Functional Neurosurgical Program

Jaslok Hospital and Research Centre

JANUARY 2007

Message from Professor D.G.T. Thomas

Dear Paresh,

I am so very pleased to know that you have established at the Jaslok Hospital and Research Centre (JHRC) in Mumbai a facility to perform Stereotactic and Functional Neurosurgery and to know that you have already carried out around 400 stereotactic procedures, including functional neurosurgery, with great success.

At the present time the majority of neurosurgery is performed with very accurate pre-operative or per-operative neuro-imaging. Thus, biopsy or resection of brain tumour depends almost entirely on CT or MRI brain scan. In many cases it is helpful to perform brain tumour surgery under full stereotactic conditions, particularly for example where biopsy of lesions which are deeply placed or are in eloquent brain areas.

At a practical level these stereotactic methods require the best forms of neuro-radiological imaging, generally CT or MRI, coupled to the use of a "stereotactic frame" which is physically attached to the patient's head so that the brain can be registered accurately in three dimensional space.

Functional neurosurgery is certainly a major growing point in neurosurgery to-day and I am very pleased to see that you have been able to introduce this at the Jaslok Hospital and I am sure that your clinical service will continue to increase. A relatively recent development has been the application of deep brain stimulation for Parkinson's disease, dystonia and some other indications. I know that you have introduced this technique at your center with good results.

It is a source of great satisfaction to see a former pupil, who undertook training in stereotactic and functional neurosurgery at The National Hospital, Queen Square with me, to be so successful as a specialist in this area of neurosurgery and to have established specialist facilities in Mumbai.

Yours sincerely,

David

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Stereotactic and Functional Neurosurgery

It gives me a great pleasure to introduce this subspecialty of Neurosurgery. Stereotactic surgery is that science that involves precise targeting of a structure within the brain, whether it be an anatomical target or a brain tumor. Based on three-dimensional constructs, it allows the surgeon to place a probe, electrode, radiation therapy beam or resection instrument, exactly where the x-ray or imaging study indicates.

Functional neurosurgery deals with diseases seen more often by neurologists than neurosurgeons and demands specialized knowledge in the pathophysiology of such maladies and applied neurophysiological techniques.

The need for Stereotactic and Functional neurosurgery program at JHRC was perceived by Prof. N. H. Wadia in 1997 who inducted me on the staff of JHRC for developing it. The JHRC Functional neurosurgical program encompasses the treatment of movement disorders, spasticity, epilepsy and intractable pain. It is designed to meet the needs of patients who are considered to be refractory to the best medical management and are therefore considered as candidates for neurosurgical interventions requiring a high degree of precision using both neuroaugmentive and neuroablative techniques. As such it involves the collaboration of the Stereotaxy and Functional Neurosurgery expert, Movement Disorder specialist, Pain specialist, Epileptologist or Paediatric neurologist; ensuring that patients are carefully screened prior to recommending a surgical intervention. This multi-disciplinary effort is only possible in a tertiary referral centre such as JHRC, where the various disciplines can be brought together in the complex management of these disorders.

We plan to introduce this new subspecialty with a series of quarterly newsletters. The first newsletter will introduce stereotactic neurosurgery, followed by Movement disorders surgery, epilepsy surgery and spasticity and chronic pain management. I hope that this will be of interest to you.

Paresh K. Doshi

Dr. Paresh K. Doshi
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Jaslok Hospital and Research Centre, Mumbai.

Stereotactic Neurosurgery

In this newsletter we will introduce Stereotactic Neurosurgery and its applications. The first stereotactic procedure was performed by Spiegel and Wycis way back in 1947. Since then stereotactic techniques have become a part of the neurosurgical armamentarium. The stereotactic frame typically involves fixing the base ring of the frame (Fig. 4) to the patient's head under local anaesthesia with a number of metal screws which attach to the skull. The base ring supports the "fiducial" markers which show up on the scans. As this is a rigid design system whose dimensions are known, any structure within its boundaries can be accurately localized in three dimensions using complex mathematical formulae. Once located this structure can be approached via burr hole (Fig. 1.) or localized craniotomy (Fig. 2). This technique can be applied to perform virtually all forms of neurosurgical procedures. It is commonly used for

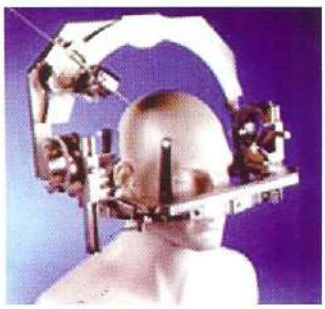
- Biopsy of brain tumors
- Excision of tumors in eloquent areas
- Evacuation of Intracerebral haematoma (ICH)
- Functional Neurosurgical procedures
- Radiosurgery
- Its future applications will include stem cell transplants, interstitial radiation or chemomodulation of brain tumors, gene therapy etc.

