

Multiple subpial transection for epileptogenic foci associated with language area detected by electrical cortical stimulation

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Purpose

To assess the efficacy and safety of combination of multiple subpial transection (MST) and resection in patients with refractory epilepsy involving the language area (LA).

Methods

MST and resective surgery were performed in 3 patients with epileptogenic foci in one or more lobes including the LAs. Epileptogenic foci were detected by intracranial subdural recording, and the LAs were detected by electrical cortical stimulation mapping.

Results

Patient 1 underwent MST in Broca's LA and frontal lobectomy. Patient 2 underwent MST in multiple lobes including Broca's and Wernicke's LAs and partial resection in the temporal lobe. A 2-stage procedure was performed for the third patient. Initially, we performed right anterior temporal lobe resection guided by intraoperative electrocorticography for temporal lobe epilepsy. Subdural grids were implanted after 3 years. A combination of MST in multiple lobes including Broca's and Wernicke's LAs and partial resection in the frontal lobe was performed. Follow-up period was 143, 37, and 44 months. According to Engel's classification, 2 patients had a class 3 outcome and 1 patient had a class 1 outcome. In patient 1, language function deteriorated immediately after surgery and almost no spontaneous speech was heard for a month after surgery. Speech functions of patients 2 and 3 were partially impaired after surgery. Their language functions improved and recovered gradually within 6 months as shown by the results of Standard Language Testing for Aphasia in Japanese.

Conclusion

If epileptogenic foci extend to the LAs, and if 2 lobes are involved, a combination of MST and resective surgery can be useful to improve seizure outcome and language function after surgery.

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Purpose

- ★ We aimed to assess the efficacy and safety of a combination of multiple subpial transection (MST) and focal resection with respect to language areas (LAs) in patients with refractory epilepsy.
- ★ Postoperative language functions were evaluated more than 3.5 years after the last surgery in 3 patients.

Method

- ★ Epileptogenic foci were evaluated by intracranial subdural recording.
- ★ Broca's and Wernicke's LAs were clearly visible on electrical cortical stimulation mapping using chronically implanted intracranial electrodes.
- ★ MSTs were performed simultaneously in Broca's and Wernicke's LAs.

Case 1

male, 21 y.o. at surgery

Seizure onset: 7 y.o. prolonged seizure and Todd's palsy on the right after measles encephalitis

Simple partial seizure (SPS): speech arrest and/or motor arrest within a minute, 3 times every week

Complex partial seizure (CPS): unresponsiveness and speech arrest followed by head deviation to the right and tonic posturing and infrequent extension to secondary generalized seizure (SGS)

Neurological: right-handed

Scalp electroencephalogram (EEG): bifrontotemporal dominant spikes (left > right)

Magnetic resonance imaging (MRI): atrophic change in the left hemisphere, predominantly in the parieto-occipital region

Ethyl cysteinate dimer-single photon emission computer tomography (ECD-SPECT): hypoperfusion in the left parieto-occipital area

Surgery (1999)

Subdural grids and depth electrodes were implanted.

Seizures originating from the diffuse frontal cortex, including Broca's LA, occurred.

Left frontal lobectomy and MST within Broca's LA were performed.

Outcome

Weekly CPS continued for 3 postoperative years, and then the patient was seizure free for 9 years → Engel's Class 1.

Preoperative scalp EEG

Fp1-Aav

Fp2

F3

F4

C3

C4

P3

P4

O1

O2

F7

F8

T3

T4

T5

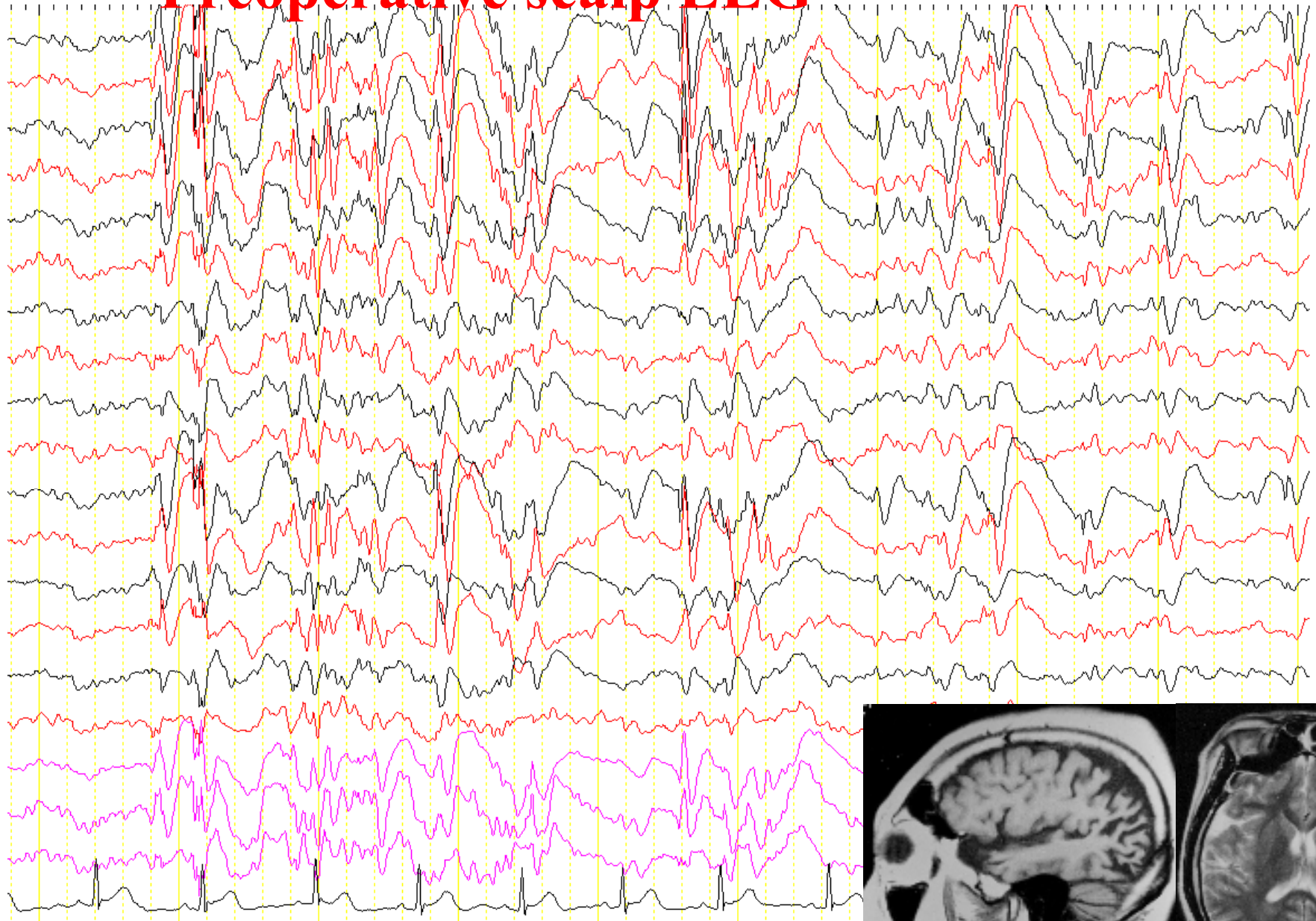
T6

Fz

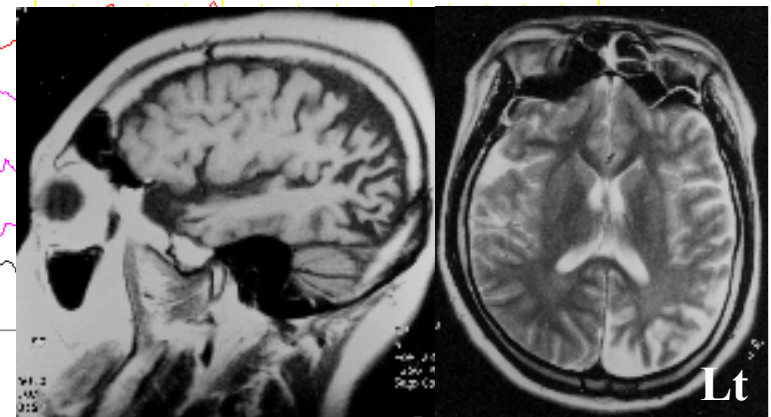
Cz

Pz

ECG



Left hemispheric atrophy
on MRI



Epileptogenic areas within Broca's language area → **MST**
Extended premotor and prefrontal epileptogenic areas → **resection**

Motor area
Language area

epileptogenic area (++)

epileptogenic area (+)

