulation, unilateral left stimulation. The patients were asked to prolong the vowels /a/ and /i/ as long as the can and to read sentences which contained special linguistic phonemes (plosives: /b/, /p/, /g/, /k/, /d/, /t/). In addition, they estimated their subjective intelligibility with a visual analogue scale under these four conditions. We used special software of the Acoustics Research Institute (S_TOOLS-STx Version 3.7.5) to analyse the acoustic parameters of the plosives (burst, time of closure, voice onset time).

Results. The frequencies of plosives showed that the patients are able to produce more accurate plosives without stimulation. This result was seen in all kind of Austrian plosives. The patients did not estimate their best intelligibility in the off-condition, but this may be influenced by the returning of the motor symptoms after turning the stimulation off.

P66. Optimization of battery saving oriented by voltage X pluse width curve in STN–DBS

E. T. Fonoff, R. Bonifácio, M. Rúbia, N. Lara Jr, E. B. Reis, and M. J. Teixeira
São Paulo, Brazil

Introduction. Best clinical results aligned to battery saving are the primary goes in postoperative programming of DBS therapy for PD. In this study the authors approach the relationship between voltage, pulse width (PW) and related clinical responses, suggesting a simple strategy for optimization of battery saving, not affecting clinical results.

Material and methods. Gait and upper limb rigidity (UPDRS III) were evaluated in fourteen patients with unilateral STN–DBS. During evaluation protocol, the whole range of PW (60–450 μs) was explored with increasing voltage, passing through the voltage level related to clinical improvement until the voltage level that rendered side effects. After this initial protocol, 6 patients were followed during 2 subsequent periods of 3 months changing only the PW (60 and 210 μs) seeking for the best clinical responses. UPDRS III (off-state) and voltages related to each PW were compared.

Results. The first protocol yielded a curve (voltage X PW) of both, clinical response and side effects. The same clinical response in short PW was related to higher voltages and wider therapeutic window (ThW), while long PW was related to lower voltages, but narrower ThW. The UPDRS III in 2 PW (60–210 μs) did not reveal any statistical differences, while the voltage level in shorter PW was significantly higher than voltages in longer PW (210 μs). According to the equation $Et = V2 \times PW \times F \times T/R$, the voltage influence (V2) in total energy (Et) spent is higher then PW's.

Conclusion. This strategy seems to contribute with energy saving specially, preserving the same clinical responses.