IMPROVING OUTCOME PREDICTION IN PEDIATRIC EPILEPSY SURGERY

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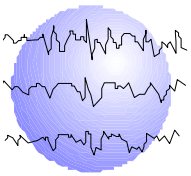

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ABSTRACT

RATIONALE: Selection of pediatric epilepsy surgical candidates requires analysis of many variables to identify patients likely to significantly benefit with minimal complication/s. This retrospective review will identify predictive trends between diagnostic variables and outcome.

METHODS: We analyzed patients who underwent initial resective surgery at Minnesota Epilepsy Group from Jan 2000-Dec 2001. Seizure semiology, ictal/interictal scalp EEGs, and MRIs were analyzed. Neuropsych testing, MRS, PET with glucose, alpha-methylo-L-tryptophan, flumazenil isotopes, and SPECT studies were reviewed if obtained in the evaluation. Diagnostic abnormalities were characterized by their lateralization/location in the frontal, temporal, parietal or occipital lobe. Findings were categorized by support, neutrality or conflict with region of resection. Supporting variables were located within the region of resection. Neutral findings were ipsilateral but not in the region of resection. Any diffuse or contralateral abnormality to the region of resection was defined as a conflicting variable. Diffuse cognitive dysfunction was excluded. Patients were scored at follow-up at 6-, 12-, 24-months by Engel classification, percent seizure reduction, change in neuropsych status, and complication.

RESULTS: 29 consecutive subjects were identified and reviewed; 13 (44.8%) underwent temporal lobe only resections; extra-temporal resections included 6 (20.7%) frontal; 1 (3.4%) parietal, 9 (31%) multi-lobe. In subjects with available follow-up data, 13/25 (52%) were seizure free at 12-months and 9/20 (45%) were seizure free at 24-months. At 12-months, 7/11 (63%) patients with temporal lobectomy were seizure free compared with 6/14 (43%) with extra-temporal resections. Age of epilepsy onset, duration, and etiology did not vary between outcome groups of Engel class I or II vs Engel class III or IV. Subjects with <2 diagnostic variables in conflict were significantly more likely to be in Engel I or II at 12- ($p<0.001$) and 24-months ($p<0.001$) by Fischer's Exact Test. 12/16 (75%) of subjects with <2 conflicting variables were seizure free at 12-months. Supporting and neutral variables did not differ between the outcome groups. The majority of conflicting variables were noted through scalp EEG recording, however conflicting MRI and neuropsychological variables also contributed to poor outcome.

CONCLUSION: Subjects with <2 diagnostic abnormalities contralateral to the targeted epileptogenic zone achieved Engel class I or II surgical outcome in 93% and 87% of cases at 12- and 24- months respectively. None of the individuals with <2 conflicting variables attained Engel I or II outcome at 24-months.

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INTRODUCTION:

Selection of pediatric epilepsy surgical candidates requires analysis of many variables to identify patients likely to significantly benefit with minimal complication. This retrospective review will identify trends between diagnostic variables and outcomes.

METHODS:

We analyzed patients who underwent initial resective epilepsy surgery at Minnesota Epilepsy Group from January 2000 though December 2001. Seizure semiology, ictal/interictal scalp EEG, and MRI were analyzed on all patients. Neuropsychological testing, MRS, PET, and SPECT studies were reviewed if obtained in the presurgical investigation. PET studies utilized glucose, alpha-methyl-L-tryphtophan, and/or flumazenil isotopes. Diagnostic abnormalities were characterized by their lobar location and lateralization to the surgical resection. Lobar determinations included frontal, temporal, parietal, or occipital. Findings were categorized by support, neutrality or conflict with the region of resection. Neutral findings were ipsilateral but not in the region of resection. Any diffuse or contralateral abnormality to the region was defined as a conflicting variable. Diffuse cognitive dysfunction or mental retardation was the only variable excluded. Patients were scored at follow-up intervals of 6, 12, and 24 months following surgery using a Modified Engel classification, percent seizure reduction, change in neuropsychological status, and complication.

