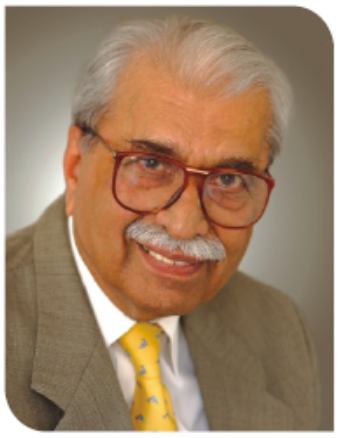
Functional Neurosurgical Program

Epilepsy - Spasticity - Chronic Pain

Jaslok Hospital & Research Centre

Message from Dr. Noshir H. Wadia



Functional Neurosurgery has been defined variously, but one definition states that it is a surgical method of treatment of conditions where the central nervous system is abnormal although the structure or anatomy is normal.

The reach of Functional Neurosurgery is constantly increasing. Beginning with a hand-eye guided approach assisted at times by plain radiographs, functional neurosurgery has now reached a point where with advanced and sophisticated neuroimaging, practically any area of the central nervous system can be targeted with precision by instruments, probes assisted by devices etc. to stimulate or ablate it.

Nearly a century ago the trigeminal ganglion was targeted and ablated by injecting alcohol into it with a wide-bore needle through the foramen ovale at the base of the skull to give relief for trigeminal neuralgia. Today with sterotaxic equipment and powerful imaging relief can be given to patients with Parkinson's disease, incapacitating tremor, intractable pain, etc. And by surgical or other invasive procedures reduce the disability, if not 'cure' the disease.

In this third edition of "Functional Neurosurgery" Dr. Paresh Doshi has highlighted a wide variety of conditions where relief can be given when drugs have failed to do so. Just one example should suffice complex partial seizures caused by mesial temporal sclerosis can be very disabling, especially as single or multiple anticonvulsants often are not able to control it. Besides, a lifetime of taking these drugs can cause side effects and the whole idea is daunting. It is here that in properly selected patients a temporal lobectomy can lead to arrest of seizures and if not, reduce their frequency on the dose of drugs. Such Functional Neurosurgery, as has been mentioned in the previous two newsletters is being performed at the Jaslok Hospital and Research Centre.

Dr. Noshir H. Wadia
Director, Department of Neurology
Jaslok Hospital & Research Centre

Message from Dr. Paresh K. Doshi

Dear Colleague,

It has been some time that I wrote to you. In this newsletter, I plan to highlight treatment of spasticity, chronic pain & epilepsy. These diseases, once considered to be manageable only medically, can now be offered surgical treatment. Once again, it has been possible to offer comprehensive care & treatment for these disorders due to a multidisciplinary approach. This is combined with the state of the art neurophysiology, neuroradiology & nuclear medicine facilities.

The epilepsy surgical program was started in 2000. We have been performing epilepsy surgeries including temporal lobectomy, lesionectomy, corpus callosotomy, Hemispherotomy, etc. The video telemetry unit that records ictal and interictal EEG along with video is equipped to store & process the data of 4 - 6 days duration; similarly, the PET scan, is one of the first few in the countries and is helpful in identifying the seizure focus. The latest 3Tesla MRI machine provides quick and detailed images for elaborate epilepsy protocols. Recently, we have incorporated invasive EEG recordings in our preoperative workup.

The Chronic Pain management, program was started by Pain specialist in 2002. A large spectrum of pain management treatments, ranging from blocks to advanced pain therapies, is offered. We have most advanced radiofrequency lesion generator to provide radiofrequecy lesions for pain treatment. Recently, the Chronic Pain Management clinic hosted the first joint conference with Weill Cornell Medical College on "Comprehensive Review on Advanced Paint Therapies-2007." More than 150 delegates including 20 faculties deliberated on advanced pain management therapy techniques.

The spasticity program was started in 2004, as multidisciplinary team that included paediatric neurologist, stroke specialist, physiotherapist and paediatric orthopaedic surgeon. Surgeries ranging from neurectomies to Intrathecal Baclofen pump are being routinely performed.

