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CASE REPORT

# Orbito-frontal epilepsy masquerading as temporal lobe epilepsy—a case report

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Temporal lobectomy fails to control seizures in a considerable percentage of patients who do not have hippocampal sclerosis. One theoretical reason for failure of surgery is that some of these patients may in fact have extratemporal epilepsy. We present a 28-year-old woman with clinical and scalp electroencephalogram (EEG) evidence of right temporal lobe epilepsy (TLE) supported by functional imaging with interictal positron emission tomography (PET) and ictal single-photon emission computerized tomography (SPECT). An invasive EEG monitoring was prompted by the discovery of a small right orbito-frontal lesion on MRI. Monitoring documented seizure onset at the lesion, with rapid right temporal involvement. The patient was almost seizure-free after a lesionectomy. The index of suspicion of orbito-frontal epilepsy should be high in patients with apparent TLE when the scalp EEG and neuroimaging data are not congruent, or if temporal lobe pathology cannot be identified on structural imaging.



*Key words:* orbito-frontal epilepsy; temporal lobe epilepsy; clinical seizure semiology; electrographic seizure pattern; neuroimaging.

## INTRODUCTION

Temporal lobe epilepsy (TLE) is the most common of the cryptogenic and symptomatic epilepsies. It is often refractory to antiepileptic drugs and requires surgical therapy. A favourable surgical outcome depends on accurate localization of the epileptogenic focus. For this purpose the presurgical evaluation involves an expanded battery of tests which should ideally be congruent with respect to localization. Although not all tests in the presurgical evaluation need to show congruent abnormalities, the chance of false localization increases in the absence of a structural lesion corresponding to electrical abnormalities. For example, temporal lobectomy fails to control seizures in a considerable percentage of patients who do not have hippocampal sclerosis[1]. One theoretical reason for the failure of surgery is that some of these patients may in fact have extratemporal epilepsy. We present a patient with strong evidence of TLE by clinical features, scalp electroencephalogram (EEG) recordings, and functional neuroimaging, but who was found to have extratemporal epilepsy related to a small orbito-frontal lesion.

## CASE REPORT

A 28-year-old right-handed woman had experienced seizures since the age of 19. Her only epilepsy risk factor was a positive family history in one first-degree cousin. There were no febrile convulsions in infancy.

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Seizures were characterized by occasional feeling of 'butterflies in the stomach' associated with fear followed by loss of awareness and fast non-purposeful activity then postictal tiredness.

Complex partial seizures (CPS) lasted 20 seconds to 2 minutes and frequently evolved into generalized

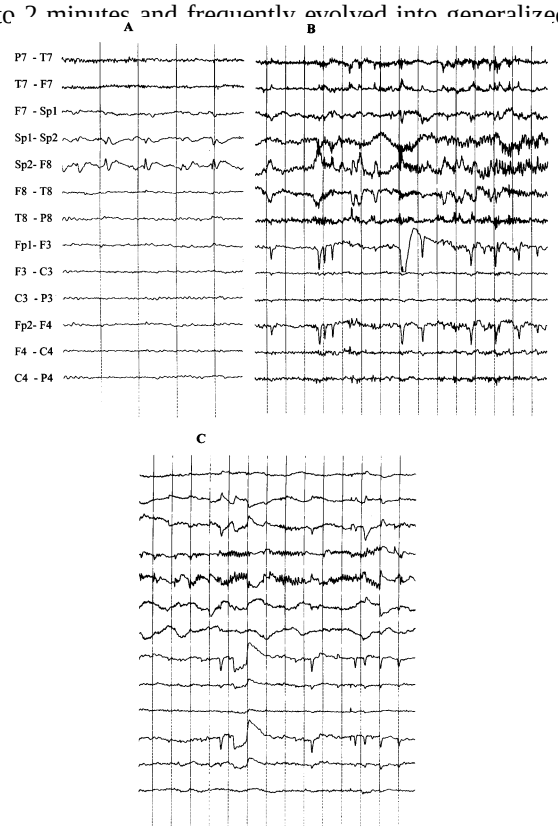


Fig. 1: Electrographic findings from two sessions of EEG-video monitoring with scalp and sphenoidal electrodes. A, Epileptiform discharges recorded from the right sphenoidal electrode. B, Ictal onset of a typical complex partial seizure. The first rythmic discharge was right temporal with predominance in the right inferomesial temporal region. C, Recurrent polyspike discharges recorded from the right sphenoidal electrode postictally in one seizure.