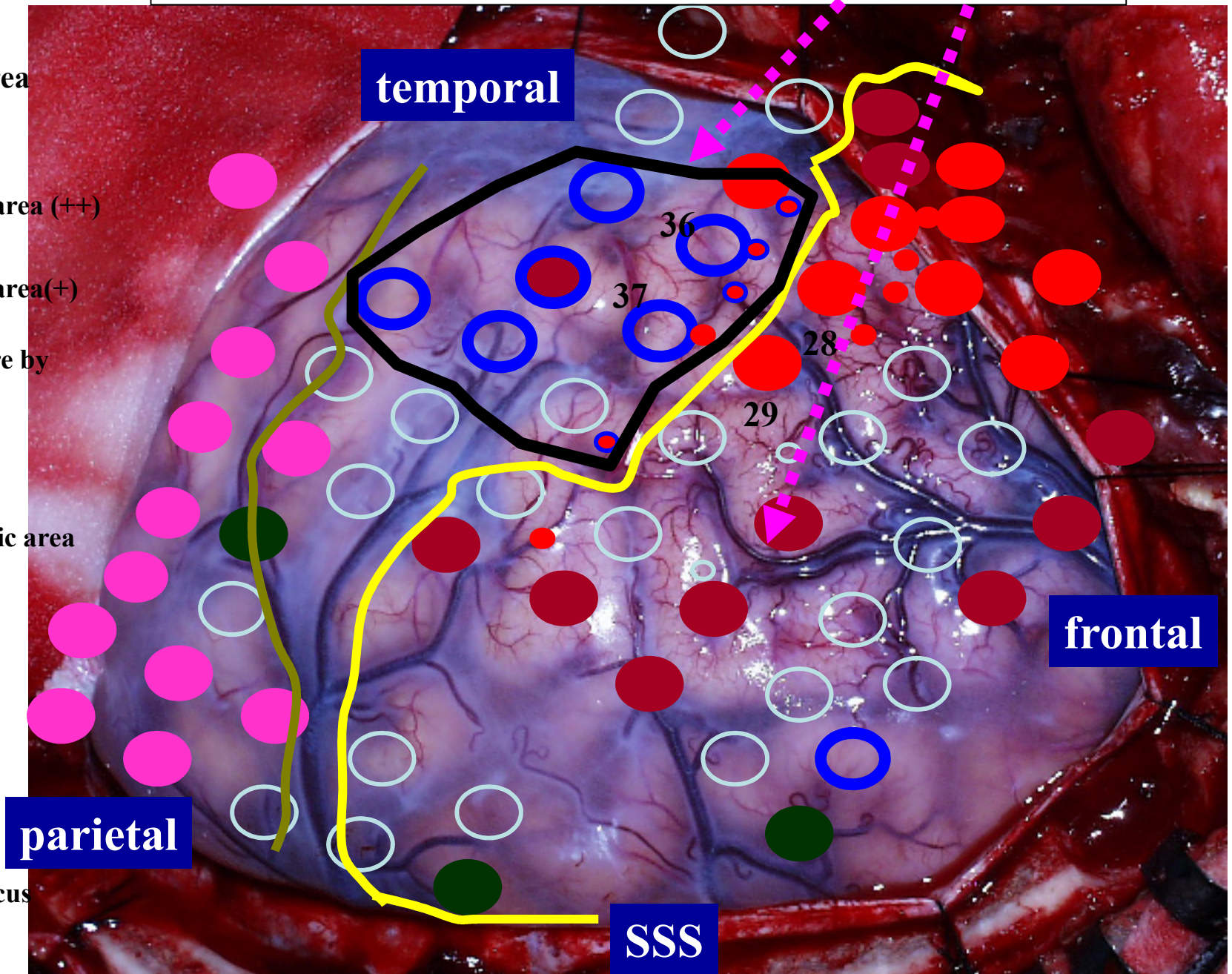
induced seizure by stimulation

No response

Deep epileptogenic area

resection area

precentral sulcus



before surgery



after surgery

3wk

6m

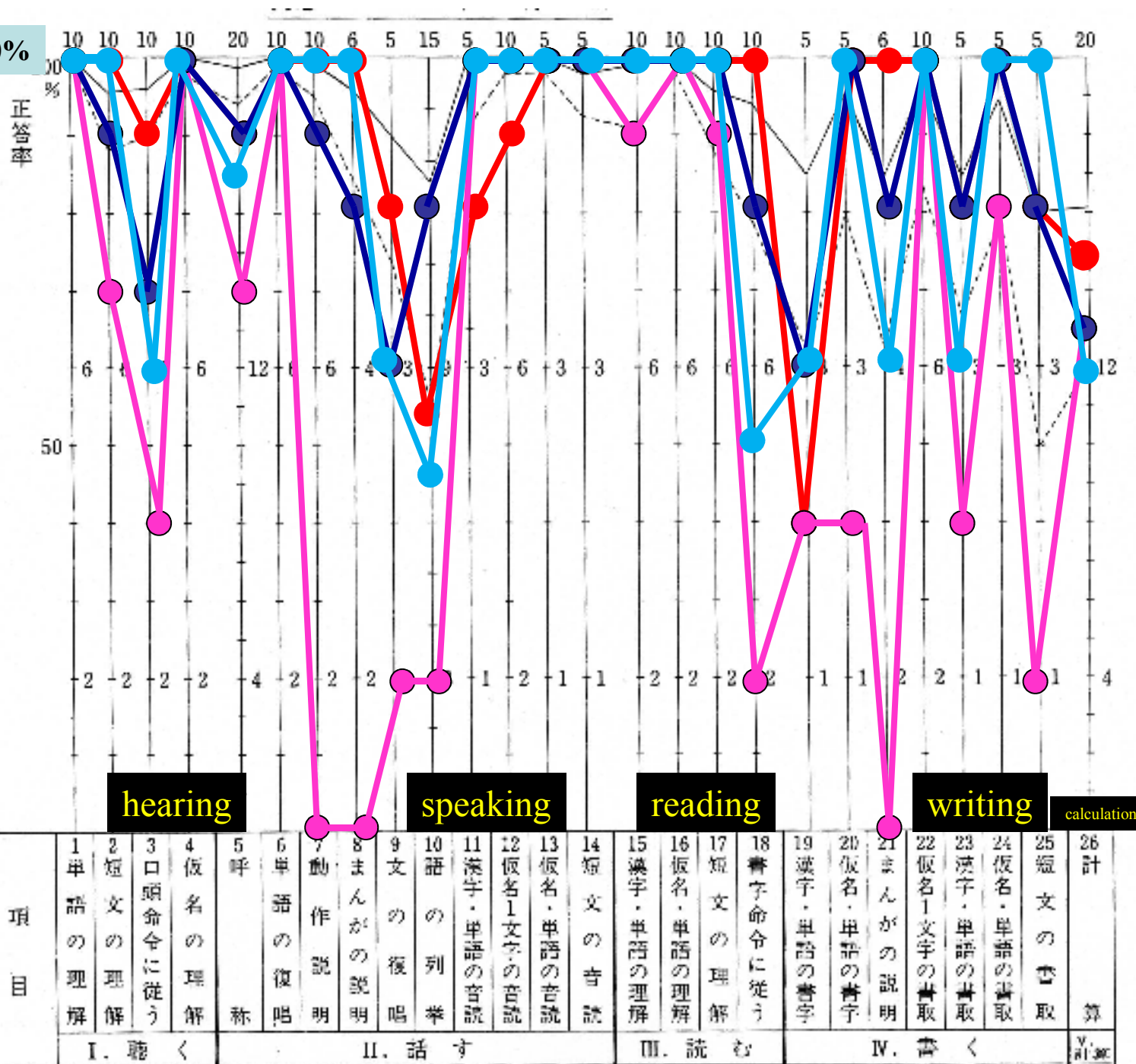
11y4m

SLTA

Standard language test
for aphasia in Japanese

Surgery
1999

Correct 100%



hearing

speaking

reading

writing

calculation

● 5m before op

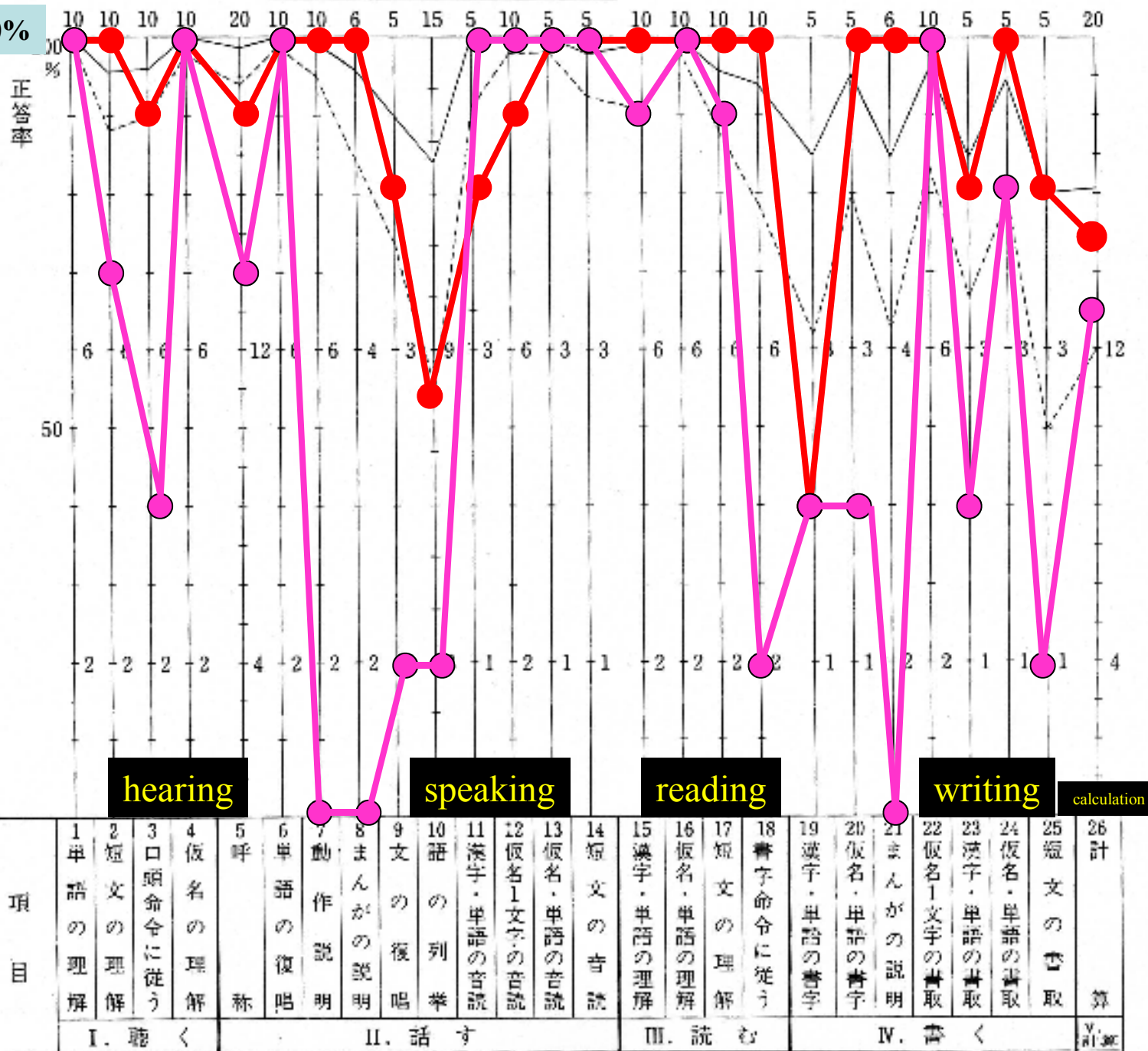
● 3wk after op

SLTA

Standard language test
for aphasia in Japanese

Surgery
1999

Correct 100%



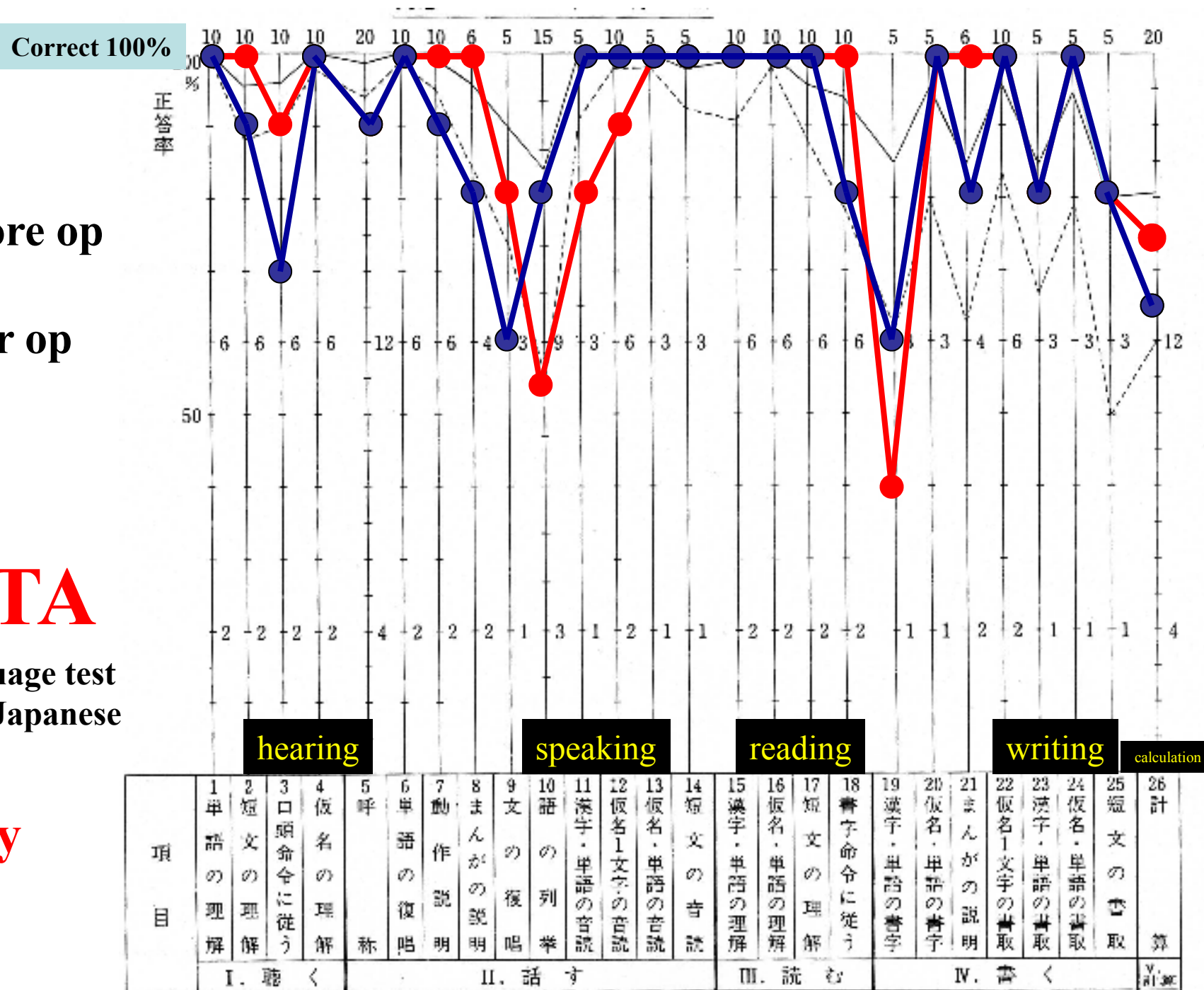
● 5m before op

● 6m after op

SLTA

Standard language test
for aphasia in Japanese

Surgery
1999



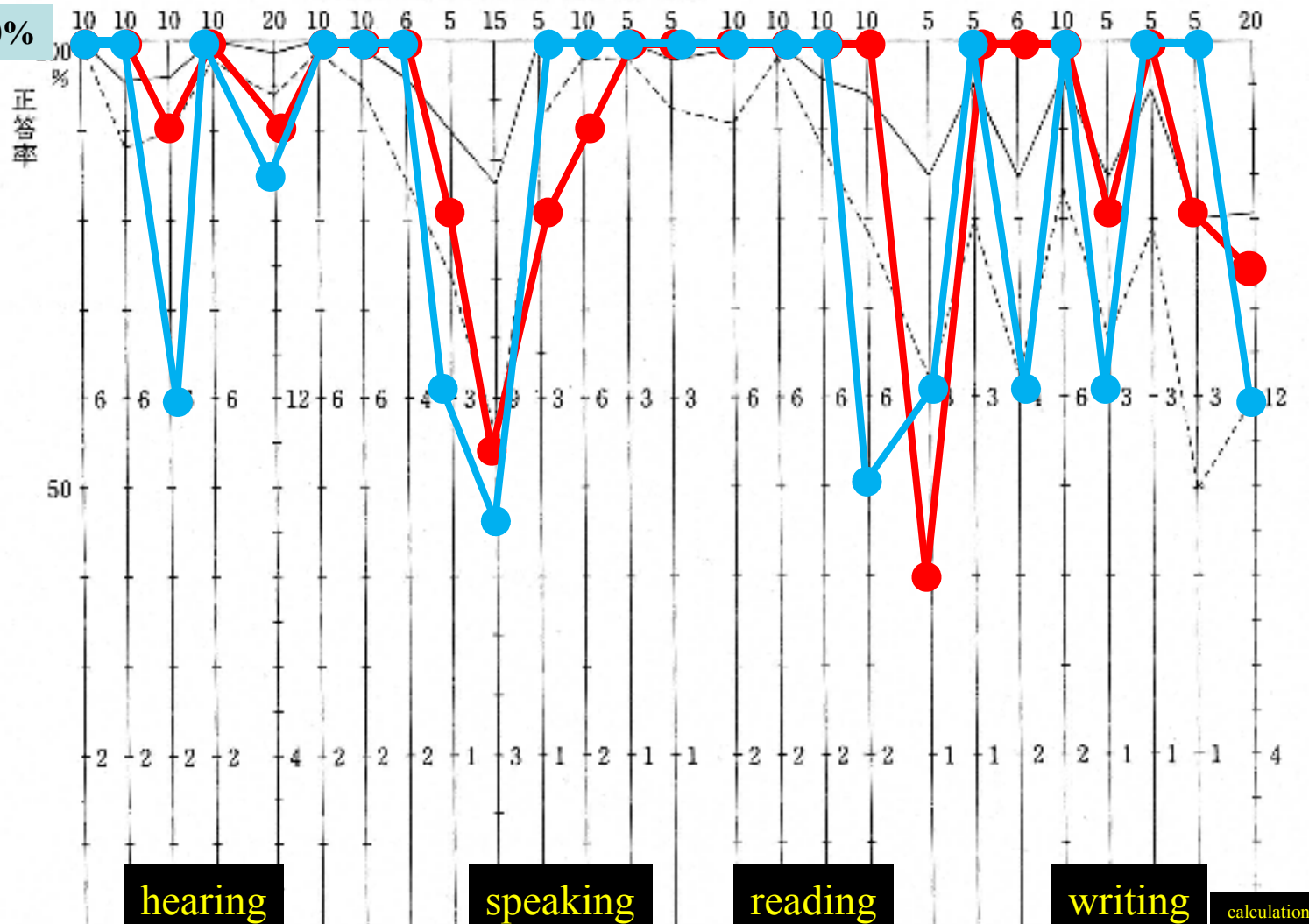
- 5m before op
- 11y4m after op

SLTA

Standard language test
for aphasia in Japanese