(Fig. 1) Burr Hole

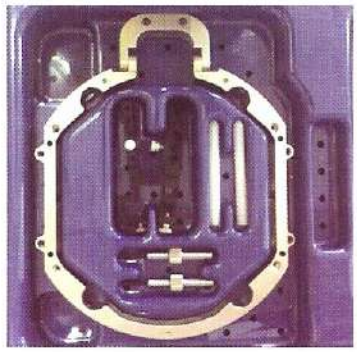
(Fig. 2) Awake craniotomy

We perform almost all stereotactic procedures under local anaesthesia with the patient fully awake. This reduces the morbidity of the procedure and period of hospitalization. However, to ensure patient safety, we have a senior anaesthesiologist present during the procedure. For a biopsy, typically we would admit the patient for 2 days, and for a craniotomy, 5 days. The surgical protocol involves intraoperative confirmation of the tissue diagnosis by smear examination of the specimen. This ensures that before concluding the surgery we are confident of having obtained representative tissue in adequate quantity for final histopathological evaluation. The stereotactic procedure is concluded only after a postoperative check CT scan confirms the exact location of the intervention and the absence of any intracranial haemorrhage.

Stereotactic Set up: We use Cosman Roberts Wells (CRW) stereotactic frame (Fig. 3) for all interventions. We have a wide selection of head rings to suit each individual indication. These include head rings with a swivel to accommodate craniotomy flaps, MRI compatible headrings and the latest lightweight, intubation capable and MRI compatible headring. (Fig. 4). Similarly we have various types of forceps (Fig. 5) to biopsy tumors of different consistencies and a special haematoma evacuator to aspirate solid clots. All this ensures that we can select the optimal treatment for each individual patient.



(Fig 3) CRW stereotactic frame



(Fig. 4) MRI and Intubation Compatible head ring

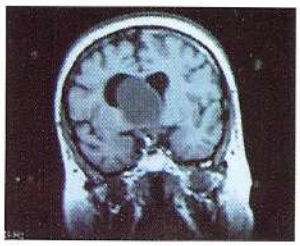
(Fig. 5) Biopsy forceps

CT and MRI: We have the latest multislice CT scanner capable of performing brain scans in a minute. No stereotactic program is complete without capabilities of MRI stereotaxy. We have the most advanced 3 tesla MRI machine to give accurate high quality images. We also have the facility of MRI stereotaxy under GA, most suitable for young children. MRI is specifically required in targeting ill-defined tumors not clearly visible on CT or lesions of the brain stem where it offers superior delineation of the lesion.

Histopathology: The backbone of any successful stereotactic biopsy surgery is histopathology. Histopathologists perform a H & E examination on the intraoperative smear. They offer a provisional diagnosis on the speciment along with confirmation of the representativeness and adequacy of the sample sent. The final histopathological work up involves elaborate staining, immunohistochemistry, tumor markers and electron microscopic examination as required.

Clinical Cases

Case 1: A 40 year old male presented with a recurrent craniopharyngioama (Fig. 6). He had undergone craniotomy for craniopharyngioma 34 years ago, followed by radiation. The recurrent tumor was mostly cystic in nature with few enhancing areas. Conventionally, he would have undergone a repeat surgical exploration. This could have resulted in significant morbidity in view of past surgery and irradiation. He was therefore referred to us for consideration of stereotactic evacuation. We performed stereotactic evacauation followed by omaya chamber insertion (Fig.7). This ensured that if there was any further recurrence of the cyst we could tap him. He has continued to remain asymptomatic since the procedure.



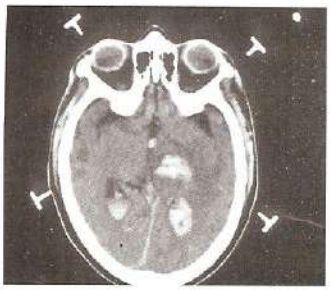
(Fig. 6) Recurrent cystic craniopharyngioma

(Fig. 7) Omaya reservoir in cystic & calcified craniopharyngioma

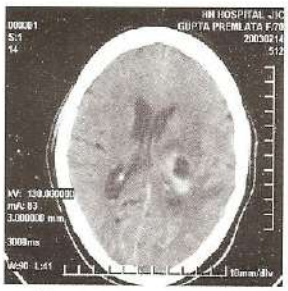
Case 2: A 52 year old lady presented with 4th, 5th and 6th cranial nerve palsies and hemiparesis. CT scan revealed a nodular lesion in the midbrain and pons with a radiological diagnosis of glioma. She was advised to undergo radiotherapy as the surgery for tissue diagnosis was considered hazardous. However, when she consulted us we offered her a stereotactic biopsy. The biopsy revealed the lesion to be a tuberculoma. She recovered completely following a course of anti Koch's thearapy (Fig. 8).

