

# Electroencephalographic seizure-onset patterns in focal Status Epilepticus

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# Seizure-onset (SOn) patterns:

- Studied in intracranial EEG in presurgical studies
- To better define the epileptic zone and in correlation with the outcome
- **Tanaka** studied the correlation between scalp and intracerebral EEG seizure-onset patterns
- Quantitative and qualitative studies characterizing the onset patterns in (**SE**) are lacking

FULL-LENGTH ORIGINAL RESEARCH

Epilepsia®

## Association between scalp and intracerebral electroencephalographic seizure-onset patterns: A study in different lesional pathological substrates

Hideaki Tanaka<sup>1,2</sup>  | Hui Ming Khoo<sup>1,3</sup> | François Dubeau<sup>1</sup> | Jean Gotman<sup>1</sup>

**BRAIN**  
A JOURNAL OF NEUROLOGY

## Intracranial electroencephalographic seizure-onset patterns: effect of underlying pathology

Piero Perucca, François Dubeau and Jean Gotman

# Aim of the study:



1. To quantify **focal seizures' duration** within a SE episode and to characterize their **onset patterns**



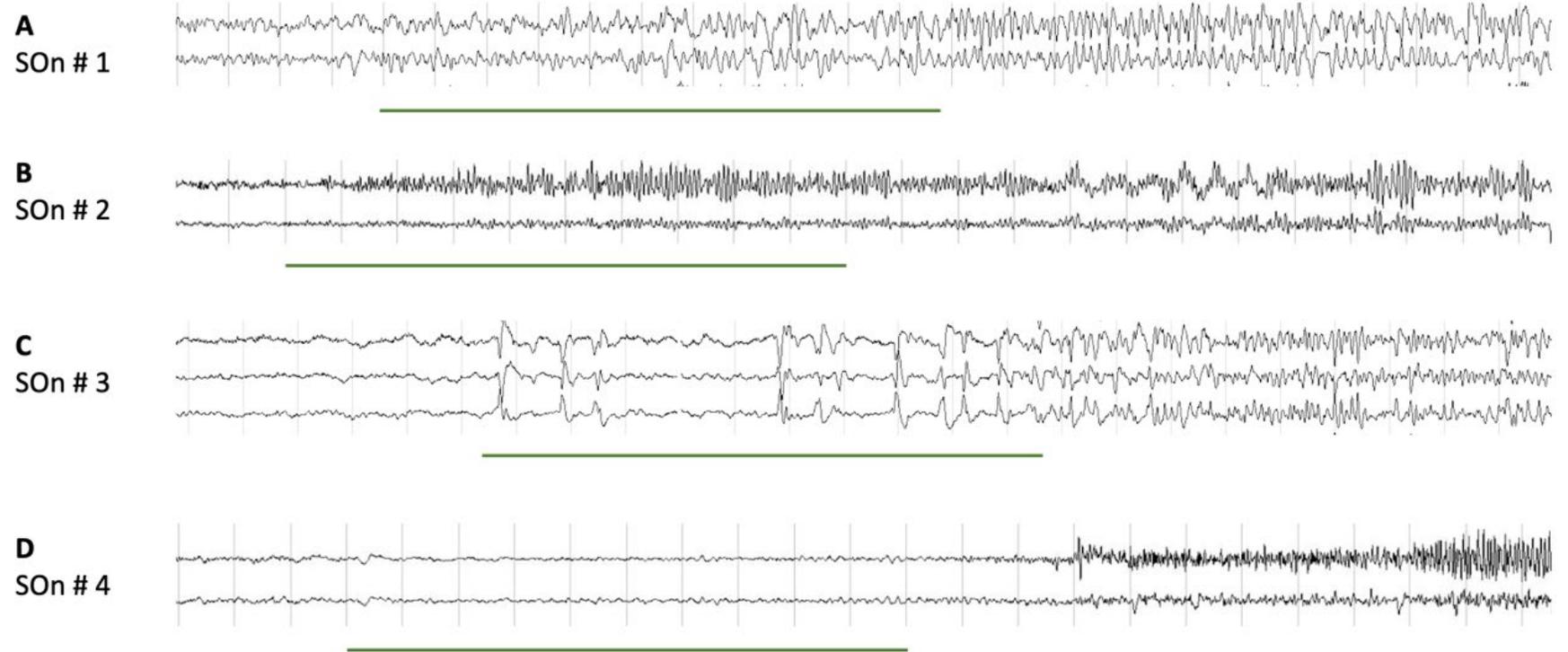
2. To assessed whether different SOn patterns are associated with different clinical and treatment outcomes