Surgery
1999

Correct 100%



項 目	1 単語の理解	2 短文の理解	3 口頭命令に従う	4 仮名の理解	5 呼称	6 単語の復唱	7 動作説明	8 まんがの説明	9 文の復唱	10 語の列挙	11 漢字・単語の音読	12 仮名1文字の音読	13 仮名・単語の音読	14 短文の音読	15 漢字・単語の理解	16 仮名・単語の理解	17 短文の理解	18 書字命令に従う	19 漢字・単語の書字	20 仮名・単語の書字	21 まんがの説明	22 仮名1文字の書取	23 漢字・単語の書取	24 仮名・単語の書取	25 短文の書取	26 計
	I. 聴く				II. 話す										III. 読む				IV. 書く						V. 計算	

Case 2

female, 36 y.o. at 2nd surgery

Seizure onset: 28 y.o.

SPS: auditory aura

CPS: unresponsiveness, **ictal speech** followed by head deviation to the left and weekly secondary generalized seizures (**SGS**)

Postictal left hemiparesis (Todd's palsy) and confusional state continued after SGS.

Neurological: completely right-handed

Scalp EEG: no spikes

MRI: no organic lesion and no mesial temporal sclerosis

First surgery (2004)

Right anterior temporal lobe was resected initially for temporal lobe epilepsy using intraoperative electrocorticography .

Seizure-free period was only 2 months.

Wada test was performed twice because of decreased postoperative verbal memory.

Her language dominance was revealed in the right hemisphere.

Second surgery (2007)

Subdural grids and depth electrodes were implanted.

We detected 2 independent types of seizures (frontal lobe and temporal lobe origins).

Seizure foci included Broca's and Wernicke's LAs.

Under awake anesthesia using propofol, partial resection in middle frontal gyrus followed by MST within Broca's LA was performed to confirm whether language function was preserved.

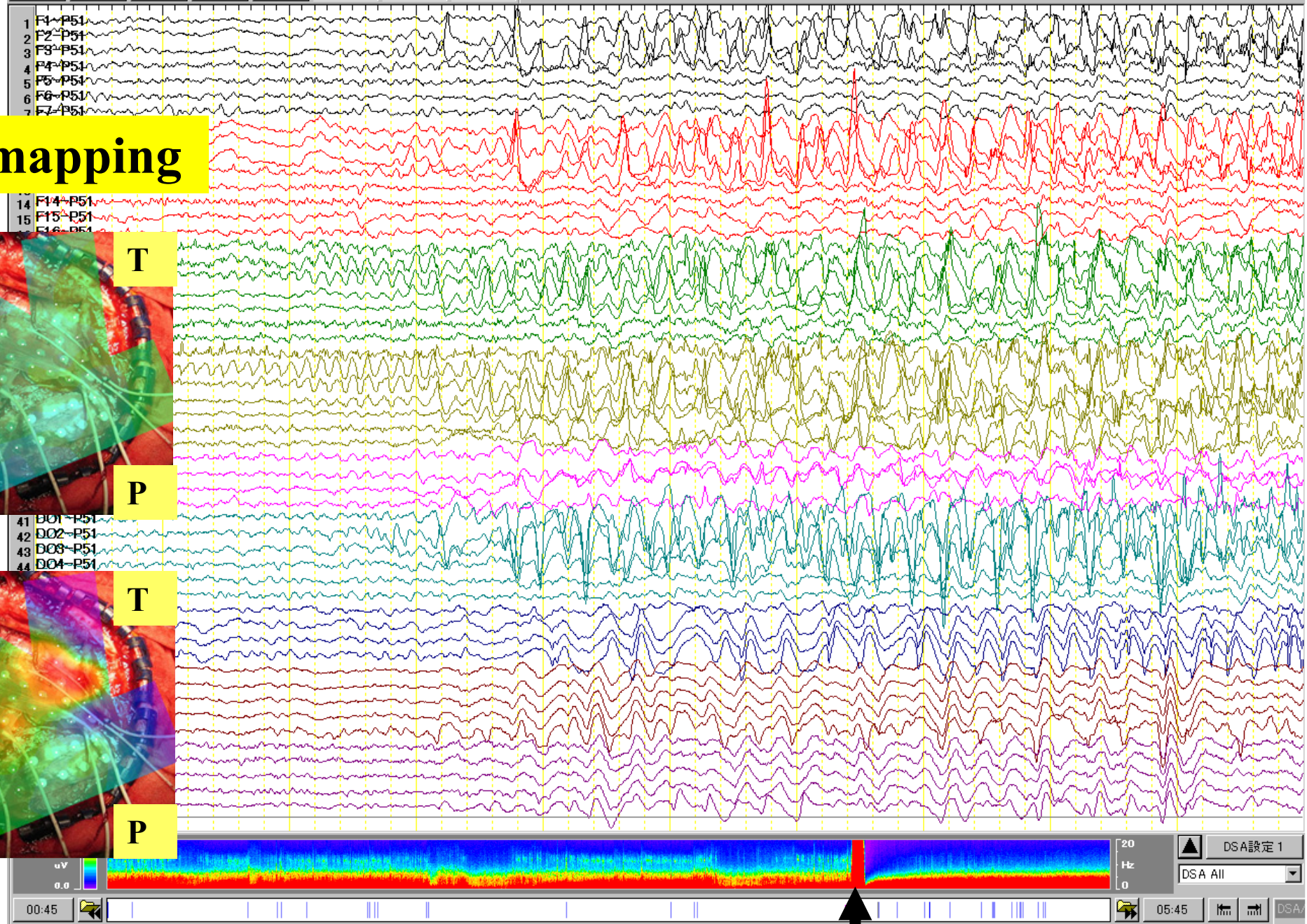
Finally, MST within Wernicke's LA was performed under general anesthesia.