In near future we shall be introducing psychiatric disorders surgery and Neuromodulation for intractable epilepsy.

Dr. Paresh K. Doshi

Epilepsy:

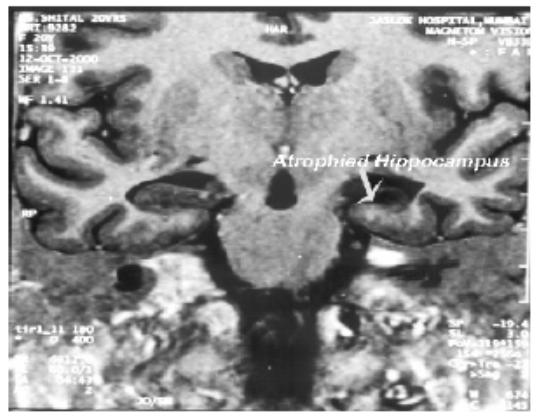
Epilepsy is a most common neurological disorder. Its lifetime prevalence is 20/1000 and prevalence of active epilepsy is 5/10001. Of this, 70% can be controlled with medical treatment, the remaining 30% that are intractable can be investigated for surgical treatment; of this, 25% will benefit by surgical treatment. If we extrapolate to consider the 14-15 million population of Mumbai, 5250 patients can potentially benefit from surgery. Even if half of them had access to the surgical treatment it would take three epilepsy surgeons three years (if they operated daily one case) to clear the backlog.

The main expertise of the epilepsy surgery program involves three key elements. The first is to identify the epileptic focus, the second is to define its relationship with eloquent areas like motor strip, speech center or memory, and the third is to resect it without morbidity.

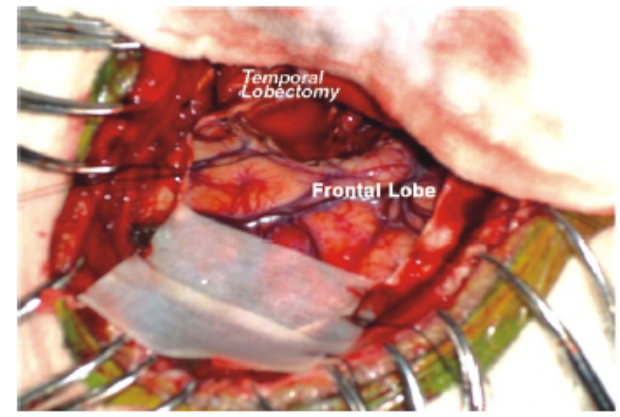
The standard epilepsy surgical protocol involves detailed review by neurologist, followed by EEG and Video EEG recordings, MRI, PET or SPECT scan and neuropsychology. We have been able to successfully perform ictal SPECT scans which are logistically very difficult as the tracer has to be injected within few seconds of ictus.

Temporal Lobectomy:

This is the most common epilepsy surgery. In most centers it is a primary line of treatment, as the long-term morbidity of medical management is more than the surgical treatment.2 Initially, we used to offer surgery to patients having unilateral disease confirmed by seizure semiology, MRI, (Fig. 1) EEG and neuropsychological assessment. After performing more than 50 temporal lobectomies (Fig 2) with good success, we have now started offering this surgery to patients who are more challenging in nature. Some of these cases include unilateral temporal lobe epilepsy with normal hippocampus on the MRI, patients with burnt out hippocampus, having severely atrophied hippocampus with seizure onset contra lateral to the side of atrophy3 and occasional patients with bilateral temporal lobe epileptogenecity. There has been no permanent morbidity or mortality. The rate of surgical complications (e.g. infection, etc.), has been less than 3% with more than 90% patients achieving seizure control.