# Methods:

- This is a **retrospective** study of adult SE episodes prospectively collected from September 1st 2015 to August 31st 2019 at the Ospedale Civile Baggiovara
- For each seizure, the duration was calculated by visual inspection
- **Seizure-onset patterns (SON)** were defined as the first alteration of EEG signal in the context of a SE episode
- To classify a pattern the **morphology** and the **frequency** of the ictal discharge was determined by visual analysis and it was defined as the predominant ictal frequency within the first 10 second of the seizure

# Example of Son patterns

- **SO<sub>n</sub> # 1** = rhythmic slow activity: sinusoidal activity at <13 Hz;
- **SO<sub>n</sub> # 2** = paroxysmal fast activity: sinusoidal activity at  $\geq 13$  Hz;
- **SO<sub>n</sub> # 3** = repetitive epileptiform discharge:
- **SO<sub>n</sub> # 4** = suppression: suppression of background activity to  $\leq 10 \mu\text{V}$ ;
- **SO<sub>n</sub> # 5** = artifacts: no visible EEG pattern because of artifacts at seizure onset



## Comparison group

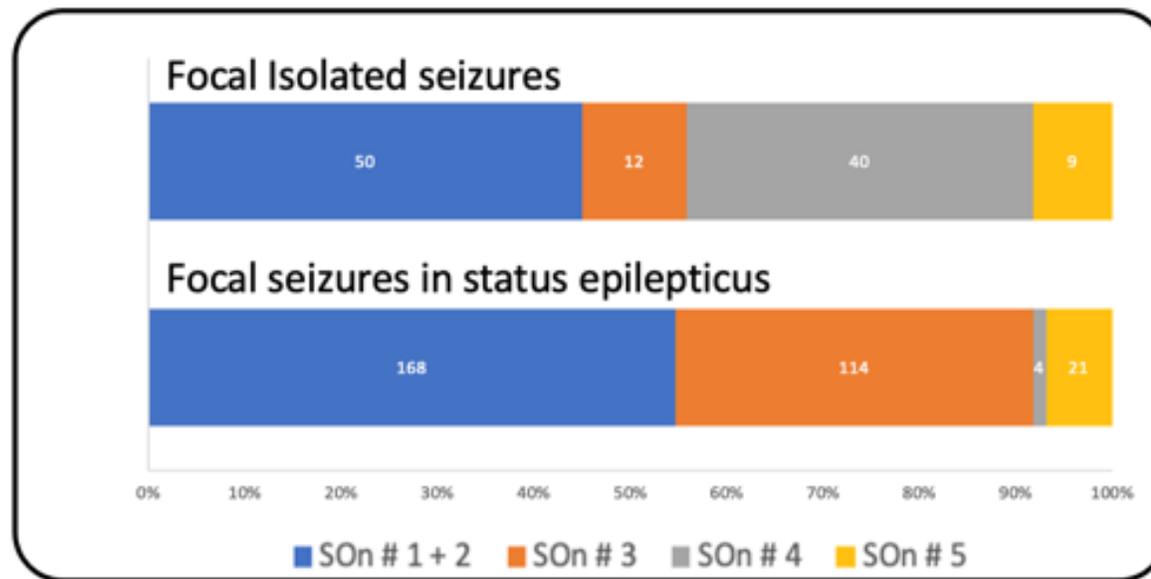
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- We reviewed the **duration** and the **types of SOn patterns** of single seizures recorded in patients admitted to the **epilepsy monitoring unit (EMU)** either for epilepsy surgery work-up or for diagnostic/treatment reasons from January 2020 to August 2021