RESULTS:

Twenty-nine consecutive pediatric subjects were identified and reviewed. Demographic variables are presented in Table 1. Average age of epilepsy onset was 3.3 years and the average duration of epilepsy was 7.3 years prior to surgery. Monthly seizure frequencies averaged 113. The number of presurgical AED averaged 4.8 and the average number of AED prescribed at the time of surgery was 2.2. Following surgery, patients averaged 1.8 AED prescriptions. Hand dominance was undetermined in 27.6%. These variables are listed in Table 2 based on Engel Classification 12 months post-operatively.

The distribution of surgical procedures is presented in Figure 1. Surgery was performed on the dominant hemisphere in 34.5% and non-dominant hemisphere in 37.9% (Figure 2). Thirteen (46%) underwent temporal lobe only resections. Extra-temporal resections included six (22%) frontal, one (3.4%) parietal, and nine (31%) multi-lobar. Cortical mapping was performed in 89.7% of subjects, which demonstrated functional overlap in 41.4% of the total.

In subjects with available follow-up data, 13/25 (52%) were seizure free at 12 months. At 24 months, 9/20 (45%) were seizure free. Temporal lobe only resections demonstrated seizure freedom in 7/11 (63%) at 12 months and in 6/9 (66%) at 24 months. Extra-temporal resections were associated with seizure freedom in 6/14 (43%) at 12 months and in 3/11 (27%) at 24 months. Age of epilepsy onset, duration, and etiology did not vary between outcome groups on Engel I or II versus Engel III or IV.

The average number of supporting diagnostic variables was 5.3, and the average number of conflicting variables was 1.5. The average number of neutral variables was 2.9. The average net (supporting – conflicting) was 3.5 variables.

Subjects with <2 diagnostic variables in conflict were significantly more likely to be in Engel I or II at 12 months ($p < 0.001$) and 24 months ($p < 0.001$) by Fischer's Exact Test. Twelve of sixteen (75%) subjects with <2 conflicting variables were seizure free at 12 months, and 3/16 (19%) were classified as Engel class II. At 24 months following surgery, 9/15 (60%) were seizure free and 4/15 (27%) were classified as Engel II. In subjects with 2 or more conflicting variables despite the number of supporting variables, only 1/9 (11%) was found to be seizure free at 12 months. None of the (0/5) subjects with 2 or more conflicting variables were seizure free at 24 months. Supporting and neutral variables did not differ between the outcome groups.

The majority of conflicting variables were noted through scalp EEG recording, however conflicting MRI and neuropsychological variables also contributed to poor outcome.

CONCLUSION:

Subjects with <2 diagnostic abnormalities contralateral to the targeted epileptogenic zone achieved Engel class I or II surgical outcome in 93% and 87% of cases at 12 and 24 months respectively. None of the individuals with 2 or more conflicting variables attained Engel I or II outcome at 24 months.

Figure 1

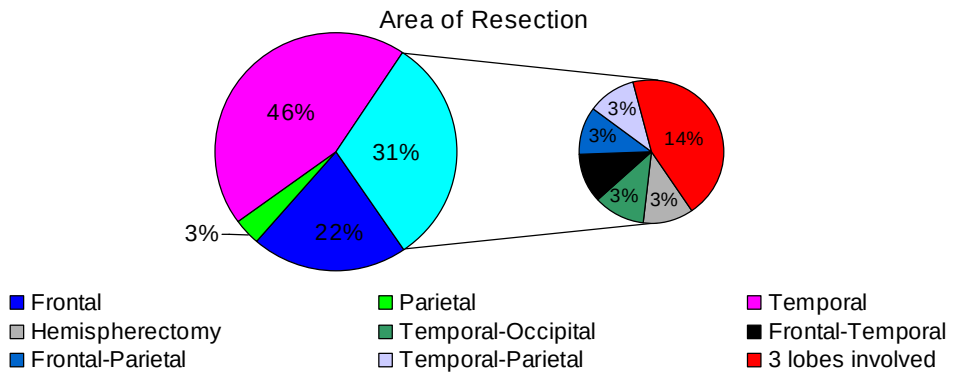


Table 1

Demographics	**% of Patients**
Gender: N=29	
Male	45
Female	55
Hand Dominance	
Right	69
Left	21
Undetermined	10
Developmental Assessment	21
Normal	66
Global Delay	3
Behavioral	7
Speech Delay	3
Motor Delay	
Etiology	
Encephalomalacia	14
Trauma	5
Tumor	26
Genetic/Degenerative	5
Congenital	27
Undetermined	23