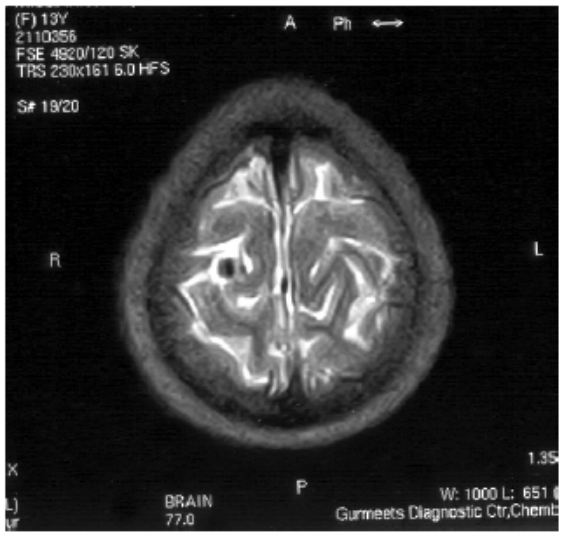
(Fig. 1) MRI showing medial temporal sclerosis (MTS)



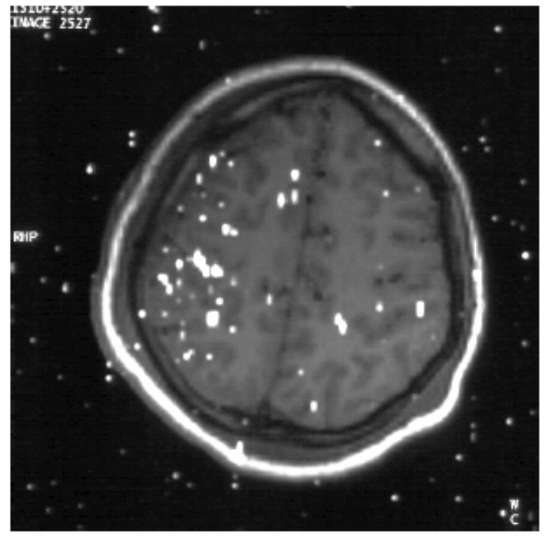
(Fig. 2) Temporal lobectomy performed

Lesionectomy:

The next common groups of patients that may benefit from surgery are patients with lesional epilepsy. Once again, if the surgery is undertaken for epilepsy control, the patient undergoes detailed preoperative workup as outlined earlier. The common causes of such epilepsy are benign lesions like focal cortical dysplasia, granuloma, (Fig. 3) ganglioglioma, Dysembryoplastic neuroepithelial tumors (DNET), etc. In cases of lesional epilepsy we also incorporate functional MRI to define the relationship of lesion to eloquent areas, when the lesion is in their vicinity (Fig. 4). Total lesion excision is the goal except in certain difficult situations and lesions. Most of the surgeries are done in awake condition using image guidance (e.g. stereotactic equipment) (Fig.5). For medial temporal lesions or temporal lobe lesions, we advocate temporal lobectomy and amygdalohippocampectomy along with lesion excision.



(Fig. 3) Calcified Granuloma in the postrolandic gyrus



(Fig. 4) Functional MRI-white area represent the motor areas

(Fig. 5) Patient undergoing awake cramiotomyt

Corpus callosotomy and Hemispherotomy:

(Fig. 6) Corpus Callosotomy

Corpus callosum is the largest white matter connecting two hemispheres. Sectioning of the corpus callosum disconnects the two hemispheres and prevents the spread of seizure discharges. (Fig. 6) The disorders that respond to this form of surgery include tonic and atonic attacks that are frequently seen in Lennox Gastaut Syndrome, multicentric complex partial seizures with secondary generalization, etc. This is a palliative procedure and the aim is to reduce the frequency and intensity of seizures. Besides it is very effective in controlling the falls associated with tonic and atonic seizures. We usually perform anterior 2/3rd callosotomy in most patients, but prefer total callosotomy when the ictal discharges are located posteriorly also and the patient has gross mental retardation. Hemispherotomy has now replaced the conventional hemispherectomy.Patients with Sturge-Weber syndrome, Rasmussen's encephalitis, hemimegaencephaly, etc. who have unilateral hemispheric epilepsy benefit from this surgery. The present technique involves temporal lobectomy, corpus callosotomy, peri-insular, frontal and occipital disconnections. This reduces the postoperative morbidity and blood requirements and hence improving the overall outcome. If performed before the age of 6-7 years, the risk of speech deficit and increase in the hemiparesis is negligible (Fig. 7-9)

