



# A survey of epilepsy surgery in India



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## ABSTRACT

**Purpose:** Epilepsy surgery (ES) not only remains one of the most underutilized of all accepted medical interventions, but there has also been a decrease in referrals for ES in recent years in high-income countries. We undertook this study to determine the temporal trends of ES and its current state in India. **Methods:** We asked the directors of epilepsy centers across India to complete an online questionnaire about the number and type of ES procedures carried out from 1995 or commencement of the program till December 2012.

**Results:** During the 18-year period, a total of 4252 ES have been undertaken. On an average, 420 ES were being carried out each year in India. Three-fourths of resective surgeries involved the temporal lobe. Although majority of patients were selected for ES by noninvasive strategies, 13 centers had performed long-term invasive EEG monitoring to select complex cases. In between 1995–2000 and 2007–2012, the number of ES carried out in India registered an increase by three-fold.

**Conclusions:** A steadily increasing number of eligible patients with drug-resistant epilepsy in India are undergoing ES in recent years. This temporal trend of ES in India is in contrast to the recent experience of high-income countries.

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## 1. Introduction

Two randomized controlled trials have established that in selected patients with drug-resistant epilepsies (DRE) surgical treatment is superior to continued medical treatment [1,2]. Yet, epilepsy surgery (ES) not only remains one of the most underutilized of all accepted medical interventions [3], but there has also been a decrease in referrals for ES in recent years in high-income countries like Sweden [4], United States [5] and United Kingdom [6]. In contrast, in low- and middle-income countries (LAMIC), where 80% of people with epilepsy worldwide reside, the demand for ES far exceeds its availability [7]. For example, in a survey conducted in 2006 ES was found to be available in only 13% of LAMIC compared with 66% of high-income countries [8].

While ES in India originated in the early 1950s and progressed well during the 1980s and early 1990s, as had happened in the rest of the world, enthusiasm for ES evaporated due to the availability of more effective antiepileptic drugs, less than satisfactory surgical

outcomes and mistaken identity of ES with psychosurgery [9]. In 1995, ES was re-initiated in India at the Sri Chitra Tirunal Institute of Medical Science and Technology (SCTIMST), Trivandrum and at the All India Institute of Medical Sciences (AIIMS), New Delhi [9].

This survey represents the first attempt to compute the temporal trends of ES in India during an 18-year period and to determine the current state of ES in India.

## 2. Methods

We defined ES as surgery undertaken primarily to control drug-resistant seizures rather than for removing an underlying brain lesion. We inquired through multiple sources and identified 18 centers across India which undertook presurgical evaluation and ES during the last two decades. We asked the director of each ES center to complete a questionnaire online regarding ES carried out at his/her center from January, 1995 or commencement (whichever is later) through December, 2012. The questionnaire included year of commencement of ES, number and types of ES undertaken and the presurgical evaluation strategies followed. We did not attempt to ascertain the surgical substrate and postoperative outcome through this questionnaire survey. The Ethics Committee of SCTIMST, Trivandrum, where both authors worked

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during the period of the study, gave permission to undertake this questionnaire survey.

### 3. Results

All the 18 ES centers responded to our questionnaire, and the survey was completed in September, 2013. The demographics of the centers, the presurgical evaluation procedures utilized by them and the surgical procedures undertaken are summarized in Table 1. All except four centers commenced in the new millennium (Supplementary Table 1). Two-thirds of the ES centers were under non-governmental management. Half of the centers were located in southern India (Supplementary Fig. 1).

#### 3.1. Annual rate

As on December 31, 2012, a total of 4252 ES have been conducted across the country from 1995 onwards. The year 2012 contributed to the maximum of 560 ES. On an average, 420 surgeries were being carried out each year in India. Seven centers carried out more than 25 surgeries per year. Of them five centers carried out more than 50 surgeries annually, and these centers accounted for 79% of the ES done annually in India. An additional five centers performed 10–25 ES annually. These centers are trying their best to increase the number of surgeries. The two leading ES centers in India, SCTIMST, Trivandrum and AIIMS, New Delhi, together contributed to 2256/4252 (53%) of ES performed

**Table 1**

The demographics of the 18 epilepsy surgery centers in India, and the presurgical evaluation procedures utilized and the surgical procedures carried out by them.