Outcome

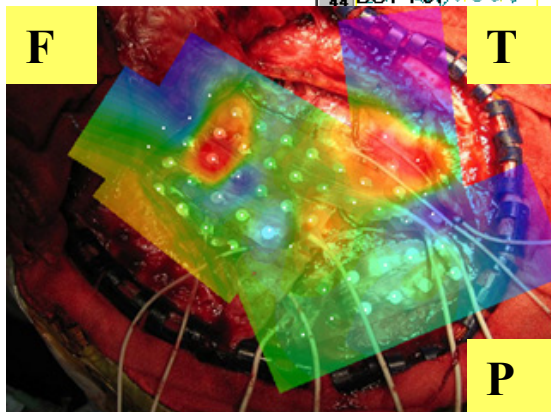
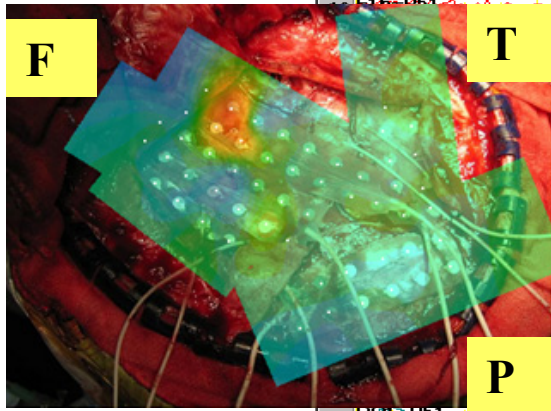
SGS disappeared completely and CPS reduced to less than 50% → Engel's class 3.

Frontal lobe origin (no auditory aura)

再生 2007/06/23 ディスク番号
ファイル(F) 表示(B) ショウワ(W) ツール(L) コ
50 uV 0.3 s 60 Hz TRACE
Sens TC HF Pat

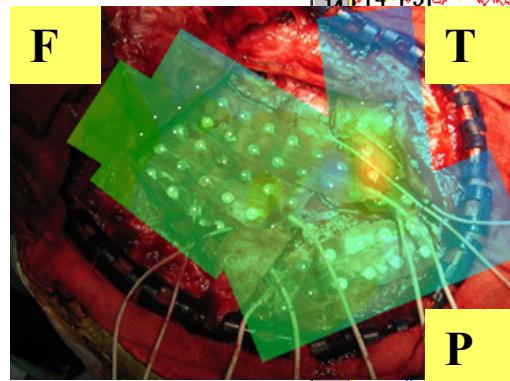


Voltage mapping



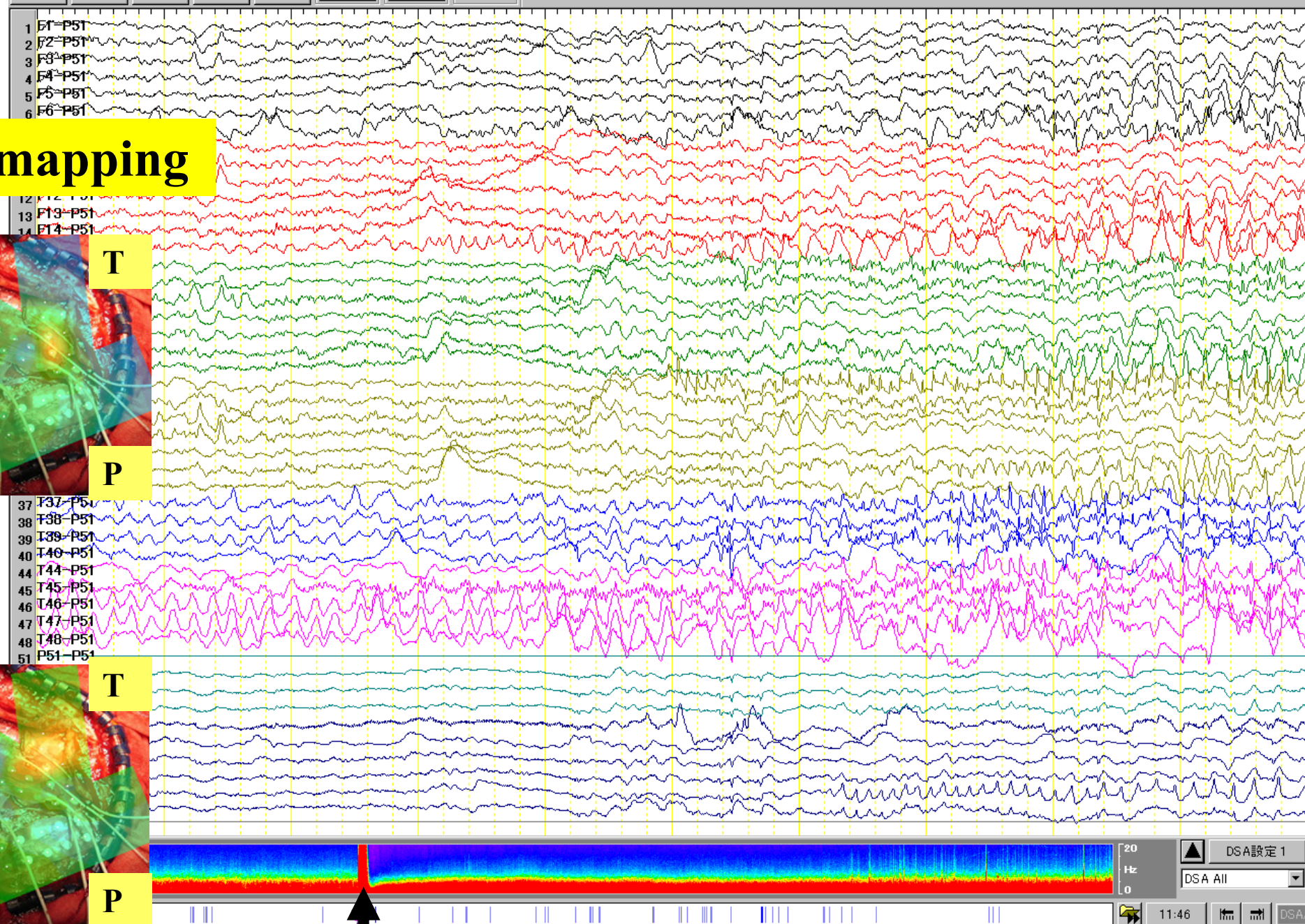
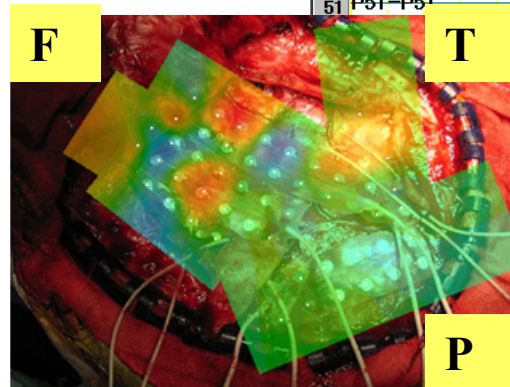
Temporal lobe origin (auditory aura followed by CPS)