Figure 2

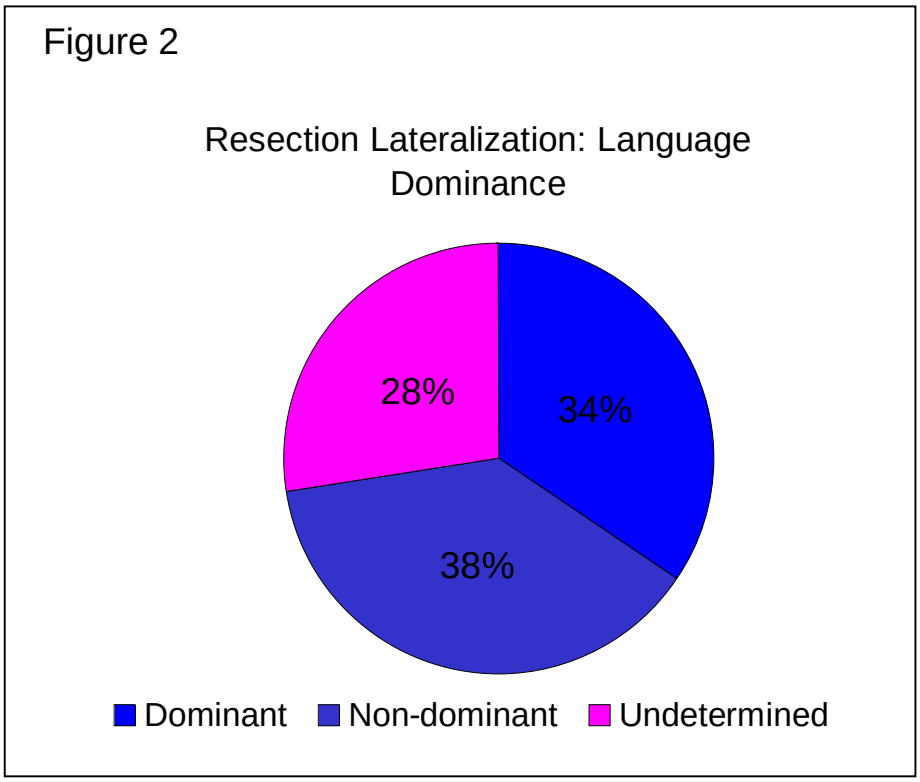
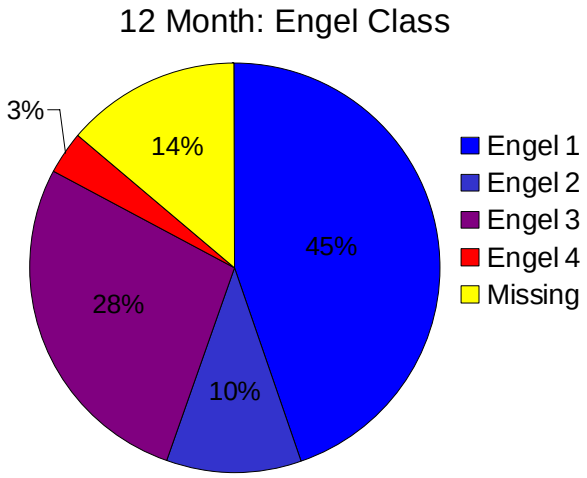


Table 2

12 Month Engel Class: clinical variables of epilepsy duration, age of onset, seizure frequency, number of presurgical AEDs, and number of AEDs at time of surgery (N=25)