Attribute	N (%)
<b>Geographical distribution</b>	
Southern India	9 (50.0)
Central India	3 (16.7)
Northern India	6 (33.3)
<b>Year of commencement</b>	
1995–1999	4 (22.2)
2000–2004	6 (33.3)
2005–2009	5 (27.8)
2010–2012	3 (16.7)
<b>Source of funding</b>	
Government	6 (33.3)
Private trust/corporate	12 (66.7)
<b>Presurgical evaluation procedure</b>	
Long-term video-EEG monitoring	18 (100)
Use of sphenoidal electrodes	6 (33.3)
1.5 T magnetic resonance imaging	18 (100)
3.0 T magnetic resonance imaging	15 (83.3)
Neuropsychological assessment	18 (100)
Wada test	7 (38.9)
Interictal single photon emission tomography	16 (88.9)
Positron emission tomography	16 (88.9)
Functional MRI	13 (72.2)
Diffusion tensor imaging tractography	10 (55.6)
Invasive video-EEG monitoring	13 (72.2)
Intraoperative electrocorticography	14 (77.8)
Intraoperative cortical stimulation and mapping	11 (61.1)
Extraoperative cortical stimulation and mapping	7 (38.9)
<b>Surgical procedure</b>	
Anterior temporal lobectomy with amygdalohippocampectomy	18 (100)
Selective amygdalohippocampectomy	6 (33.3)
Lesionectomy	18 (100)
Extratemporal resection (lobar and multilobar)	16 (88.9)
Hemispherotomy	14 (77.8)
Corpus callosotomy	12 (66.7)
Hypothalamic hamartoma resection	9 (50.0)
Multiple subpial transection	5 (27.8)
Vagus nerve stimulator implantation	9 (50.0)

during the study period. The names of the centers and the number of ES undertaken by them during the study period are provided in Supplementary Table 1.

#### 3.2. Type of surgical procedures

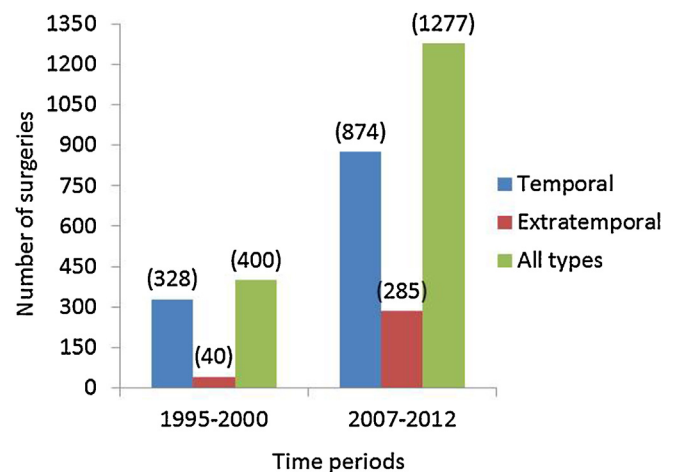
The breakup of surgical procedures is depicted in Table 1. All 18 centers carried out temporal lobe resections. Six centers, in addition, performed selective amygdalohippocampectomy. Sixteen centers carried out extratemporal and multi-lobar resections. Hemispherotomy was performed in 14 centers and hypothalamic hamartoma resection in 9 centers. Five centers undertook multiple subpial transections over eloquent cortex. Corpus callosotomy was done in 13 centers and 9 centers were involved with vagus nerve stimulator (VNS) implants. Among the 5 centers that consistently operated more than 25 patients each year, 2413 out of 3210 (75.2%) resective surgeries involved the temporal lobe. Extratemporal resections were less common 643 (20%). Hemispherotomy and corpus callosotomy accounted for 131 (4.1%) and 93 (2.8%) surgeries, respectively. Out of the 38 VNS implantations that had been carried out till the survey end-point, 21 (55.3%) were carried out at SCTIMST, Trivandrum.

#### 3.3. Presurgical evaluation strategies

All the 18 centers had their own long-term video-EEG monitoring units. Table 1 shows the number of centers that utilized fluoro-deoxy glucose-positron emission tomography (PET), ictal single photon emission computed tomography (SPECT) and functional MRI. Intraoperative electrocorticography was routinely carried out by 14 centers. Thirteen centers had performed long-term invasive EEG monitoring and 7 had undertaken extra-operative cortical stimulation and mapping.

#### 3.4. Temporal trends

The temporal trends in the number of ES carried out together at SCTIMST, Trivandrum and AIIMS, New Delhi are depicted in Fig. 1. When compared to the 1995–2000 period, during 2007–2012, the total number of surgeries increased by 3.2-fold, temporal resective surgeries increased by 2.7-fold and extratemporal resective surgeries increased by 7.1-fold.



**Fig. 1.** Temporal trends of epilepsy surgery undertaken together at the Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum, Kerala, and All India Institute of Medical Sciences, New Delhi, according to type of surgical procedures. All types include, in addition to temporal and extratemporal resections, multilobar resections, hemispherectomies/hemispherotomies, corpus callosotomies and hypothalamic hamartoma resections.

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