(Fig. 7) Preoperative MRI showing extensively damaged Rt. Cerebral hemisphere

(Fig. 8) Postoperative CT scan showing temporal lobectomy, anterior & posterior disconnection

(Fig. 9) Patient walking without hemisparesis postoperatively

Spasticity:

Spasticity is a common sequelae of many neurological disorders. The common causes of spasticity include: Cerebral palsy, multiple sclerosis, stroke, spinal cord injury, paraplegia and hemiparesis from various etiologies ranging from tumor to infections, etc. It is usually managed conservatively with Baclofen, Physiotherapy, orthopaedic interventions and botulinum toxins. Patients not responding to these forms of treatment may benefit from neurosurgical interventions.

Patients are evaluated in the spasticity clinic by the neurosurgeon and physiotherapist. Appropriate help is taken from pediatric neurologist, neurologist or orthopaedic surgeon to evaluate these patients. Based on the findings a wide range of treatment options are offered to these patients.

Neurotomy:

It is usually offered to relieve focal spasticity to improve cosmesis or functionality. The common nerves subjected to neurotomy include median, musculocutaneous (Fig 10 a & b) and tibial nerve. Selective resection of motor fascicles of involved nerves is performed using intraoperative microscope and stimulation. It also does away with the need for repeated botulinum toxin injections.

(Fig. 10 a) Before neurotomy

(Fig. 10 b) After neurotomy

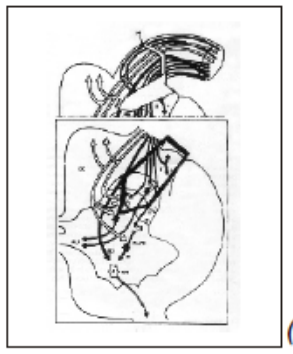
Musculocutaneous Neurotomy for hemiplegic hand

Dorsal Root Entry Zone (DREZ) Rhizotomy:

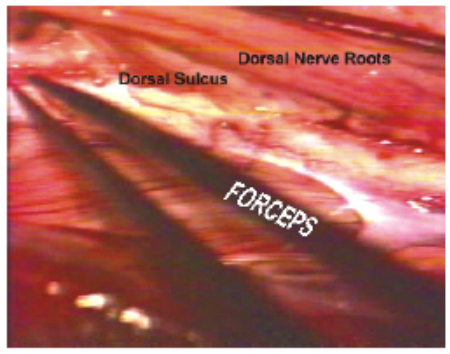
The aim is to interrupt the spinal reflex arc at the level of DREZ, without damaging the larger leminiscal fibers conducting deep pain and touch. The surgery exposes the appropriate spinal segments (for e.g. in lower limb L1-L5) and under microscopic guidance selectively lesions the DREZ. Patients suffering from paraplegia with spasticity are the most ideal candidates. (Fig 11 a & b)

(Fig. 11 a) Anatomical aspects of DREZotomy

(Fig. 11 b) Intraoperative picture (microscopic magnification) making lesion in DREZ



Drezotomy



(Fig. 11 a)

(Fig. 11 b)

Selective Functional Dorsal Rhizotomy:

This surgery is useful in treating cerebral palsy patients. The purpose of this surgery is to partially interrupt the post ganglionic dorsal root fibers, based on the preoperative assessment of various muscles groups contributing to spasticity. As only dorsal roots are disconnected the motor function remains preserved. This surgery is useful for patients suffering from spasticity with preserved motor function, e.g. cerebral palsy patients.