Voltage mapping

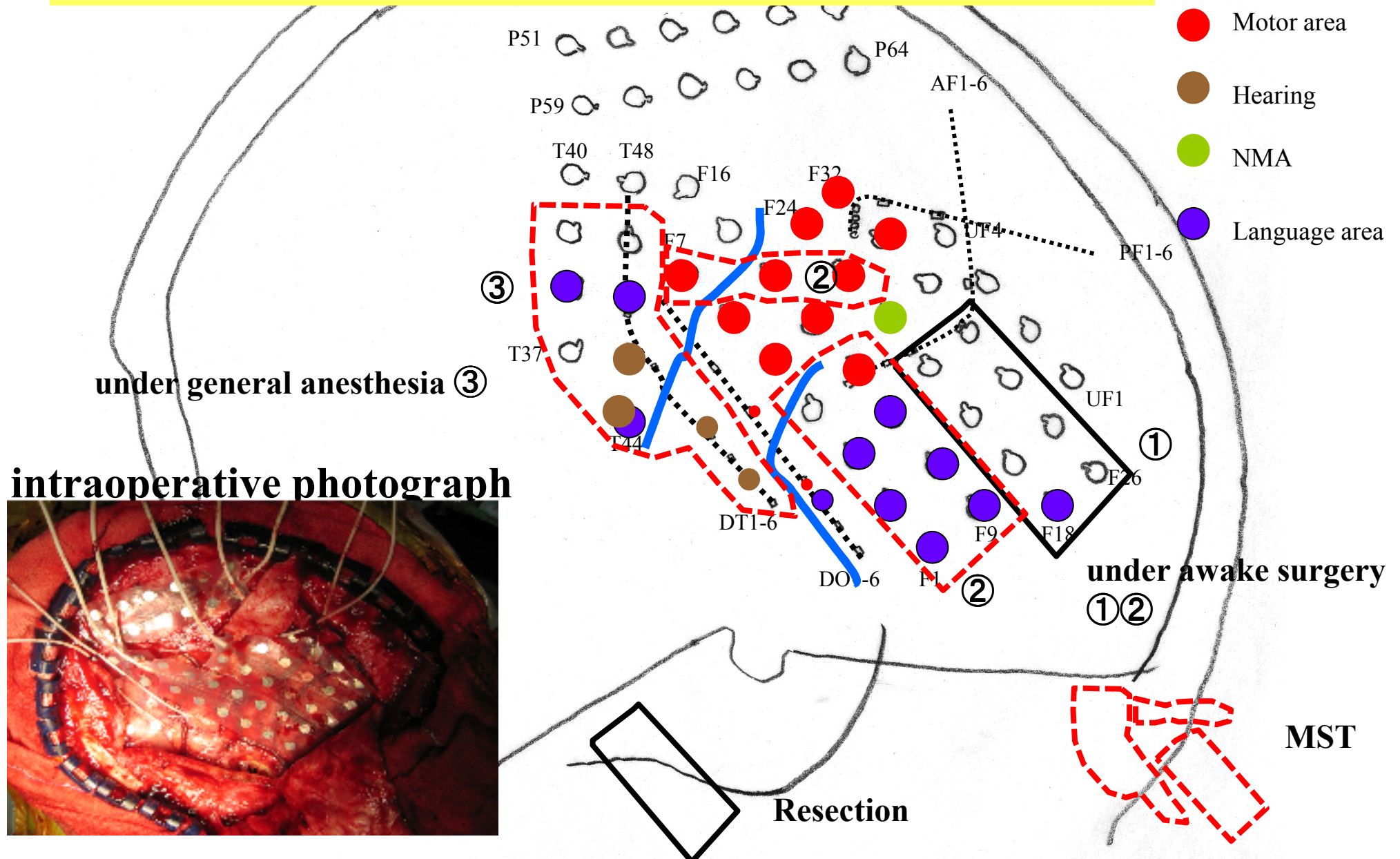


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Focal resection and multiple subpial transection after functional mapping



before surgery



after surgery

2m

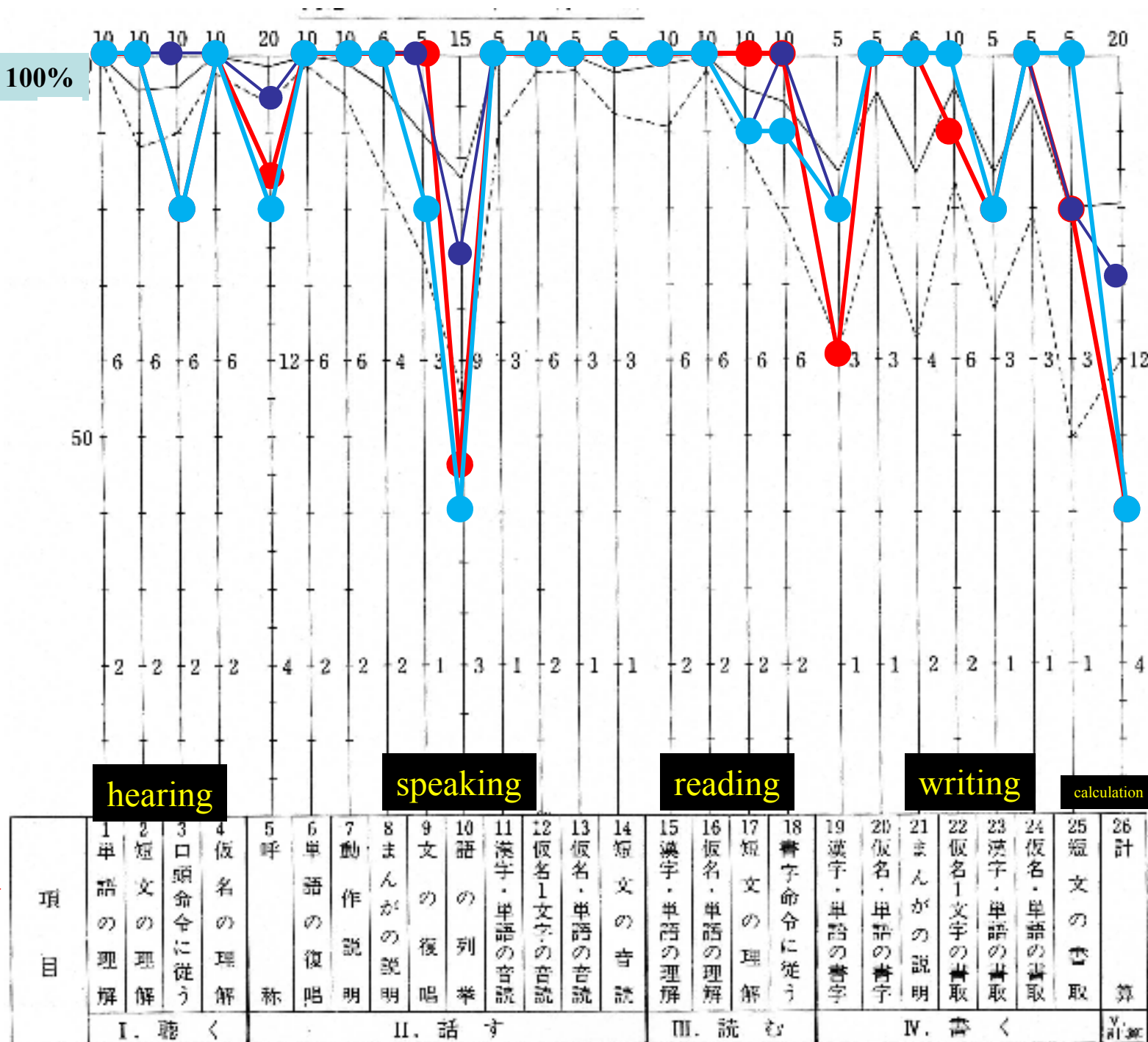
1y10m

SLTA

Standard language test
for aphasia in Japanese

Second surgery
2007

Correct 100%



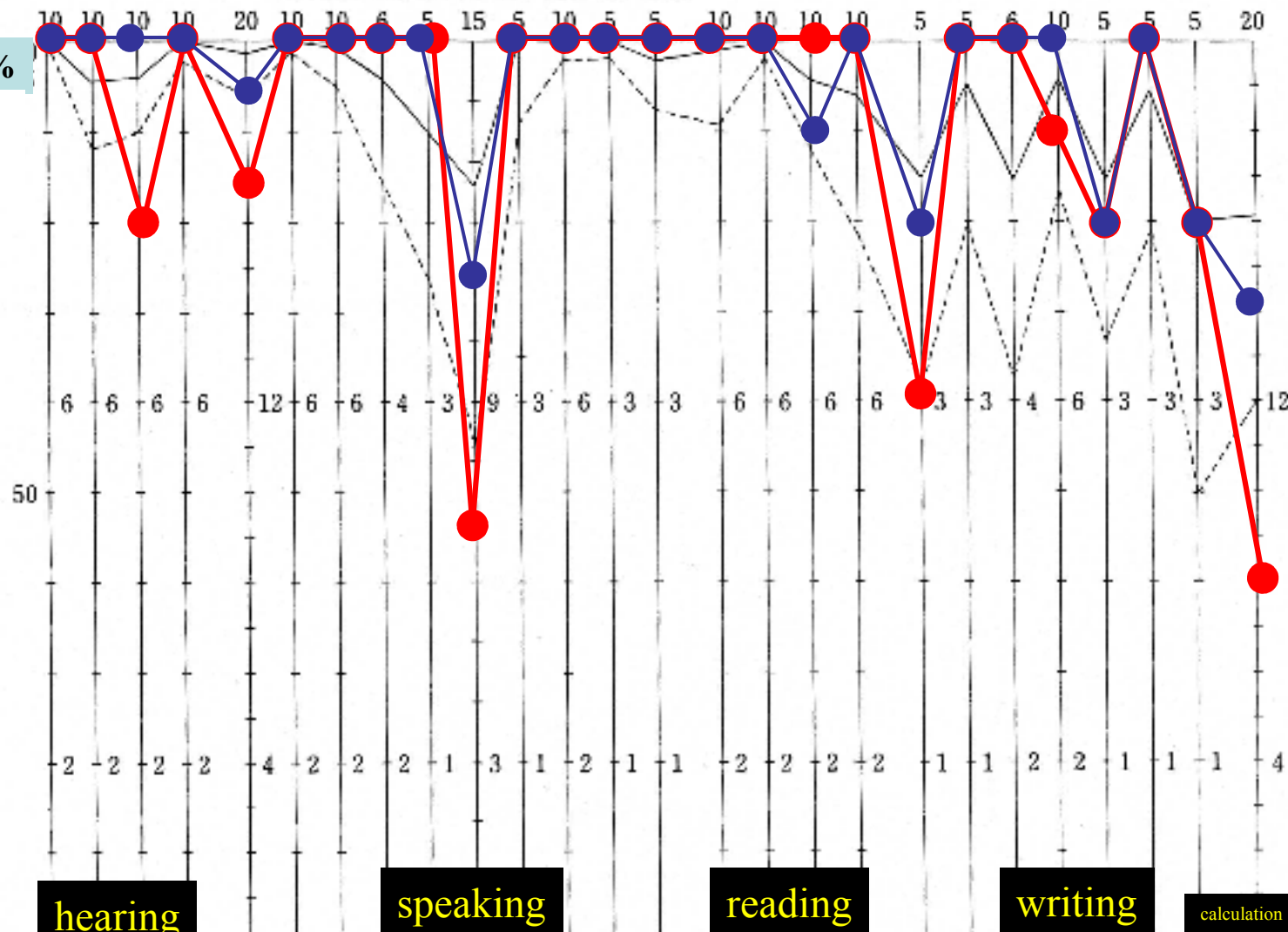
before surgery



after surgery



Correct 100%



SLTA

Standard language test
for aphasia in Japanese

Second surgery
2007

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	I. 聴く				II. 話す										III. 読む				IV. 書く					V. 計算		