tonic–clonic seizures (PGTC). At initial presentation at age 25 years, she reported an average of 20 CPS and 10 PGTC per month. Seizures remained intractable despite several adequate antiepileptic drug trials. She requested evaluation for epilepsy surgery. Prolonged EEG-video monitoring with sphenoidal electrodes recorded six habitual CPS. All were characterized by restless, hyperkinetic behaviour with rapid upper extremity fumbling and picking automatisms (more on the right), drinking, and dressing, repetitive moaning and humming sounds, and later oroalimentary automatisms. Her activity became slower later in the seizure. There was preserved ictal and postictal speech. The seizure duration was generally 1.5 minutes but ranged from 1–2 minutes. Seizure electrographic onset was with 5–6 Hz rhythmic activity in the right temporal region, with inferomesial predominance (Fig. 1(a)). Interictal epileptiform discharges were recorded exclusively from the right temporal area (Fig. 1(b)). Brain MRI revealed a $20 \times 8$ mm$^2$ lesion in the mesial orbito-frontal region inferior to the genu of the corpus callosum (Fig. 2(a)). There was no significant asymmetry in the size of the hippocampus. Interictal

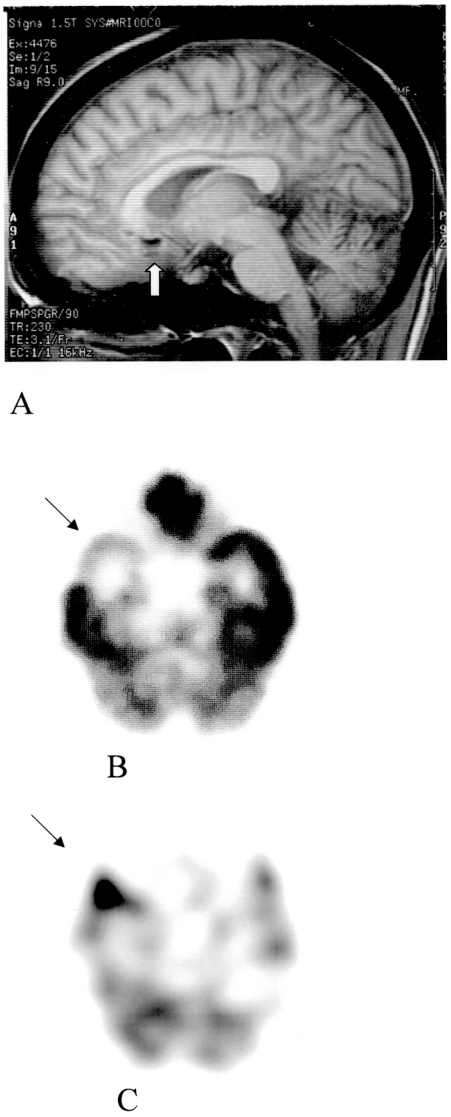


Fig. 2: Neuroimaging data. A, MRI showing a right mesial orbitofrontal lesion. B, PET scan showing right temporal hypometabolism. C, Ictal SPECT scan demonstrating right anterior temporal hyperperfusion. The scale for both PET and ictal SPECT is the inverse gray scale with darker colour indicating higher metabolism or perfusion.

PET showed right temporal hypometabolism both laterally and mesially and no orbito-frontal abnormality (Fig. 2(b)). She was readmitted for EEG-video monitoring and ictal SPECT. The clinical and EEG findings were identical to the first study, except for repeated polyspike trains emanating from the right sphenoidal electrode postictally after one CPS (Fig. 1(c)). Ictal