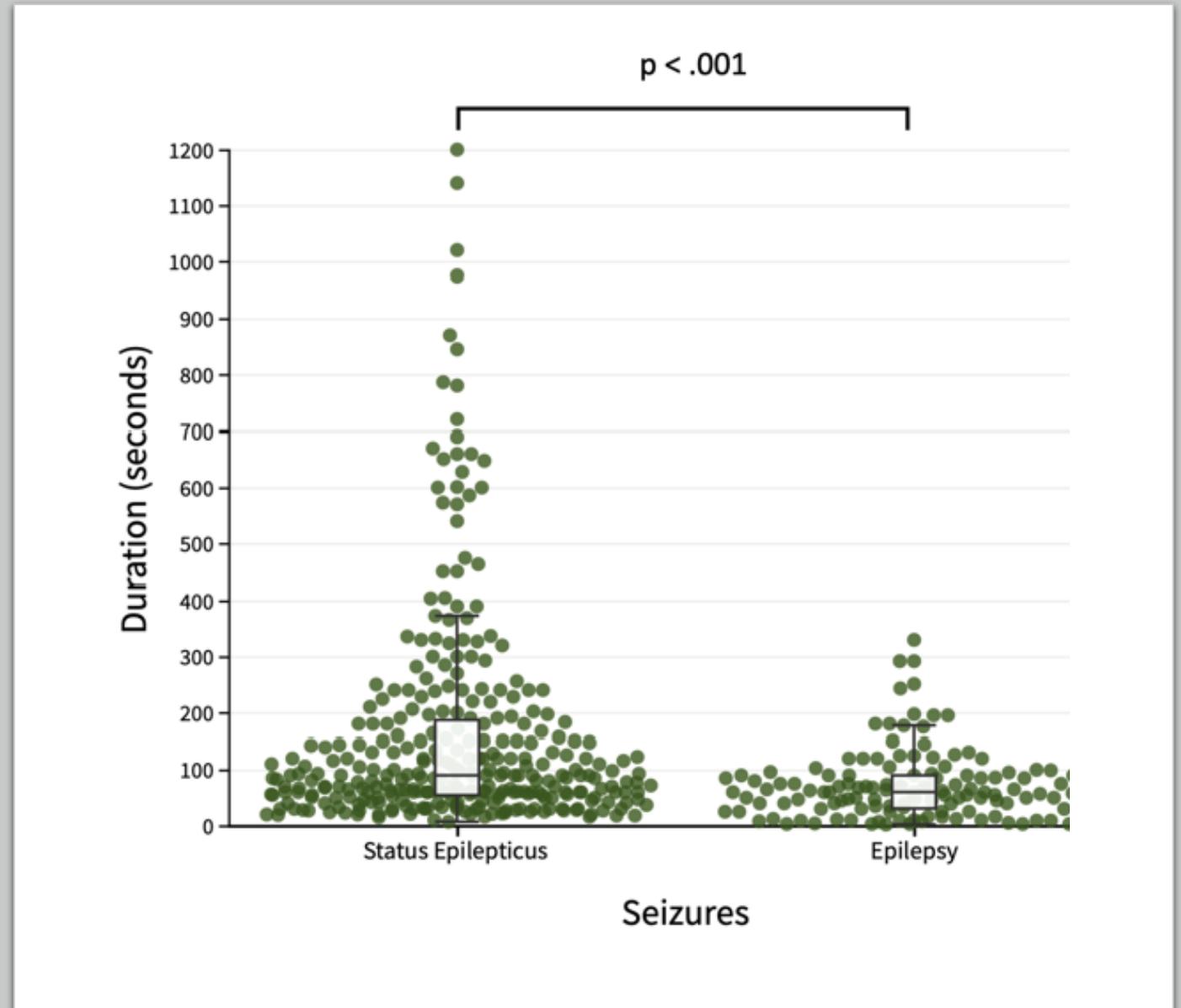
# Results:

- SE group: **307** seizures in **100** patients
- EMU group: **121** isolated seizures in **42** patients
- To note:
  1. **Son#1+2** is the most frequently pattern observed in our population as observed by Tanaka
  2. **Son #3** more frequently observed in the SE group
  3. **Son#4** more frequented observed in the EMU group