Intrathecal Baclofen (ITB) Pump:

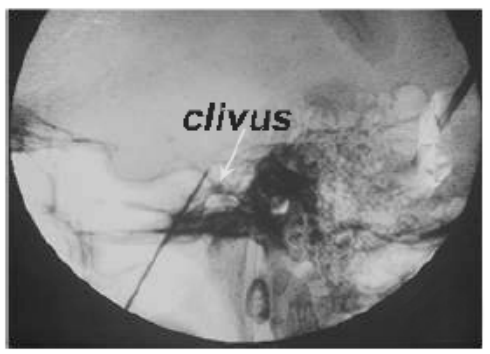
This is the most recent treatment option for spasticity. The purpose is to administer Baclofen directly in to the Intrathecal space where it directly acts on the GABA receptors of dorsal horn. This reduces the average dose (from 60mg p.o. to 100 microgm.). It involves a trial phase where in, a test dose is administered to assess the benefit. At Jaslok hospital the response is independently assessed by the neurosurgeon, neurologist, patient and his family and the physiotherapist. If the response is satisfactory, permanent implantation of the drug delivery pump in performed. A catheter is passed intrathecally under fluoroscopic guidance and connected to the implantable and programmable pump. The pump can be programmed by telemetry and the refill of the drug performed by percutaneous injection in to the pump chamber.

Chronic Pain:

The pain clinic is managed by our pain specialist. It offers medical and surgical therapies, including fluoroscopic guided epidura l and root sleeve injections, radio frequency ablation, alcohol ablation etc. Patients who do not respond to this treatment options may require following advanced pain therapies.

Radiofrequency rhizotomy for trigeminal neuralgia:

Trigeminal neuralgia is the most common cause of facial pain. When the patient fails to respond to medical treatment or develops side effects surgical options should be considered. The two most common surgical therapies include micro vascular decompression (MVD) and radiofrequency thermocoagulation (RFTC). MVD is more widely available in major neurosurgical institutes, but RFTC is available at only select centres. RFTC is a day care procedure. It involves fluoroscopic guided canulation of foramen ovale and positioning the needle in the gasserion ganglion corresponding to the painful division (Fig. 12). After physiological confirmation a thermal lesion is made. The pain relief is instantaneous. There is selective numbness in the distribution of the neuralgic pain, which the patient gets accustomed to, over a period of time. The recurrence rate is Slightly higher than MVD, but as it is a day care procedure, it can be repeated without any concern.



(Fig. 12) Lateral radiography showing needlethrough the foramen ovale at the level of clivus

Spinal cord stimulation:

It was found that stimulating the dorsal columns of the spinal cord through epidurally placed electrodes, provides pain relief by modulating the nociceptive input at the level of dorsal horn. Electrodes are placed either percutaneously or by small laminotomy in the epidural space & connected to pulse generator to deliver current. This produces a pleasant sensation in the distribution of the pain & blocks painful signals. The most common indication for SCS is failed back syndrome. Patients who have undergone previous back surgeries & suffering from residual neuralgic or neuropathic pain responds well to this treatment. Other indications include pain from peripheral vascular disease, angina pectoris, reflex sympathetic dystrophy and Causalgia, post amputation pain etc.

Motor cortex stimulation (MCS):

Deafferentation pain, such as thalamic pain, has proved to be the most difficult pain syndrome to control even with stimulation therapy. Pain control in such cases can be attempted by stimulating at a level more rostral to the thalamic relay nuclei. Tsubokawa & Katayama demonstrated that stimulation applied to precentral gyrus rather than the postcentral gyrus sometimes produced stronger pain inhibition. Studies patients with MCS have shown that the cortical stimulation increases CBF in the ipsilateral thalamus, cingulate gyrus, orbitofrontal cortex and brainstem. Indications for MCS include Anesthesia Dolorosa, Trigeminal deafferentation pain & central pain secondary to stroke. Severe motor deficit is a contraindication for MCS, Post herpetic neuralgia, Peripheral deafferentation pain syndromes like brachial plexus or sciatic nerve injury, Spinal Cord injury & Phantom limb and stump pain. MCS involves epidural implantation of the stimulating electrode across the motor strip and stimulation using the implantable pulse generator.

Dr. Paresh K. Doshi
Incharge - Stereotactic and Functional Neurosurgical Program,
Jaslok Hospital & Research Centre, 15, Dr. G. Deshmukh Marg, Mumbai-400026, India. Phone: +91 22 66573185
pareshkd@gmail.com; www.parkinsonsdiseasesurgery.net