# Clinical application of spatiotemporal source analysis in patients with epilepsy - onset, propagation and network

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**[Abstract]**

This article describes the feasibility of spatiotemporal source analysis in clinical evaluation of epilepsy.

**[Introduction]**

Spatiotemporal source analysis of epileptic spikes recorded on MEG is a useful tool for investigating the pathophysiology of epilepsy, whereas it is rarely used in the clinical settings. Here, we present a case series of epilepsy with representative source maps, and discuss these source distribution patterns and their clinical relevance.

**[Methods]**

We analyzed MEG spikes by using minimum norm estimate (MNE) as previously described[1]. Briefly, the MEG sensor space (Fig. 1A) was co-registered to the head model derived from the patient's MRI, by using the digitization data of the head (Fig. 1B-D). We calculated the forward- and inverse-solution by applying a distributed source model. The source distribution was calculated along with the time course (Fig. 1E). These maps were visually examined and interpreted. We reviewed such maps of 250 patients retrospectively.

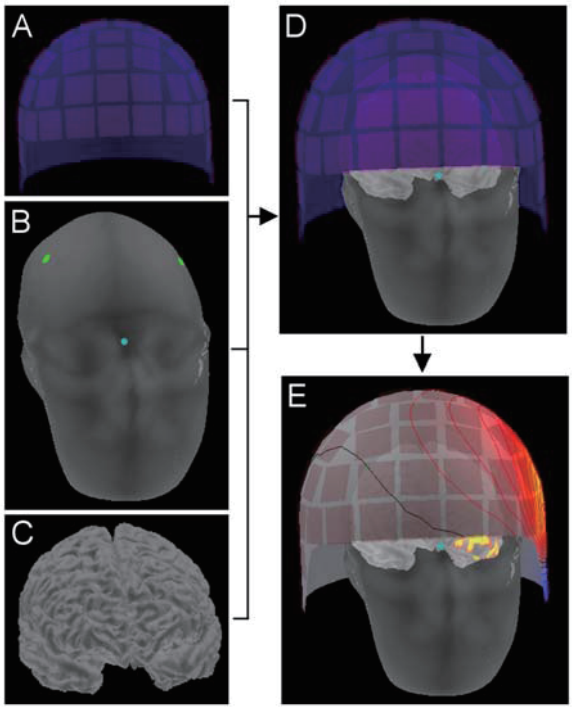


Fig.1. Schematic representation of MNE

## [Results and Discussion]

At each time point, two major patterns of source distribution were observed; Restricted and widespread. Combining these patterns in the early phase and peak of spikes, we found three types of source maps; (1) Restricted in early phase + Restricted at peak. This type of maps showed restricted sources staying in the same area (Fig. 2A) or moving from one to the other (Fig. 2B), (2) Restricted in early phase + Widespread at peak (Fig. 2C) and (3) Widespread in early phase + Widespread at peak (Fig. 2D). These patterns suggested the spike onset/propagation and underlying networks as compared with intracranial EEG findings[2]. In a group of 37 patients with temporal lobe epilepsy, Type 1 and Type 2/3 were associated with favorable and unfavorable outcomes of epilepsy surgery, respectively[3].

## [Conclusion]

Spatiotemporal source analysis provides useful information for understanding the spike propagation and epileptic neural networks. The source distribution patterns may provide the prognostic implication of epilepsy surgery. While we have revealed its clinical value by investigating a patient group with temporal lobe epilepsy, further studies will be necessary for fully understanding the clinical relevance of these source maps in various epileptic syndromes.

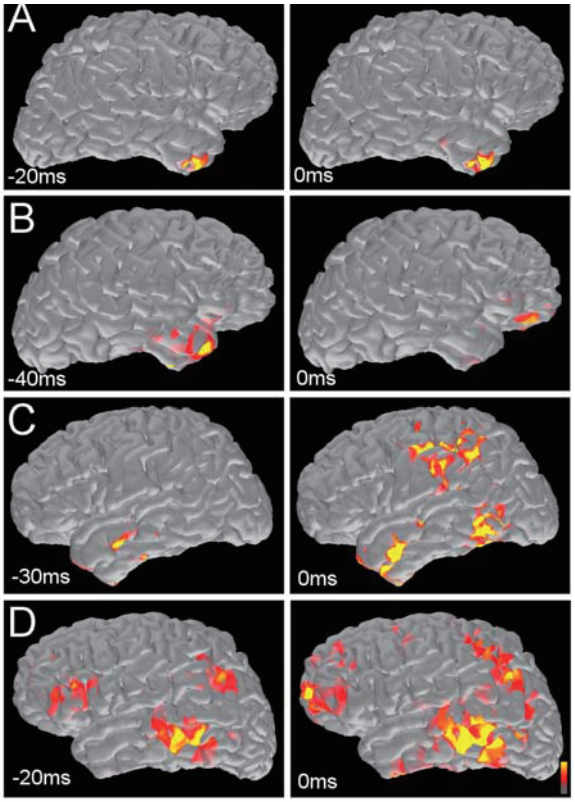


Fig. 2 Representative source maps

## [References]

[1] Tanaka N, et al., 2015. Clinical application of spatiotemporal distributed source analysis in presurgical evaluation of epilepsy. Front Hum Neurosci. 8:62.

[2] Tanaka N, et al., 2010. Propagation of epileptic spikes reconstructed from spatiotemporal magnetoencephalographic and electroencephalographic source analysis. Neuroimage. 50:217-22.

[3] Tanaka N, et al, 2014. Clinical value of magnetoencephalographic spike propagation represented by spatiotemporal source analysis: correlation with surgical outcome. Epilepsy Res. 108:280-8.