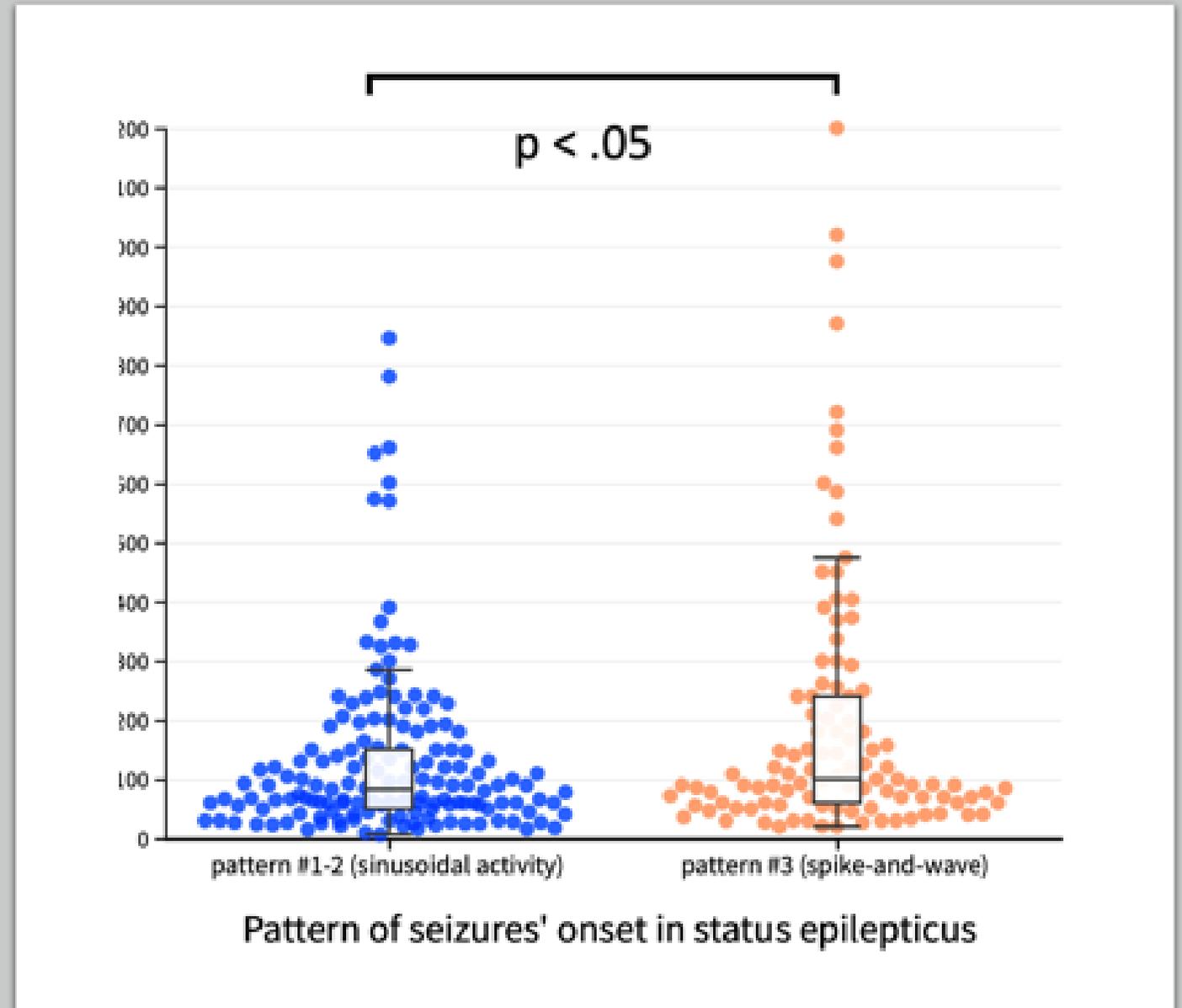
# Durations of seizures:

- **SE group:** median duration 90 seconds (IQR 136 seconds)
- **EMU group:** median duration 60 seconds (IQR 55 seconds)
- The differences were confirmed after the exclusion of the bilateral tonic-clonic seizures.
- We evaluated the relationship and influence of clinical variables on seizures duration in patients with SE; we found that **only acute symptomatic etiology significantly increased the seizures' duration**
  - (B = 0.256, 95%CI 0.123-0.883, p = 0.01).



