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Ipsilateral facial sensory and motor responses to basal fronto-temporal cortical stimulation: Evidence suggesting direct activation of cranial nerves

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Abstract

To clarify the generator mechanism of sensory and motor facial responses ipsilateral to electrical stimulation of the inferior fronto-temporal cortex in epilepsy patients. Out of 30 patients who have been evaluated with chronically implanted subdural electrodes for medically intractable partial seizure or brain tumor involving the basal frontal or temporal cortex, 4 patients (age ranging 24–57 years) showed sensory and motor responses in the ipsilateral face to high frequency electrical cortical stimulation of the inferior fronto-temporal cortex. We investigated motor evoked potentials (MEPs) in the facial muscle by single pulse stimulation in 2 out of 4 patients. Three patients showed both sensory symptoms and muscle contraction in the ipsilateral lower face when the orbitofrontal or basal temporal cortex was stimulated with 50 Hz electric current. One patient had only sensory symptoms in the lower face when ipsilateral basal temporal area was stimulated. MEPs at the left orbicularis oris muscle were constantly elicited with the onset latency of 7 ms throughout the stimulus rate of 2–30 Hz in 1 patient out of 2 patients was tested. In another patient, MEP onset latency was 3.0 ms with 11 Hz stimulation. With electrical stimulation of the basal fronto-temporal cortex, the ipsilateral facial twitch might occur through either the direct activation of the facial nerve by the current spread in the middle cranial fossa or through the mechanism similar to blink reflex.

Keywords: Cortical stimulation; Sensory/motor response in the lower face; Epilepsy; Motor evoked potentials (MEPs); Blink reflex

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1. Introduction

It has been reported that electrical stimulation of the basal temporal cortex elicits facial sensory and motor responses ipsilaterally (Lesser et al., 1985). It was postulated that the sensory response was due to stimulation of the pial branch of the trigeminal nerve (Lesser et al., 1985), but physiological mechanisms underlying the ipsilateral motor response still remain unclear. In the present study of 4 patients, we observed sensory and motor responses in 3 patients, and recorded motor evoked potentials (MEPs) at the ipsilateral face to electrical stimulation of the basal temporal cortex in 2 patients. The main purpose of this study is to clarify the generator mechanism of sensory and motor facial responses to electrical stimulation of the inferior fronto-temporal cortex in epilepsy patients.

2. Patients and methods

2.1. Patients

We evaluated 30 patients with medically intractable partial seizures or brain tumor involving frontal or temporal lobes, age ranging 24–57 years (average age of 37 years), by continuous video-EEG monitoring with chronic implantation of subdural electrodes in the Departments of Neurology and Neurosurgery, Kyoto University Hospital during the recent period of 2 years. Electrode grids were needed for the purpose of functional mapping to remove the tumor or epileptic areas. Four out of those 30 patients showed sensory/sensorimotor responses in the ipsilateral face to high frequency electrical cortical stimulation during functional mapping.

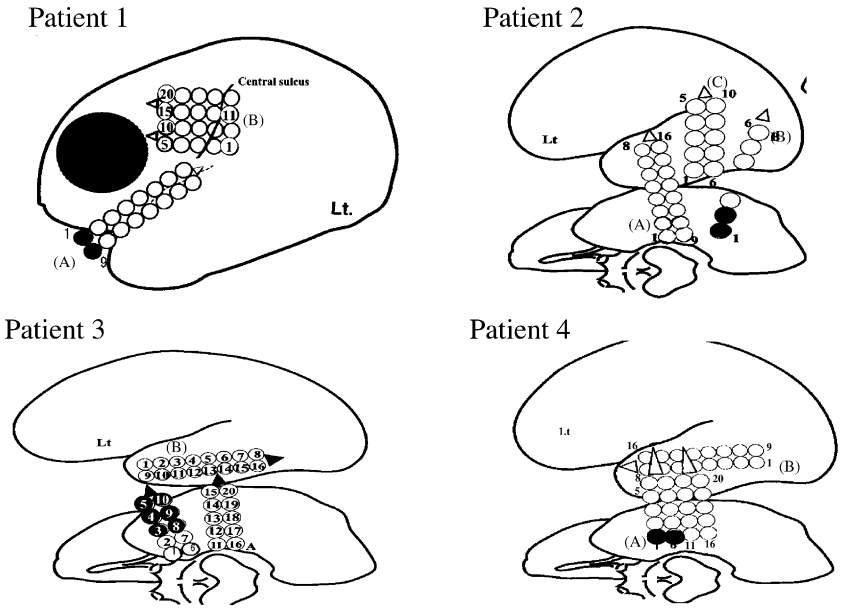

Fig. 1. Placement of subdural electrodes and the location of electrodes which elicited sensory or sensory-motor responses in lower face upon electrical stimulation in four cases studied. In Patient 1, 8 × 2 (A plate) and 5 × 4 (B plate) subdural electrode grids were placed over the left orbitofrontal area. Sensory and motor responses were elicited at electrodes 1 and 9 on plate A. In Patient 2, three electrode grids: 8 × 2 (A plate), 5 × 2 (C plate), and 6 × 1 (B plate) were placed over the left mesial to basal temporal areas. Sensory and motor responses at the electrodes 1 and 2 on plate B. In Patient 3, two 5 × 2 (A plate) and one 8 × 2 (B plate) subdural electrode grids were implanted over the left mesial, basal to lateral temporal areas. Sensory response was in electrodes nos. 3–5, 8, 9 and 10 on plate A. In Patient 4, one 5 × 4 (plate A) and one 8 × 2 (plate B) subdural electrode grids were placed over the left mesial, basal to lateral temporal area. Electrodes 1 and 6 are the sensory and motor responses areas on plate A. Note that filled black circle is sensory or sensory-motor response area/areas. Large black circle for Patient 1 is the previous tumor resected area.