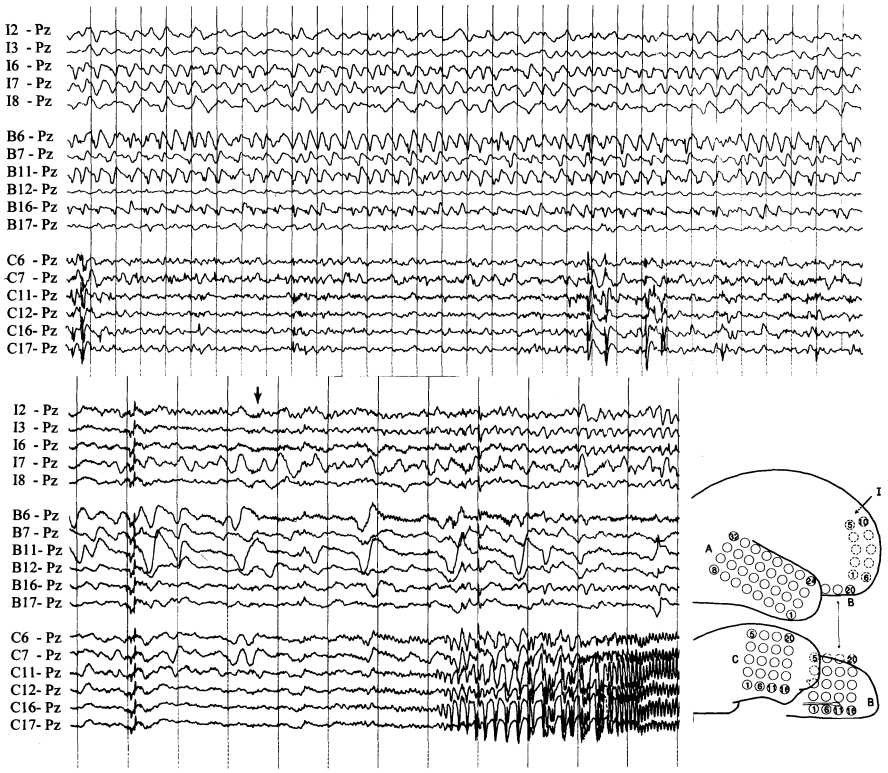


Fig. 3: Subdural grid recordings. The electrode grid placement is demonstrated at the bottom right. Top, Interictal EEG sample from selected electrodes. Rhythmic delta activity was recorded from the inferior aspect of the mesial frontal grid and the mesial aspect of the orbito-frontal grid. Spikes and sharp waves were intermixed in the mesial orbito-frontal delta activity. In addition, independent epileptiform discharges were recorded from the basal temporal region. Bottom left, Ictal onset showing fast low voltage rhythmic activity (arrow) in the mesial orbito-frontal region (mainly I6 and B6), before appearance of ictal activity in the basal temporal region. The interval between vertical lines is one second for both tracings.

SPECT with injection 15 seconds after seizure onset, showed right temporal hyperperfusion (Fig. 2(c)). On neuropsychological testing she had normal intelligence and verbal memory scores. Her visual memory was mildly impaired, implying involvement of the non-dominant right hemisphere. There were no signs of right frontal dysfunction. The intracarotid amobarbital procedure showed strong left hemispheric dominance for language and memory. She passed memory testing after right injection with a score of 5/5, but failed with left injection scoring 2/5.

Despite the right temporal localization by EEG, PET, and ictal SPECT there was concern about the role of the right orbito-frontal lesion in seizure generation. She was therefore implanted with subdural grid electrodes over the right orbito-frontal, mesial frontal, lateral temporal, and basal temporal regions (Fig. 3). Habitual CPS showed EEG ictal onset in the right inferior–anterior aspect of the mesial frontal grid, with spread to the mesial-basal temporal region. Six subclinical ictal discharges were also recorded from the mesial aspect of the orbito-frontal grid. The EEG recorded extremely frequent epileptiform discharges from the mesial orbito-frontal area, and very frequent epileptiform discharges from the rest of the orbito-frontal grid, basal temporal and lateral temporal regions (Fig. 3). Delta activity was recorded from the right mesial orbito-frontal and right inferior lateral temporal cortex.

The patient underwent a right mesial orbito-frontal lesionectomy. Histology revealed a pilocytic astrocytoma. One day after surgery she had a cluster of her typical complex partial seizures with associated right frontal oedema on CT scanning, but was subsequently seizure free. She was discharged on carbamazepine 800 mg per day, but she lowered her dose to 400 mg per day shortly thereafter. She remained seizure-free for 1 year before having three atypical seizures within one month. The first two were simple partial seizures with brief (20–30 seconds) facial twitching and eye blinking, and the third seizure was secondarily generalized. There was no recurrence for six months after increasing here carbamazepine dose to 800 mg per day.

