

# Evaluating the Correlation Between Preoperative Examination Results, Prognosis, and Pathology Results in Temporal Lobe Epilepsy Patients

Temporal Lop Epilepsili Olgularda Ameliyat Öncesi İnceleme Sonuçlarının Prognoz ve Patoloji Sonuçları İle Korelasyonunun Değerlendirilmesi



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## Summary

**Objectives:** This prospective study aims to compare the diagnostic value of different preoperative examinations in patients who underwent TLE surgery for treatment-resistant temporal lobe epilepsy, following histopathological evaluations, and to evaluate the seizure-freedom rates observed during the postoperative follow-up.

**Methods:** In this study, 35 patients who were followed-up in our clinic diagnosed with drug-resistant TLE were evaluated prospectively. The epileptic focus was determined for all patients. The different preoperative, noninvasive examinations were compared to each other, and with postoperative pathology results. Patients were followed up for two years after surgery.

**Results:** Concerning determining the epileptic focus, our findings showed that PET and cranial MRI had similar effectiveness compared to ictal EEG and semiology, which represent the gold standard in preoperative examinations. When we correlated the imaging methods with ictal EEG, PET scan had a considerably high lateralization value in determining the epileptic focus and had 100% sensitivity. In terms of detecting the epileptic focus, MRI had a sensitivity of 97%, routine EEG had a sensitivity of 82.9%, and MRS had a sensitivity of 79.4%. During the postoperative period, hippocampal sclerosis was observed in 71.4% of the patients. The postoperative seizure-free rate was 82.8% in the sixth month and in the first year, whereas this rate was 74.3% in the second year.

**Conclusion:** In conclusion, as in the present study, each preoperative examination has an impact on localizations and prognosis; it is also important for a good surgical prognosis that results are consistent and focused on a single location.

Keywords: Epilepsy surgery; temporal lobe epilepsy; video-EEG.

## Özet

**Amaç:** Bu çalışmamızda, ileriye yönelik olarak ilaç tedavisine dirençli temporal lob epilepsisi (TLE) nedeniyle opere edilen olguların ameliyat öncesi incelemelerinin korelasyonu ve ameliyat sonrası izlemlerinde nöbetsizlik oranlarını değerlendirmeyi amaçladık.

**Gereç ve Yöntem:** Kliniğimizde ilaç dirençli TLE tanısıyla izlenen ve cerrahi adayı olarak belirlenen 35 hasta ileriye yönelik olarak değerlendirilmiştir. Çalışmaya dahil edilen hastaların epileptik odağı belirlenmiş, preoperatif noninvaziv incelemeleri tamamlanıp incelemeleri birbirleriyle ve ayrıca ameliyat sonrası dönemdeki patoloji sonuçları ile karşılaştırılmıştır. Cerrahi sonrası iki yıl boyunca hastalar izlenmiştir.

**Bulgular:** Çalışmamızın sonucunda, epileptik odağı tespit etmede ameliyat öncesi incelemelerden altın standart olan ictal EEG ve semiyolojiye benzer şekilde, PET ve kraniyal MRG incelemelerinin de yüksek oranda katkı sağladığını gözlemledik. Görüntüleme yöntemlerini ictal EEG ile korele ettiğimizde epileptik odağı tespit etmede PET incelemelerinin lateralizasyon değeri oldukça yüksek olup duyarlılığı %100 olarak tespit edilmiştir. Kraniyal MRG'nin ise epileptik odağı tespit etmede duyarlılığı %97 iken, rutin EEG'nin %82.9 ve MRS'nin ise duyarlılığı %79.4 olarak tespit edilmiştir. Cerrahi sonrası olgularımızın %71.4'ünde hipokampal skleroz tespit edilmiştir. Olgularımızın cerrahi sonrası nöbetsizlik oranları altıncı ay ve birinci yıl %82.8 olup (Engel-I), ikinci yılda bu oran %74.3 olarak belirlenmiştir.

**Sonuç:** Sonuç olarak çalışmamızda olduğu gibi ameliyat öncesi incelemelerin her birisinin lokalizasyon ve prognoz üzerine etkisi olduğu bilinmekle beraber, sonuçların birbirleriyle uyumlu ve tek odağı lokalize etmesi iyi cerrahi prognoz açısından oldukça önemlidir.

Anahtar sözcükler: Epilepsi cerrahisi; temporal lob epilepsisi; video-EEG.