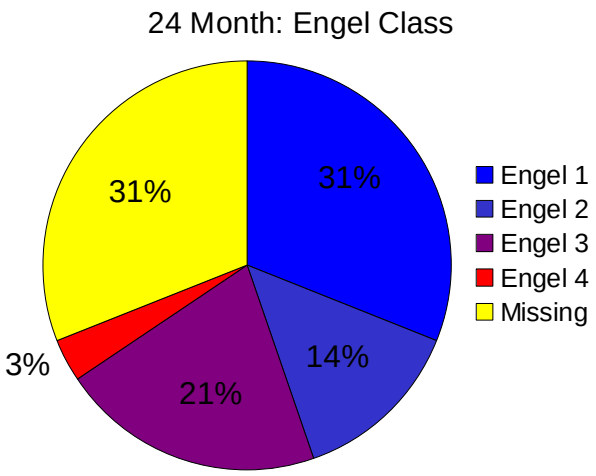
		Epilepsy Duration (Yr)	Age of Onset (Yr)	Seizure Frequency (sz/min)	# of Pre-Surgical AEDs	# of AEDs at Time of Surgery
Engel 1	x	9.462	2.9138	65.1538	4.77	2.15
	N	13	13	13	13	13
	SD	7.2009	3.34720	84.26728	2.351	8.99
Engel 2	X	6.333	4.7500	9.5000	3.33	1.67
	N	3	3	3	3	3
	SD	7.5056	2.38485	9026013	3.215	.577
Engel 3	X	4.500	4.0131	268.0000	5.38	2.38
	N	8	8	8	8	8
	SD	2.2520	4.18749	510.93640	3.249	1.061
Engel 4	X	7.500	.5000	30.0000	9.00	4.00
	N	1	1	1	1	1
	SD	-	-	-	-	-

Figure 3



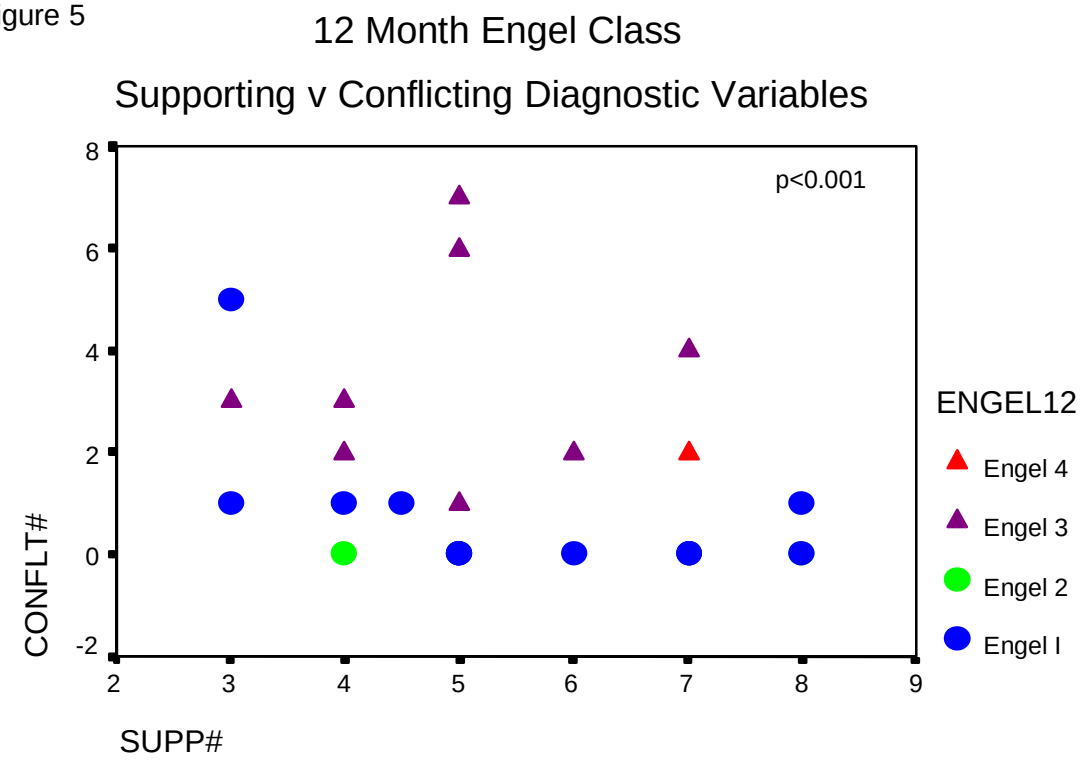
Etiology and Location		Outcome				
Surgical Resection		**Engel 1**	**Engel 2**	**Engel 3**	**Engel 4**	**Total**
Temporal	Genetic/Metabolic/degenerative	1				1
	Tumor	4				4
	Mesial Temporal Sclerosis	2	2	2		6
	Total	7	2	2		11
Frontal	Congenital	1			1	2
	Undetermined	1		3		4
	Total	2		3	1	6
Parietal	Encephalomalacia (extra-temporal gliosis)		1			1
	Total		1			1
Multi-Lobar	Congenital			2		2
	Tumor	1				1
	Traumatic	1				1
	Encephalomalacia (extra-temporal gliosis)	1		1		2
	Mesial Temporal Sclerosis	1				1
	Total	4		3		7