## DISCUSSION

Some forms of epilepsy tend to manifest with seizure spread outside the lobe of origin. For example, occipital lobe seizures tend to spread to the temporal or frontal lobe and produce clinical semiology corresponding to the region of spread[2]. Our patient demonstrates the propensity for orbito-frontal ictal activity to spread to the mesial temporal region, and manifest as TLE. The orbito-frontal area is connected to the anterior temporal areas anatomically and physiologically by the uncinate fasciculus. This fasciculus consists of a ventral part connecting the orbital cortex to the ipsilateral amygdala and hippocampus, and a dorsal part connecting the more anterior and inferior portions of the frontal cortex to the anterior temporal lobe[3,4]. Kendrick *et al.*[5] provided physiologic evidence of strong connectivity between the orbito-frontal and anterior-mesial temporal regions. In 34 patients undergoing either temporal lobectomy for seizures or combined temporal and frontal resective surgery for psychosis, strychnine was applied to the orbito-frontal and temporal regions while the scalp EEG was being recorded. In the patients who had strychnine applied to the orbito-frontal area, spikes were first detected in the ipsilateral mesial temporal cortex followed by the contralateral mesial temporal cortex then and to a lesser extent the frontal poles[5]. This demonstrates the strong physiologic connectivity between the orbito-frontal and the ipsilateral mesial temporal areas, and provides a plausible anatomical and physiological explanation for false temporal localization of orbito-frontal epilepsy and resultant failure of some temporal resections.

Orbito-frontal seizures are not easy to diagnose. They are difficult to detect by scalp EEG, and depth or subdural electrodes are usually required for seizure localization[6]. In addition, their clinical manifestations are not well delineated. Swartz and Delgado-Escueta found nine cases, reported between 1957 and 1975, with strong proof of orbito-frontal seizure origin[7]. Almost all these patients had automatisms with complex motions such as kicking, random struggling, walking, running, screaming, and frightened expressions. Ludwig *et al.*[8] suggested two clinical syndromes among patients with orbito-frontal epilepsy: some patients primarily had psychomotor seizures and others had loss of consciousness with head and eye deviation followed by generalized convulsions. Other reports have emphasized the frequent early and abrupt onset of complex motor automatisms associated with vocalization, and, frequently, with oroalimentary automatism[6,9–12]. Therefore it appears that there may be some variability in the clinical manifestations of orbito-frontal seizures. There have been only few reports of an orbito-frontal epileptogenic focus resulting in signs and symptoms attributed to the anterior temporal area and vice versa[4,13].

Our patient may illustrate a phenomenon of secondary epileptogenesis in the mesial temporal region. Frank Morrell[14] described stages of secondary epileptogenesis in patients with brain tumours as a source of seizures. In 'intermediate' secondary epileptogenesis there was EEG evidence of bilateral independent foci, but there was 'running down' of the secondary focus with complete relief of seizures after resection of the primary focus. In 'independent' secondary epileptogenesis, excision of the primary focus did not result in cessation of epileptiform discharges or seizures from the secondary focus. Our patient had electrographic evidence favouring early (intermediate) secondary epileptogenesis.

Our patient's clinical seizure semiology includes some features reported to occur in orbito-frontal epilepsy. The rapid onset of automatisms and the abrupt hyperkinetic behaviour were somewhat atypical for TLE. Together with the MRI findings, this made us proceed with subdural grid implantation. Although the EEG findings were quite typical of TLE, one seizure showed atypical trains of polyspike activity from the right sphenoidal electrode postictally. We have not seen such activity in patients with documented TLE. The right temporal hypometabolism recorded by PET may indicate that temporal dysfunction may result from an ipsilateral orbito-frontal epileptogenic focus, and may reflect dysfunction from secondary epileptogenesis. The false localization by ictal SPECT may relate to rapid spread of ictal activity to the temporal region, and is a warning that the ictal SPECT alone may be misleading in instances of rapid spread of seizure activity. This experience leads us to suggest that orbito-frontal epilepsy should be considered in patients with apparent TLE, who do not have temporal pathology, or who have clinical semiology that is atypical for TLE.

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