before surgery



after surgery

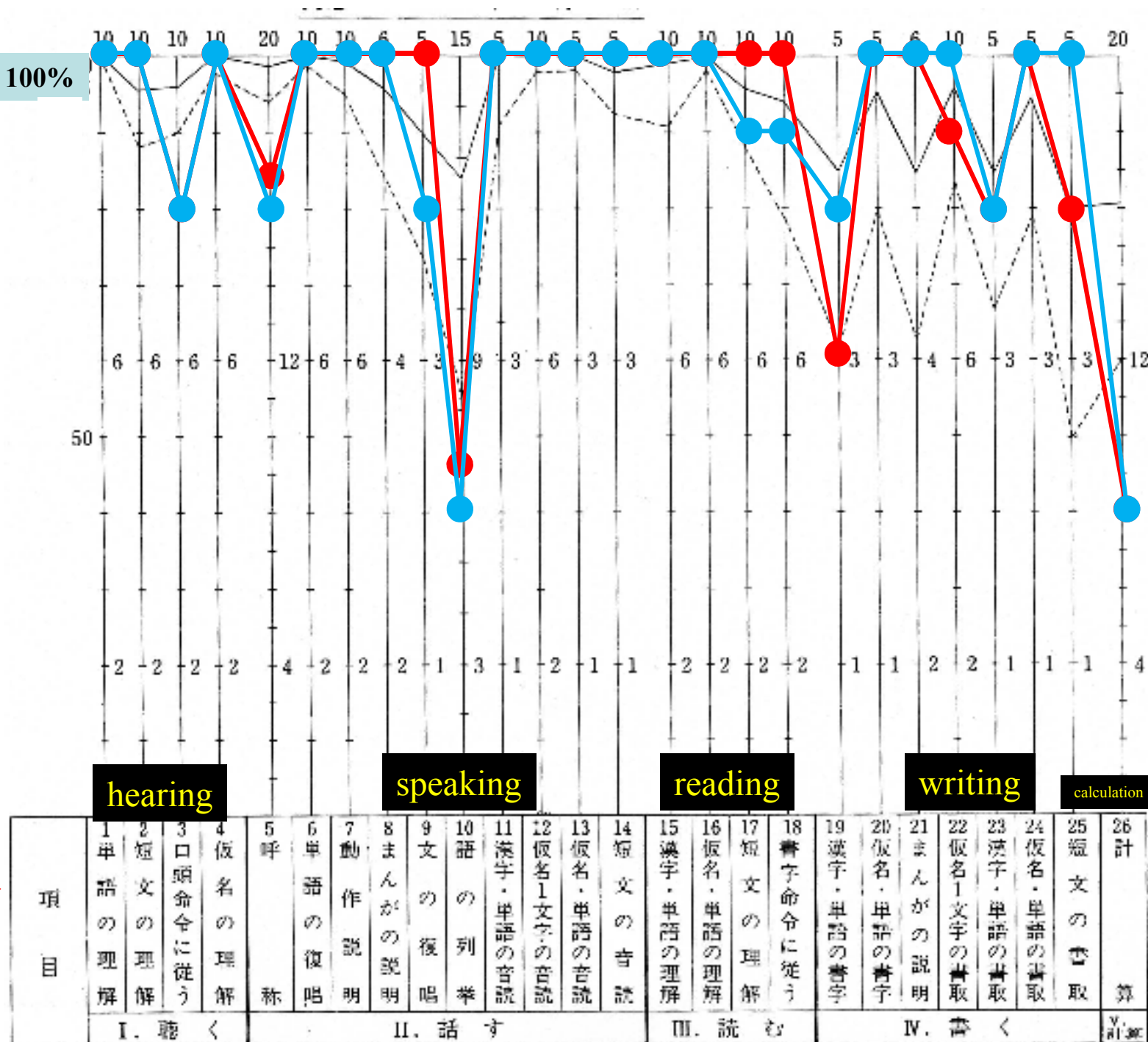
● 1y10m

SLTA

Standard language test
for aphasia in Japanese

Second surgery
2007

Correct 100%



Case 3

male, 37 y.o. at surgery

Seizure onset: 10 y.o.

SPS: speech arrest within a minute

CPS: unresponsiveness, staring, and speech arrest followed by head deviation to the right, figure 4 position and SGS once a week

Neurological: right-handed

Scalp EEG: no spikes

Magnetoencephalography (MEG): dipole concentration in the left posterior insular portion

MRI: small high intensity area in the left insular cortex

Positron emission tomography (PET): hypometabolism in the left temporoparietal and insular area

Surgery (2008)

Subdural grids and depth electrodes were implanted.

CPS originating from frontotemporoparietal extended area was observed.

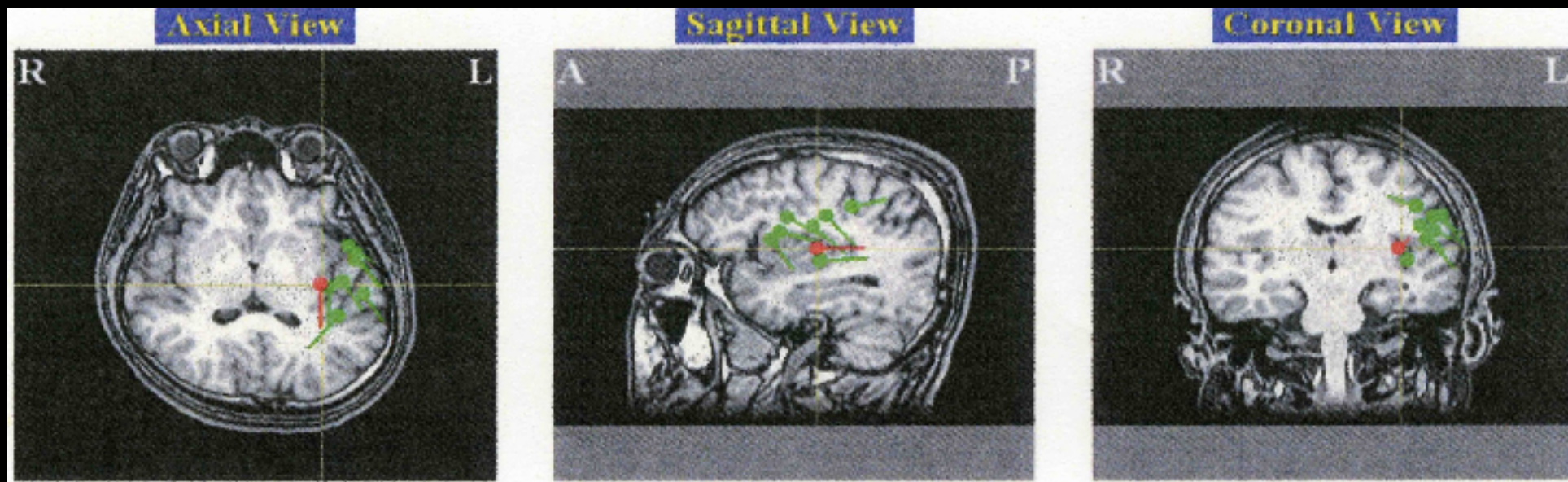
Seizure foci included Broca's and Wernicke's LAs.

Under general anesthesia, corpectomy in temporal cortex and MST within Broca's and Wernicke's LAs were performed simultaneously.

