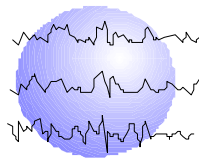


**NAMING ABILITY AFTER TAILORED LEFT  
TEMPORAL RESECTION WITH EXTRAOPERATIVE  
LANGUAGE MAPPING: GREATER RISK OF DECLINE  
WITH LATER EPILEPSY ONSET AGE**

Keith G. Davies, MD

Gail L. Risse, PhD

John R. Gates, MD



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Minnesota Epilepsy Group, P.A.<sup>®</sup>  
225 Smith Avenue N., Suite 201  
St. Paul, MN 55102  
Phone: (651) 241-5290  
Fax: (651) 241-5248

## **ABSTRACT**

**PURPOSE:** Standard temporal resection in the left, language-dominant hemisphere carries the risk of postoperative naming ability decline, a risk associated with later epilepsy onset age/absence of hippocampal sclerosis. Preoperative language mapping has been performed routinely at some centers to minimize postoperative primary language impairment, but its effect on changes in naming performance has not been explored. This study specifically examined naming outcome in relation to onset age in patients who had temporal resection after language mapping.

**METHOD:** The sample consisted of patients undergoing left tailored resection after extraoperative language mapping who had Boston Naming Test (BNT) evaluation pre- and six months postoperatively, and who had: left hemisphere dominance for language by amobarbital testing, FSIQ>69, and no lesion on MRI apart from changes of hippocampal sclerosis. Reliable Change Index (RCI) (5 for BNT) was used as an indication of meaningful change.

**RESULTS:** Twenty-two patients (14 male) met the criteria. None was aphasic postoperatively. Mean onset age was 13 years and age at surgery 27 years. There was significant correlation between onset age and change in BNT, later onset being associated with greater BNT decline ( $r=-0.51$ ,  $p<0.05$ ). There was a significant difference in BNT decline for patients with onsets <13 years and >13 years (-0.1 and -13.2 respectively,  $t=2.93$ ,  $p<0.01$ ). Overall, 11 (50%) patients had a BNT decline greater than RCI. Proportions of patients undergoing RCI decline for patients with onset <13 years and >13 years were 27% and 73% respectively ( $\chi^2=4.55$ ,  $p<0.05$ ). A multiple regression analysis showed that onset age was the only significant predictor of BNT decline. Non-significant predictors were: gender, distance from closest language site to the edge of the resection, presence of language sites on the edge of the grid, number of temporal language sites, extent of lateral temporal resection, chronological age, resection/preservation of language sites, and resection/preservation of hippocampus.

**CONCLUSION:** Naming ability in cases with early onset age (<13 years) is stable with language mapping, but a risk of decline remains for later onset age. Mapping-related factors such as resection of isolated language sites and proximity of language sites to the edge of the resection do not appear to be as important.

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## **INTRODUCTION**

Anterior temporal lobectomy (ATL) in the hemisphere dominant for language carries risks for impairing language function, specifically nominal speech, after surgery. Other aspects of language ability such as fluency and comprehension are typically unaffected. Reports of the results for language abilities following this procedure have been conflicting, and while group comparisons often show no or modest decline, it is possible to identify a sub-group which may be at risk, its size depending upon the method used to identify meaningful decline. Published studies have shown that the subgroup at increased risk will have later epilepsy onset age [3, 6], absence of early risk factors for epilepsy [8, 9], and absence of hippocampal sclerosis [1], all features of the absence of the syndrome of mesial temporal sclerosis.

Language mapping has been used as a technique to minimize the risk of producing language dysfunction after dominant hemisphere surgery. Mapping may be undertaken intraoperatively or extraoperatively, the latter also allowing ictal EEG monitoring in order that the resection may be maximized while preserving functional areas. Mapping has revealed that language sites are very variable in distribution, and not confined to well-demarcated classical language areas, when stimulation-mapping studies are performed.

Some studies have suggested that naming may also decline after tailored resections. Although group comparisons suggest no or modest risk [2, 4, 5], there is evidence that a subgroup is also at risk to naming after a tailored resection. Swanson et al, using the same criterion as Hermann et al [6], found the risk to naming (8%) to be almost identical after tailored resection with language mapping [10]. Furthermore, in a multi-center comparison of naming outcome in patients who had had standard temporal resection (with sparing or resection of superior temporal gyrus) versus those who had language mapping and tailored resection (with intra- or extraoperative mapping), there was no difference with respect to naming [3]. All groups underwent a similar decline. The predictors of decline for all groups were later age of onset and more extensive resection of lateral temporal cortex. These findings also suggest that the status of the patient with regard to the syndrome of mesial temporal lobe epilepsy may be more relevant for predicting risk to naming than the preservation of cortical language areas.

The present study aimed to examine naming ability after tailored temporal resection with extraoperative language mapping and to identify potential risk factors.

## **MATERIAL AND METHODS**

The patient sample was taken from a population of patients with intractable epilepsy undergoing left, language-dominant temporal resection after placement of a subdural electrode grid with extraoperative mapping of language cortex. The following criteria were required: left hemisphere dominant for language as evaluated with an intracarotid amobarbital procedure; pre- and postoperative neuropsychology testing which included the BNT; FSIQ >69; no lesion on MRI apart from changes consistent with hippocampal sclerosis.

### **Neuropsychology Testing**

Neuropsychology testing was performed preoperatively and six to eight months postoperatively. A comprehensive battery of tests was administered, including tests of language function, intelligence and memory. For the purposes of this study the 60-item BNT was used.

