



# Epilepsy surgery in children and young adults

## The Cleveland Clinic experience

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**S**INCE 1975, a number of investigators have studied the usefulness of surgery, particularly temporal lobectomy, as a treatment for epilepsy during childhood and adolescence. Davidson and Falconer (1975) reviewed the outcome of temporal lobectomy as a means of managing temporal lobe epilepsy in 40 children. Surgically, all patients underwent en-bloc resection of temporal lobe with portions of mesial structures. In this series, 58% of nonmass lesion patients (mesial temporal sclerosis) became seizure-free over the long term. These were the best results among patients who also had tumors, hamartomas, and other mass lesions.<sup>1,2</sup>

In 1978, Goldring described his technique of extraoperative epidural electrocorticography specifically with application to children. Seventeen of 46 patients discussed were children. He records that 70% of the group benefited from surgery (i.e., no seizures, or a significant reduction in incidence of seizures.)<sup>3</sup>

Green analyzed 28 children who underwent temporal lobectomy between 1949 and 1973. Nine patients had permanent morbidity: one had left hemiparesis, four had upper quadrant hemianopsia, three had non-disabling homonymous hemianopsia, and one had partial Kluver-Bucy syndrome. Green's study is significant in that it specifically details morbidity.<sup>4</sup>

The Mayo Clinic review done by Meyer et al<sup>5</sup> in 1986 is perhaps one of the most complete syntheses of results from temporal lobectomy to date. These investigators reviewed 50 patients from their Mayo Clinic

experience, and found that 54% were seizure free postoperatively, 10% had fewer seizures, and treatment failed in 12%. Forty percent had superior quadrantanopsia postoperatively.

Although the Cleveland Clinic series, which we report here, is at present smaller than these other series, it is clear that the results thus far compare very favorably with the earlier studies, with an overall success rate of approximately 85% in both uncomplicated and mass lesion groups. The lack of significant neurologic morbidity in both groups is also impressive, with mild visual field defects being the major cause of morbidity in about 16% of all cases.

In the Cleveland Clinic series, 27 young epileptic patients were analyzed, all of whom underwent subdural recordings. In all cases, subdural electrode plates were utilized as an adjunct to surface recordings both in terms of localization of foci and measurement of function. Seventeen of these patients were treated with temporal lobectomies, and nine of the remaining ten had seizure surgery as part of the approaches to excision of mass lesions. These patients were all treated between 1979 and 1987 and were selected on the basis of completeness of information regarding seizure frequency, follow-up documentation, extent of excision, and documented morbidity. Three cases were excluded because of inadequate documentation of at least two of the above factors.

The most commonly used surgical techniques in the management of the epilepsies in this age group are temporal lobectomy, extratemporal cortical excisions, and hemispherectomy. The series described here consisted solely of temporal lobectomy in all nonmass lesion cases.

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**TABLE 1**  
RESULTS OF SURGERY

	Group as a whole	Uncomplicated group	Tumor group*
No. patients	27	17	10
Mean age (yr)	16	16	13
Mass lesions	37%		
Association with generalized tonic-clonic seizures		23%	
Overall results			
Failure	15%	12%	20%
No seizures or < 1/mo	85%	88%	80%
No further seizures	52%	59%	50%†
Extent of resection (cm)		6.8†	
Duration of plate monitoring (da)		14	

\* Type of mass lesion: 3 astrocytoma; 2 oligodendroglioma; 2 ganglioglioma; 1 arteriovenous malformation; 1 meningioma; 1 venous angioma.

† Average distance from temporal tip. Right: 7.2 cm (#10), range 5–11 cm. Left: 6.2 cm (#5), range 4.5–7.0 cm. 56% included medial structures.

‡ One patient with venous angioma did not undergo actual seizure surgery as part excision of a mass lesion.

## METHODS

Cases involving subdural plate insertion done on patients of ages less than and including 22 years of age at the time of surgery were selected. Charts were reviewed to determine adequacy of documentation with respect to follow-up, operative technique, and morbidity; cases without appropriate information were eliminated. Twenty-seven of 30 cases between 1979 and 1987 were included; seventeen cases involved complex partial seizures without underlying mass lesions, and ten cases involved complex partial seizures with mass lesions. Because of the limited numbers in the two arms of the series, in-depth statistical analyses could not be performed.

All cases were essentially controlled in terms of surgeon and technique of electrode placement and resections, since the same surgeon carried out all the operative procedures, using a standard protocol described below.

The Cleveland Clinic approach begins with definition of focus laterality, using surface recordings, with nasopharyngeal and sphenoidal electrodes, if necessary. Attention is focused on the temporal lobe from which the bulk of epileptiform activity originates. WADA testing is also utilized to determine laterality of speech and memory. Preoperative computed tomography and nuclear magnetic resonance imaging is done to rule out the presence of structural lesions. Neuropsychologic testing, both pre- and postoperatively, plays an important role in screening potential patients and evaluating

the behavioral consequences of temporal lobe resection.

After the electrode array placement strategy has been determined by electroencephalographic (EEG) localization and correlation with clinical seizure type, the patient is taken to the operating room for electrode placement. The electrodes currently being used are 1.5 mm discs imbedded in Silastic sheets. The cables run through a Silastic sheath to a coupler which can be linked to the EEG.

A “question mark” incision or fronto-temporal-parietal craniotomy is done with special attention to assure adequate access to the floor of the middle fossa. This is vital, as mesial electrodes must be inserted in this area in most cases. A variety of grids can be employed (i. e., 8 × 8, 1 × 4 electrodes, etc). Smaller grids can be placed along the floor of the middle fossa. The grids rest directly on the arachnoid. The cables exit the dural closure and bone flap to exit subsequently from the scalp via a separate stab wound. This is closed, using “purse-string” sutures to eliminate draining of cerebrospinal fluid. Depending upon the location and number of plates inserted, an intracranial pressure monitor may also be placed at the time of surgery.

Following the procedure, the patient returns to the neurosurgical intensive care unit for 24 to 48 hours of recovery; after that point, the patient is transferred to a regular nursing unit. The electrode grids remain in place, with the cables covered by the head dressing. Electrodes have been left in place for up to 4 weeks postoperatively, permitting intensive monitoring and stimulation.

## RESULTS

Treatment failure was defined as no change in frequency of seizures postoperatively. No patients in the series had more than one seizure per month unless they were in the failure group. Reduction in seizure medications postoperatively could not be analyzed since most patients were not on monotherapy either

pre- or postoperatively. The results of surgery in the 27 young epileptic patients studied are summarized in *Table 1*.

Principal sources of morbidity in the series arose from bone flap osteomyelitis and visual field defects associated with temporal lobectomy. In the 27 patients, osteomyelitis was noted in 11% (3/27), and visual field deficits in 16% (4/26). Two cases were resections not involving visual pathways. Other motor or speech deficits were encountered in the early postoperative period but were transient.

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#### CONCLUSIONS

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The extent of resection is clearly larger in this series than the classical 5.5 cm. The fact that this can be

accomplished with minimal morbidity and high postoperative success in terms of seizure frequency is a direct result of the use of subdural plates. In the future, morbidity from infection can be reduced through the addition of epidural screw electrodes, depth electrodes, and foramen ovale electrodes to the preoperative seizure protocol at the Cleveland Clinic Foundation.

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