Figure 4



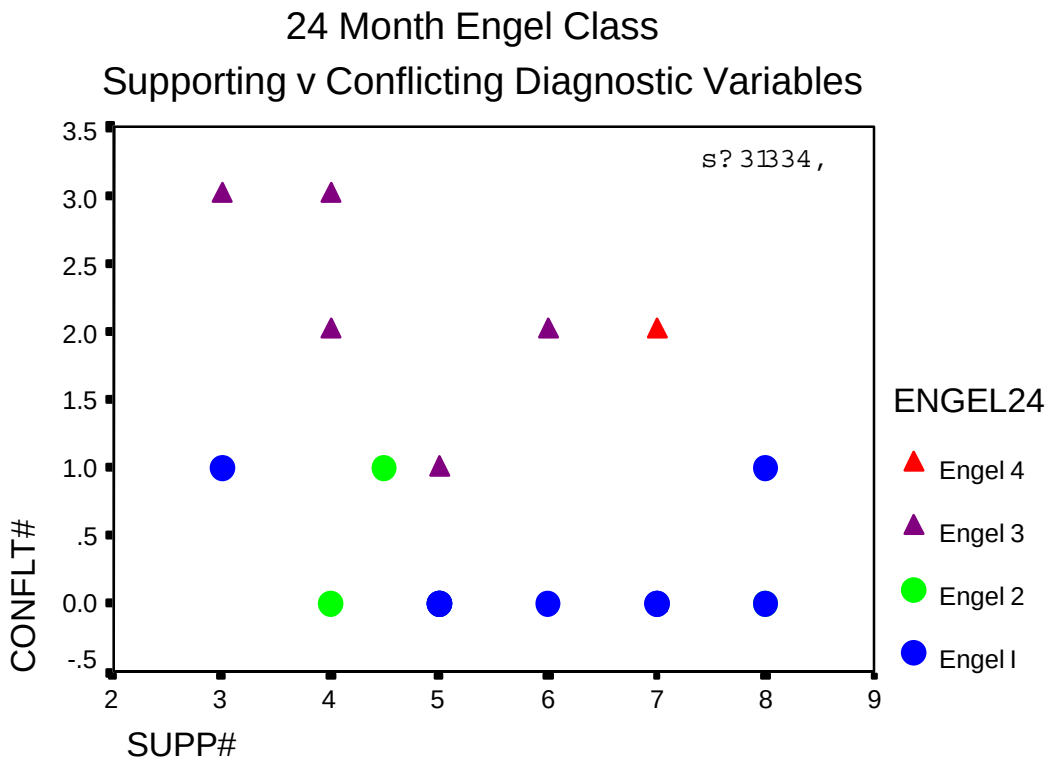
Etiology and Location		Outcome				
Surgical Resection		**Engel 1**	**Engel 2**	**Engel 3**	**Engel 4**	**Total**
Temporal	Genetic/Metabolic/degenerative	1				1
	Tumor	3				3
	Mesial Temporal Sclerosis	2	2	1		5
	Total	6	2	1		9
Frontal	Congenital	1			1	2
	Undetermined			2		2
	Total	1		2	1	4
Parietal	Encephalomalacia (extra-temporal gliosis)		1			1
	Total		1			1
Multi-Lobar	Congenital			2		2
	Tumor		1			1
	Encephalomalacia (extra-temporal gliosis)	1		1		2
	Mesial Temporal Sclerosis	1				1
	Total	2	1	3		6

Figure 5



# of Conflicting Variables	Outcome				
	Engel 1	Engel 2	Engel 3	Engel 4	Total
≤ 1	12	3	1		**16**
≥ 1	1		7	1	**9**
Total	**13**	**3**	**8**	**1**	**25**

Figure 6



# of Conflicting Variables	Outcome: Engel 1	Engel 2	Engel 3	Engel 4	Total
≤ 1	9	4	2		**15**
≥ 2			4	1	**5**
Total	**9**	**4**	**6**	**1**	**20**