### **Language Mapping Technique**

Language mapping was performed once the ictal onset had been clarified and this was undertaken in at least two sessions, aiming to locate areas with consistent language responses. For the first seventeen patients, language sites were identified by stimulation interruption of spontaneous speech (speech arrest). More recently, a more extensive battery of language modalities has been performed, testing for spontaneous speech, visual naming, reading, repetition and comprehension. Five patients were evaluated in this way. For the purposes of this study, language sites were then identified on the basis of stimulation interruption of any one of these modalities.

### **Surgical Technique**

The craniotomy was always performed with general anesthesia. At the first procedure, a subdural grid placed on the convexity of the hemisphere to ensure good coverage of frontal and temporal convexity cortex. In addition, subdural strip electrodes were placed beyond the edges of the grid to cover subtemporal, anterior frontal and subfrontal areas. The second procedure was performed aiming to resect areas identified as significant for ictal onset and to spare the temporal language area. This area was identified as a collection of consistent language sites, but occasionally isolated single sites with a language response were identified. Such sites were not always spared. Surgically, the lateral temporal cortex was resected first, and, unless memory function was considered to be at risk, mesial structures were then resected by aspiration. The fragments of the mesial structures were submitted for histopathological examination which did not allow detailed study of neuronal loss within specific sectors of the ammon's horn. Mesial structures were not resected in six cases.

## **DATA ANALYSIS**

Simple bivariate correlations (Pearson) were used to examine relationships between BNT score change and predictors which were continuous variables. The sample was dichotomized by a median onset age split (13 years) and then comparisons between the two groups undertaken using a t test of independent samples for continuous variables and chi-square test non-continuous variables.

Meaningful change in BNT score was evaluated by reliable change index (RCI). RCIs provide an index of reliable alteration in test performance, changes that cannot be attributed to common sources of measurement error inherent in test - retest designs (eg, practice effect, regression to the mean). These indices are derived from the assessment of epilepsy patients who have been tested twice but did not undergo surgery. The decline necessary to exceed the 90th centile of RCI is  $\leq -5$  for the BNT [7].

Finally, a multiple regression analysis with backward entry of variables was undertaken. Change in BNT score was the dependent variable and as independent variables: gender, distance from closest language site to the edge of the resection, presence of language sites on the edge of the grid, number of temporal language sites, extent of lateral temporal resection, chronological age, onset age, resection/preservation of language sites, and resection/preservation of hippocampus

## **RESULTS**

Twenty-two patients were identified who met the inclusion criteria. Details are given in Table 1. None was dysphasic postoperatively.

The pre- to postoperative change in BNT score by onset age for individual patients is shown in Figure 1. The mean BNT change for all patients was  $-6.0$ . There was significant correlation between BNT score change and onset age, later onset age being associated with greater BNT decline ( $r=-0.51$ ,  $p<0.05$ ). There was no significant correlation between BNT decline and chronological age, extent of lateral temporal resection, or distance from the edge of the resection to the closest language site. When the sample was dichotomized by median onset age, the mean BNT decline for patients with onset  $<13$  years was  $-0.1$  and for patients with onset age  $>13$  years  $-13.2$  ( $t=2.93$ ,  $p<0.01$ ).

Eleven (50%) patients had a BNT decline greater than RCI. Proportions of patients undergoing RCI decline were 27% for those with onset  $<13$  years, and 73% for those with onset  $>13$  years ( $\chi^2=4.55$ ,  $p<0.05$ ).

The multiple regression analysis revealed epilepsy onset age to be the only significant predictor of BNT score decline ( $F=5.87$ ,  $p<0.05$ ). Non-significant predictors were: gender, distance from closest language site to the edge of the resection, presence of language sites on the edge of the grid, number of temporal language sites, extent of lateral temporal resection, chronological age, resection/preservation of language sites, and resection/preservation of hippocampus.

## **CONCLUSIONS**

Naming ability is stable after temporal resection with language mapping in cases with early epilepsy onset age (<13 years), but for later onset age there is a risk of decline. Mapping-related factors such as resection of isolated language sites and proximity of language sites to the edge of the resection do not appear to be as important as onset age.

Naming decline with later onset age may reflect function of structures mediating language but which are not activated in the lateral temporal cortex. The naming stability with early epilepsy onset may be due to language reorganization as a result of an early insult.

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Table 1

## Patient data

Continuous variables: means (standard deviations)

	Total	Onset age		P
		<13 years	>13 years	
N	22	11	11	
Sex M/F	14/8	4/7	10/1	<0.05 <sup>†</sup>
Chronological age (years)	26.8 (11.74)	22.3 (11.49)	31.4 (10.59)	NS *
Onset age (years)	13.3 (10.76)	4.9 (3.88)	21.6 (8.61)	<0.001 *
FSIQ	92.4 (14.31)	88.9 (18.75)	95.3 (9.35)	NS *
BNT score preoperative	41.1 (12.07)	35.6 (12.54)	46.6 (9.07)	<0.05 *
BNT score change	-6.0 (12.21)	-0.1 (7.56)	-13.2 (12.72)	<0.01 *
BNT RCI decline	11 (50%)	3 (27%)	8 (73%)	<0.05 <sup>†</sup>
Extent of lateral resection	5.6 (1.63)	5.4 (1.93)	5.7 (1.33)	NS *
No of temporal language sites	6.5 (4.68)	5.3 (5.81)	7.6 (3.23)	NS *
Distance from resection to closest language site (cm)	0.95 (0.93)	1.0 (0.97)	0.9 (0.94)	NS *

*For comparison of onset ages <13years and >13 years:*

\* *t test of independent samples*

<sup>†</sup> *chi-square*

Figure 1

### Scatter graph of pre- to postoperative change in BNT score versus epilepsy onset age.

The dashed line denotes the RCI decline.

N = 22