Submitted (Geliş): 16.08.2019

Accepted (Kabul) : 25.09.2019

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## Introduction

Approximately 30% of the patients with epilepsy are monitored with a diagnosis of drug-resistant epilepsy.<sup>[1,2]</sup> Around 70% of temporal lobe epilepsies (TLE) are concurrent with hippocampal sclerosis (HS). A majority of the patients (65–90%) benefit from resective surgery in epilepsy surgery.<sup>[3,4]</sup> The decision for surgery is primarily based on clinical features, electroencephalography (EEG), and MRI (magnetic resonance imaging) data. Additionally, fluorodeoxy [18F]-Fluoro-d-deoxyglucose positron emission tomography (FDG-PET), magnetic resonance spectroscopy (MRS), neuropsychiatric testing (NPT), and in some cases functional MRI (fMRI) are considered during the surgical decision-making process.<sup>[5–8]</sup>

The present study aims to prospectively compare diagnostic values of preoperative examinations and evaluate postoperative remission rates in patients who underwent TLE surgery due to drug-resistant TLE and were evaluated histopathologically.

## Materials and Methods

### Patients

Among the patients who were monitored with the diagnosis of drug-resistant TLE in the Gazi University Medical Faculty Neurology Department's Adult Epilepsy Monitoring Unit between April 2010 and February 2011; patients with completed preoperative noninvasive examinations, determined epileptic focus, and remission or a significant decrease in seizure frequency during the postoperative follow-up were included in this study. The age range of the patients was 19–50 years and the mean age was 31.7±8.4 years. In this study, 35 patients, 20 females (57.1%) and 15 males (42.9%) were included. This study was approved by the local ethics committee (193/25.05.2011).

### Preoperative Protocol

Long-term video-EEG was performed on all patients before the surgery. The presence and the types of the aura (somatosensory, odor, autonomous, psychic) were recorded during the examination of patients' seizure history. Findings that would lead us during the lateralization of epileptic focus were recorded, and the frequency and lateralization values of all peri-ictal features were compared with EEG findings. Clinical lateralization was performed on the basis of this evaluation.

Before surgery, all patients underwent 1.5 T and 3 T MRI according to the epilepsy protocol, FDG-PET, MRS. In addition, fMRI or WADA was performed in necessary cases. Moreover, neuropsychological tests and psychiatric evaluation were performed in all cases.

The anterior temporal lobectomy (ATL) protocol was performed at the Gazi University Neurosurgery Department, and the patients were postoperatively monitored for 1–24 months concerning seizure remission. In the majority of the patients, the existing medications were tapered within postoperative 24 months.

### Statistical Analysis

SPSS v.11.5 software was used for data analysis. Descriptive statistics were shown as mean±standard deviation or median (minimum–maximum) for discontinuous variables. Categorical variables were shown as numbers and percentages (%). The McNemar test was used to determine the statistical consistency of ictal EEG and other examinations concerning lesion detection. Moreover, the diagnostic performance of routine EEG, MRI, MRS, and PET compared to ictal EEG were evaluated by calculating sensitivity, positive predictive value, and diagnostic accuracy. The McNemar test was also used to investigate the determinacy of MRI and PET results in predicting hippocampal sclerosis in surgical pathology results. Similarly, the sensitivity, specificity, positive and negative predictive values, and diagnostic accuracy of MRI and PET examinations were calculated concerning pathology. P-values <0.05 were considered as statistically significant.

## Results

### The characteristics and clinical features of the patients

The demographic characteristics and clinical features of the patients are demonstrated in Table 1.

**Table 1.** The demographic characteristics and clinical features of the patients

Variables	n=35
Age (years)	31.7±8.4
Age range (years)	19–50
Gender	
Male	15 (42.9%)
Female	20 (57.1%)
Age at disease onset (years)	13.7±9.9
Age range for disease onset (years)	1.5–45

**Surgical prognosis**

The postoperative seizure-freedom ratios of patients who underwent temporal lobectomy are summarized in Table 2.

**Evaluation of the preoperative tests**

Assessment of the contribution of preoperative tests on the localization revealed that ictal EEG and PET examinations were considerably effective in localizing the lesions (Fig. 1).

**Comparison of the ictal EEG with the other preoperative tests**

Evaluation of the consistency between the ictal EEG results and the routine EEG results regarding the localization of the lesions indicated a sensitivity value of 82.9% for routine EEG ( $p=0.031$ ). This result showed that routine EEG was not as effective as ictal EEG for localizing lesions. A comparison of ictal EEG and MRI concerning their ability to identify the same epileptogenic lesion indicated a sensitivity value of 97.1% for MRI ( $p=1.000$ ). This finding indicated that MRI had nearly the same effectiveness as ictal EEG in the localization of lesions. On the other hand, a comparison of the consistency between ictal EEG and PET indicated a sensitivity value of 100% (Table 3).