# Relationship of seizure duration and onset patterns

- In SE, seizures with a SOn pattern characterized by **spike-and-waves (SOn # 3)** had a longer duration (median 99 sec; IQR 188 sec) compared to those with **sinusoidal activity (SOn # 1-2)** (median 88 sec, IQR: 101 sec;  $p = 0.037$ ).
- Moreover, seizures with **SOn pattern # 3** showed the longest seizure duration (1200 sec).



# Son and clinical variables in SE:

- In the analysis we did not consider pattern #4 and #5 (small numbers of observations);
- Thus, Son 1+2 was compared with Son#3 (87 patients; 258 seizures).

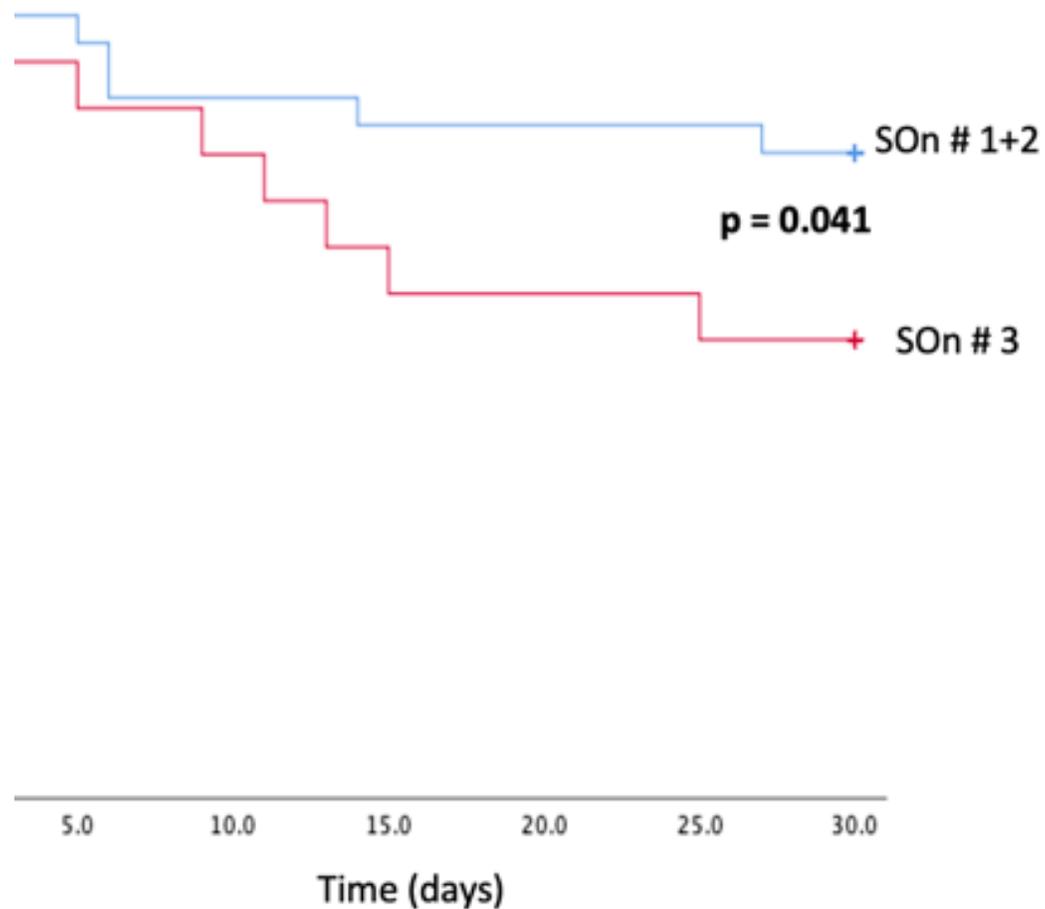
No statistical differences observed in **demographics, response to treatment, functional outcome and short and long term mortality** variables