(Fig. 8) Brainstem tuberculoma

Case 3: A 54 year old lady was flown in from Kashmir following an acute intracerebral haemorrhage (ICH). On admission she was drowsy and hemiplegic. Her CT scan revealed large haematoma in the left thalamic region with intraventricular extension (Fig. 9). She underwent stereotactic evacuation of the haemorrhage followed by clot lysis using Urokinase. The haematoma was evacuated over 48 hrs. (Fig. 10) Patient recovered her consciousness level and was transferred from ICU in 5 days and discharged from the hospital in a fully conscious state with recovering hemiplegia by the end of two weeks. A similar case who presented 10 days after haemorrhage was treated conservatively and his serial scan repeated 11 days after haemorrhage continued to reveal a persistent clot with odema and mass effect (Fig. 11 & 12). At the end of three weeks he is still dysphasic, hemiplegic and slightly drowsy. This reveals the efficacy of stereotactic evacuation of acute ICH.



(Fig. 9) Thalamic & intraventricular haemorrhage

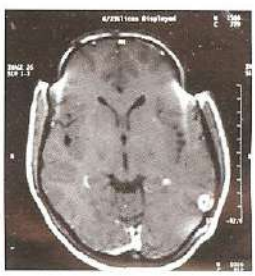


(Fig. 10) After evacuation

(Fig. 11) *ICH conservative Day 2*

(Fig. 12) ICH conservative Day 11

Some other examples of indications for stereotactic procedures



(Fig. 13) Lesion in speech cortex

A small 5 mm size lesion in the speech area removed by awake craniotomy.

(Fig. 14) Gliomatosis cerebri

Gliomatosis cerebri (Diffuse glioma) confirmed by MRI guided biopsy, probably the only means to establish the diagnosis.

(Fig. 15) Brainstem Glioma

Paediatric pontine glioma.

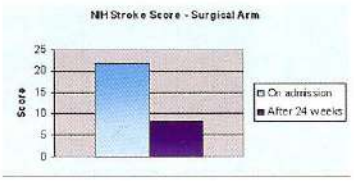
Highlights Of Jaslok Stereotaxy Program

- ★ One of the **best** and most elaborate stereotactic **systems in India**
- ★ Facilities for MRI guided stereotaxy with facilities to administer general anaesthesia.
- ★ Most of the stereotactic procedures are performed in **awake condition.**
- ★ State of the art **Histopathology** department.
- ★ We are proud to report that we have had **100% successful biopsy diagnosis** (Table 1). This is even better than the world average of 94-95% yield.
- ★ **Lowest Morbidity and Mortality.**

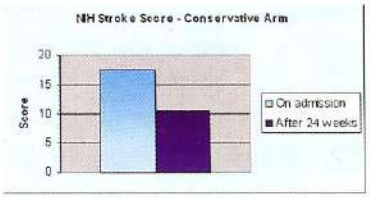
	Literature	Personal
No. of Patients	5129	128
Non Diagnostic	5.8%	0
Haemorrhage	2.1%	0
Seizures	1.8%	1
Infection	0.3%	0
Miscellaneous	0.6%	3
Morbidity	4.2%	4
Mortality	0.8%	0

Table 1. Stereotactic biopsy at Jaslok Hospital

Research: We recently concluded analysis of a Randomized trial of Conservative Management v/s Stereotactic evacuation of Intracerebral Haematoma carried out over a two year period. There were 16 patients in the surgical arm and 11 in the conservative arm. We concluded that at a follow up of 12 weeks after the haemorrhage, patients in the surgical arm had better NIH stroke scores, Barthel's index, Glasgow outcome scores and Rainkin scores. This translated in hlesser morbidity and better quality of life. We now regularly perform stereotactic evacuations in moderatedly sized (> 3 cm) brain haemorrhages.



ICH Surgical arm



ICH Conservative arm

About Dr. Paresh Doshi

- ★ In-charge, Stereotactic and Functional Neurosurgical Program, Jaslok Hospital.
- ★ Trained under Prof. David GT Thomas at the National Hospital for Neurology and Neurosurgery, Queen's square, London.
- ★ Conducted Stereotactic workshops in London in 1994.
- ★ Interviewed by BBC radio and The Royal society for his work on Stereotaxy.
- ★ Important Publications on Stereotaxy:
  - Doshi PK, et al Frameless Stereotaxy and interactive Neurosurgery with the ISG viewing wand. Acta Neurochirugica Suppl. 64: 49-53, 1995.
  - Doshi PK, et al: A Frameless Stereotactic Approach to Preoperative Neurosurgical Planning and Interactive Surgery. (abstract) Acta Neurochir (Wien) 129: 209-251.
  - "Intralesional ^{131}I- Labelled Monoclonal Antibody (Mab) therapy in Patients with Recurrent High Grade Gliomas." (abstract) J Neurooncology 21: 63, 1994.
  - "Acute Morbidity following catheter implantation for interstitial brachytherapy and antibody targeted radiotherapy for recurrent gliomas." (Abstract) British J of Neurosurgery, 1995.
- ★ Important Presentations:
  - More than 20 presentations as guest speaker at numerous congresses in Europe, Asia and India.

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