**Table 2.** Distribution of patients with respect to disability classification at the end of month six, year one and year twots

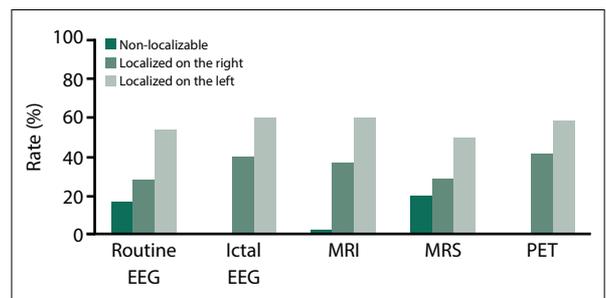
Variables	n=35	
	n	%
<b>6. month</b>		
Disability Class 1a	29	82.8
Disability Class 1c	2	5.7
Disability Class 2-3	2	5.7
Disability Class 3	1	2.9
Disability Class 4	1	2.9
<b>1. year</b>		
Disability Class 1a	29	82.8
Disability Class 1c	2	5.7
Disability Class 2-3	2	5.7
Disability Class 3	1	2.9
Disability Class 4	1	2.9
<b>2. year</b>		
Disability Class 1a	26	74.3
Disability Class 1c	2	5.7
Disability Class 2-3	4	11.4
Disability Class 3	2	5.7
Disability Class 4	1	2.9

**Comparison of the PET and other preoperative examinations**

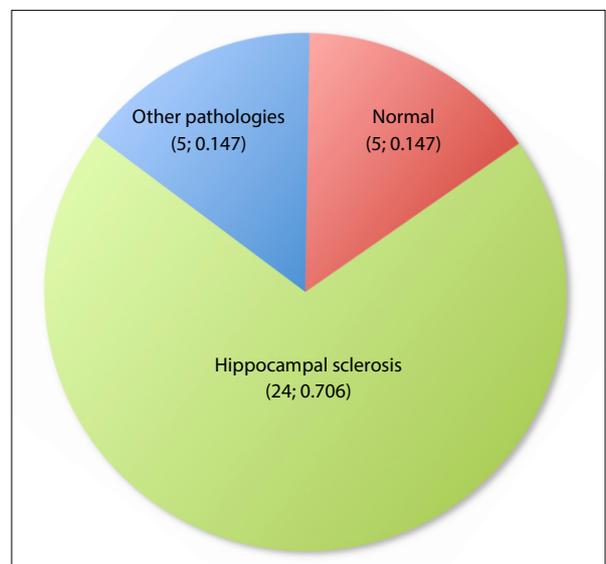
The consistency between PET and routine EEG with respect to their ability to localize epileptic foci was 82.4%. When the consistency between ictal EEG and PET was compared, a considerably higher sensitivity value (100%) was observed. The higher sensitivity value was possibly associated with the inclusion of a homogenous patient group into this study that had a clear diagnosis of temporal lobe epilepsy (as determined by ictal EEG). The consistency value between PET and MRI was 97.1%, while the consistency value between PET and MRS was 78.8% (Table 4).

**Postoperative pathology results**

The distribution of the pathology results of patients who underwent temporal lobectomy is shown in Figure 2. According to these results, hippocampal sclerosis was observed in 70% of the patients, normal pathology was ob-



**Fig. 1.** Comparison of the contributions of preoperative tests on the localization.



**Fig. 2.** Distribution of the postoperative pathology results.

**Table 3.** Evaluation of the consistency between the ictal EEG results and the results of the other imaging tests with respect to their ability to localize the lesions

Indicators	Definitions	Routine EEG	MRI	MRS	PET
Number of patients	N	35	35	34	34
Sensitivity	TP/(GP+FN)	29/35 (82.9%)	34/35 (97.1%)	27/34 (79.4%)	34/34 (100.0%)
Specificity	TN/(TN+FP)	–	–	–	–
PPV	TP/(TP+FP)	29/29 (100.0%)	34/34 (100.0%)	27/27 (100.0%)	34/34 (100.0%)
NPV	TN/(FN+TN)	–	–	–	–
Accuracy	(TP+TN)/(N)	29/35 (82.9%)	34/35 (97.1%)	27/34 (79.4%)	34/34 (100.0%)
p-value		0.031	1.000	0.016	–

EEG: Electroencephalography; MRI: Magnetic resonance imaging; MRS: Magnetic resonance spectroscopy; PET: Positron emission tomography; TP: True positive; TN: True negative; FP: False positive; FN: False negative; PPV: Positive predictive value; NPV: Negative predictive value. P-value (\*p<0.05).

served in 15% of the patients, and other pathologies were observed in 15% of the patients (Fig. 2).

## Discussion

In the current study, we compared different preoperative examinations, which are used to determine patients for epilepsy surgery, regarding their potential to lateralize and localize the epileptogenic focus.