	SOn # 1+2 (n=48) obs (%)	SOn # 3 (n=39) obs (%)	p value
Response to Treatment RSE/SRSE	28 (58%)	24 (62%)	0.762
30-days functional outcome	4 ± 2.2	4 ± 2.2	0.971
Median ± SD	30 (63%)	24 (62%)	0.927
mRS value	25 (52%)	21 (54%)	0.711
Worsening mRS ≥ 4			
30-days mortality			
Yes	6 (13%)	10 (26%)	0.116
1-year mortality			
Yes	25 (52%)	18 (46%)	0.582

## Results:

With a **75-years cut off**, patients with SOn # 3 had a significantly **higher 30 days mortality** compared to those with SOn # 1+2 (Log Rank test,  $p = 0.041$ ).

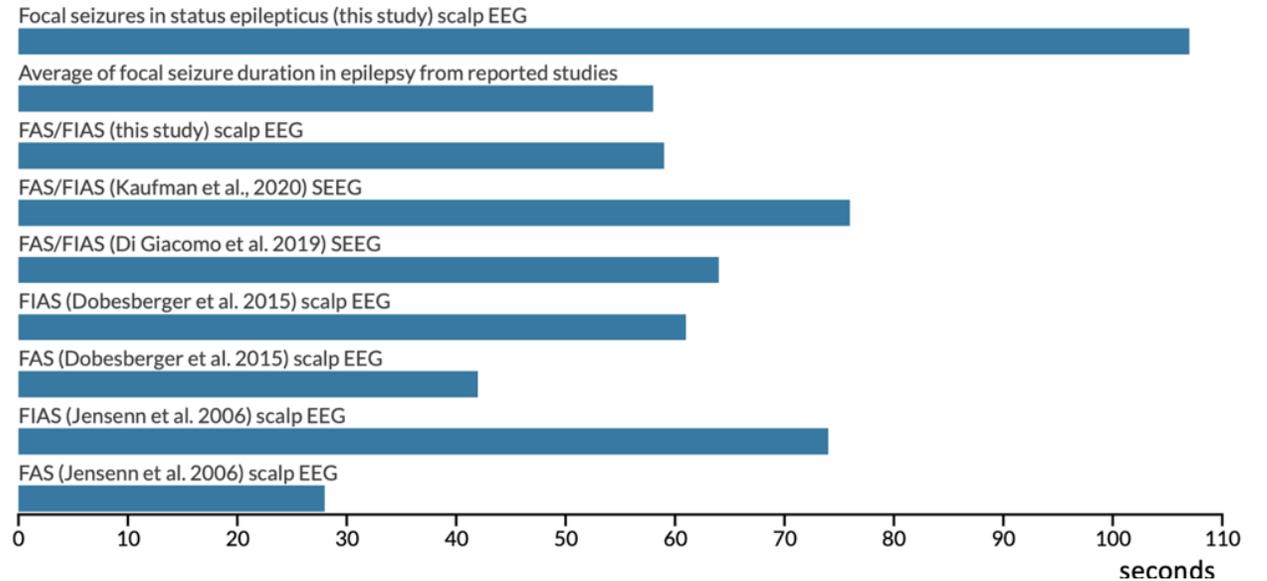
When consider toghether, type of pattern and age at SE onset, patients older than 75 years old with Son#3 had a significantly higher risk of 30-days mortality with respect to younger patients (HR 4.059; 95% CI 1.508-10.924,  $p= 0.006$ )



# Discussion:

- the analysis showed that focal seizures in a SE episode **have different characteristics** from the isolated seizures.
- Focal seizures in SE **have a longer duration**
- **Seizure onset patterns** in SE are different from those observed in isolated seizures

## median seizures' duration (seconds)



# Conclusions and Future perspectives

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- The differences in **types distribution** and **durations** highlight the presence of differences in the pathophysiology and **mechanisms underlying** the developing and maintaining of SE
- To further increase our understanding is necessary to **replicate and expand our findings**
- To improve our understanding of seizure generation and hopefully to **improve new therapeutic targets and strategies**



Grazie per  
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