Routine EEG and interictal EEG are less useful in determining the epileptic focus than ictal EEG. Previous studies have shown that the sensitivity of interictal EEG varies between 25–95%.<sup>[9–12]</sup> Gilliam et al.<sup>[6]</sup> evaluated the correlation between MRI, interictal EEG, and ictal EEG concerning prognosis and postoperative pathology on 90 patients with mesial temporal lobe epilepsy. This study has shown that surgery can provide seizure management in approximately 80% of the patients, for which MRI and interictal EEG are consistent.

In the current study, we included the cases whose ictal EEG could lateralize the epileptogenic focus 100%. This high rate could result from including a limited number of patients who had only mesial temporal lobe epilepsy.

In our study, the consistency between ictal EEG and MRI examinations was 97.1% concerning epileptogenic focus detection. Moreover, hippocampal sclerosis was detected in 94.1% of these cases. There was a good surgical prognosis in 94% of the cases with mesial temporal sclerosis in which unilateral interictal EEG change, consistent MRI findings, and ≥90% ictal EEG change were detected.<sup>[13]</sup>

The consistency between ictal EEG and MRS was 79.4% with regard to epileptogenic focus detection. The diagnostic value of MRS was 81% in different studies, which showed that our study was consistent with the literature.<sup>[14,15]</sup>

In the present study, the consistency between routine EEG and PET was 82.4% concerning epileptic focus localization. When the consistency between ictal EEG and PET was compared, the sensitivity was considerably high (100%). The high sensitivity rate could result from including a homogeneous patient group with definite temporal lobe epilepsy, as diagnosed by ictal EEG.

PET enables correct localization of seizure focus in 85% of TLE patients. It also shows local hypometabolism in approximately 60% of MRI negative cases. This provides a reduced need for invasive monitoring and good prognostic indicators after surgery, as well.<sup>[16,17]</sup>

The consistency between PET imaging and MRI have been reported in the range of 73–83% in different series.<sup>[18,19]</sup> In our study, the consistency between PET and MRI was 97.1%, and the consistency between PET and MRS was 78.8%.

The patients who underwent temporal lobectomy were followed up at sixth month, first year, and second year after surgery, for evaluation of seizure status. Following surgery, most of the patients switched from polytherapy to monotherapy within two years, and their medications were gradually tapered according to individual evaluations.

Hippocampal sclerosis was observed in 70.6% of the cases with temporal lobectomy; 14.7% of the cases were categorized with other pathologies, and the remaining 14.7% of the cases were categorized with normal pathology.

While preoperative examinations showed findings that were consistent with hippocampal sclerosis in certain patients, the histopathological findings were normal (14.7%). Similar values have been reported by Cheon et al.<sup>[20]</sup> and MRI may not detect atrophy in 15% of the cases with TLE, as well.<sup>[21]</sup>

The limitations of the current study include a homogenous patient group (who were chosen as candidates for TLE surgery and who had complete preoperative examinations), a small sample size, and a short follow-up period. In addition, the patients who were included in the current study may not reflect the entire TLE population. The high seizure-free rates may result from gradually tapering the medications during the 24-month postoperative period. Future studies on a larger cohort, and with a long-term follow-up period may allow us to reach a definite conclusion on controversial findings.

### Conclusion

Concerning detecting the epileptic focus, our findings suggest that PET and MRI have similar effectiveness compared to ictal EEG, whereas routine EEG and MRS are less effective. Regarding the seizure-free rates after surgery, 82.8% of the patients were classified as Engel Ia at the sixth month and first year, whereas this rate was 74.3% in the second year. A good surgical prognosis depends on determining the correct candidate, and the good consistency between preoperative examinations and results. Furthermore, surgery leads to a significant decrease in seizure frequency in patients who are followed up with resistant temporal lobe epilepsy, increases the patients' life quality, and decreases the number of medications.

### Ethics Committee Approval

Ethics committee approved.

### Peer-review

Externally peer-reviewed.

### Conflict of interest

The authors declare that they have no conflict of interest.

### Authorship Contributions

Concept: M.K.G., İ.Y., Ö.A., A.Y.Ö., G.K., E.B.; Design: M.K.G.,

İ.Y., Ö.A., A.Y.Ö., G.K., E.B.; Supervision: M.K.G., İ.Y., Ö.A., A.Y.Ö., G.K., E.B.; Materials: M.K.G., İ.Y., E.B.; Data collection &/or processing: M.K.G., İ.Y., E.B.; Analysis and/or interpretation: M.K.G., İ.Y., E.B.; Literature search: M.K.G., İ.Y., E.B.; Writing: M.K.G., İ.Y.; Critical review: M.K.G., İ.Y., E.B.

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