Outcome

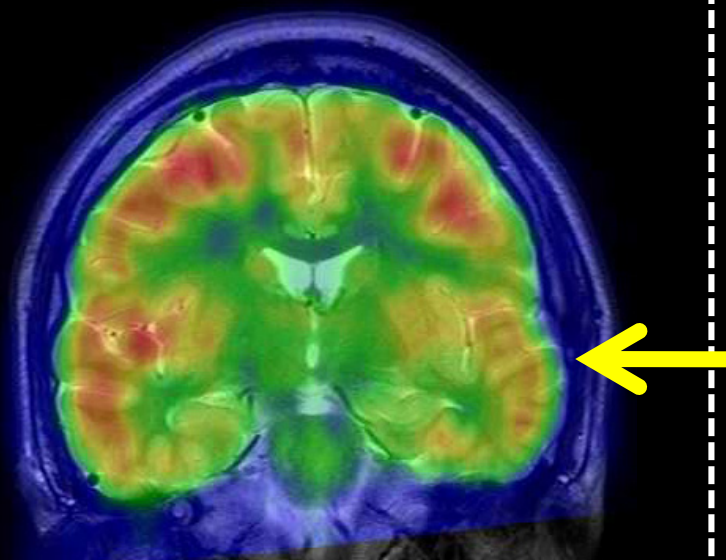
Patient was seizure free for 15 months and then relapsed → Engel's class 3.

MEG

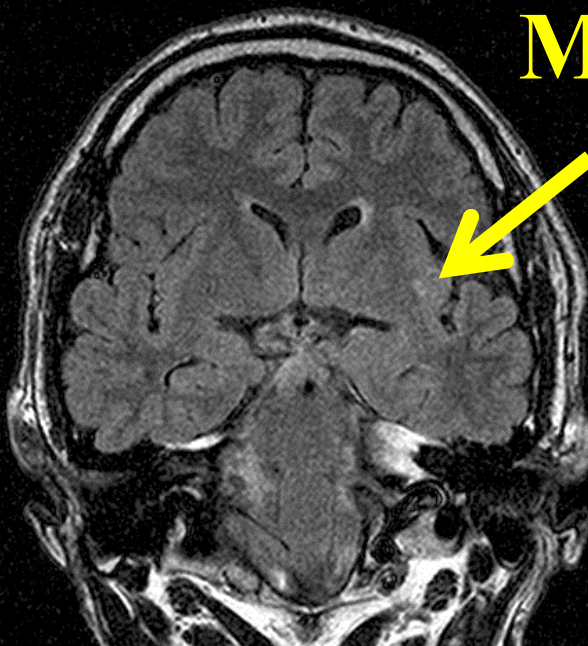


Rt

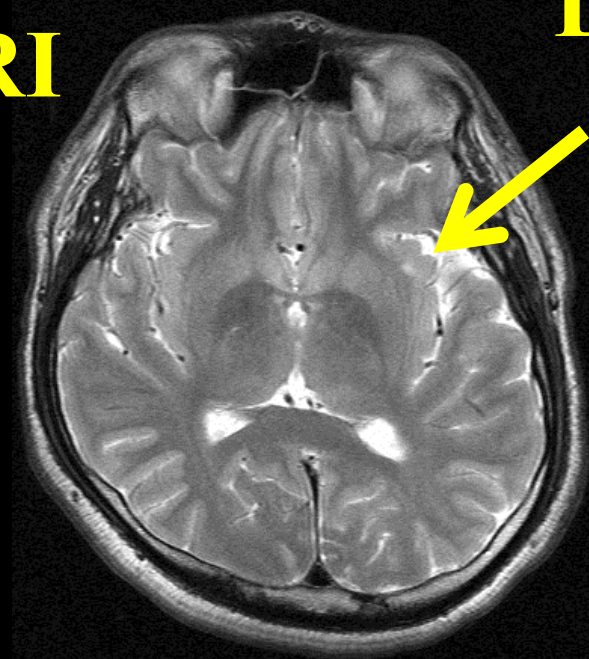
PET



MRI

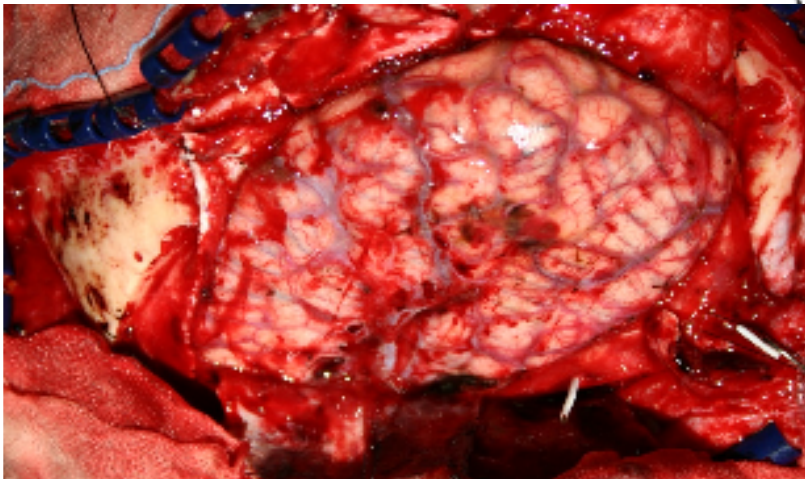
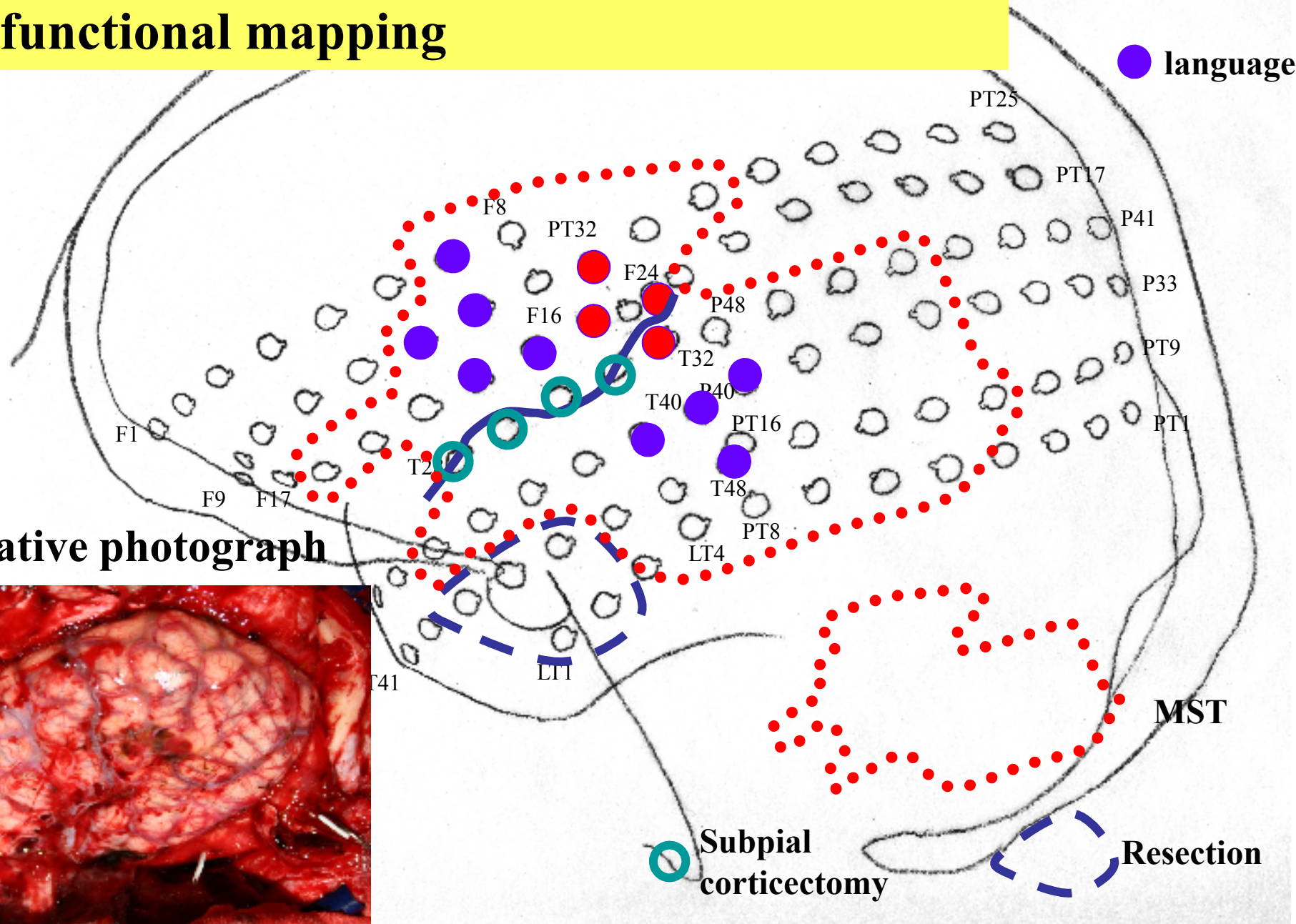


Lt



Focal resection and multiple subpial transection after functional mapping

- motor
- language



before surgery



after surgery

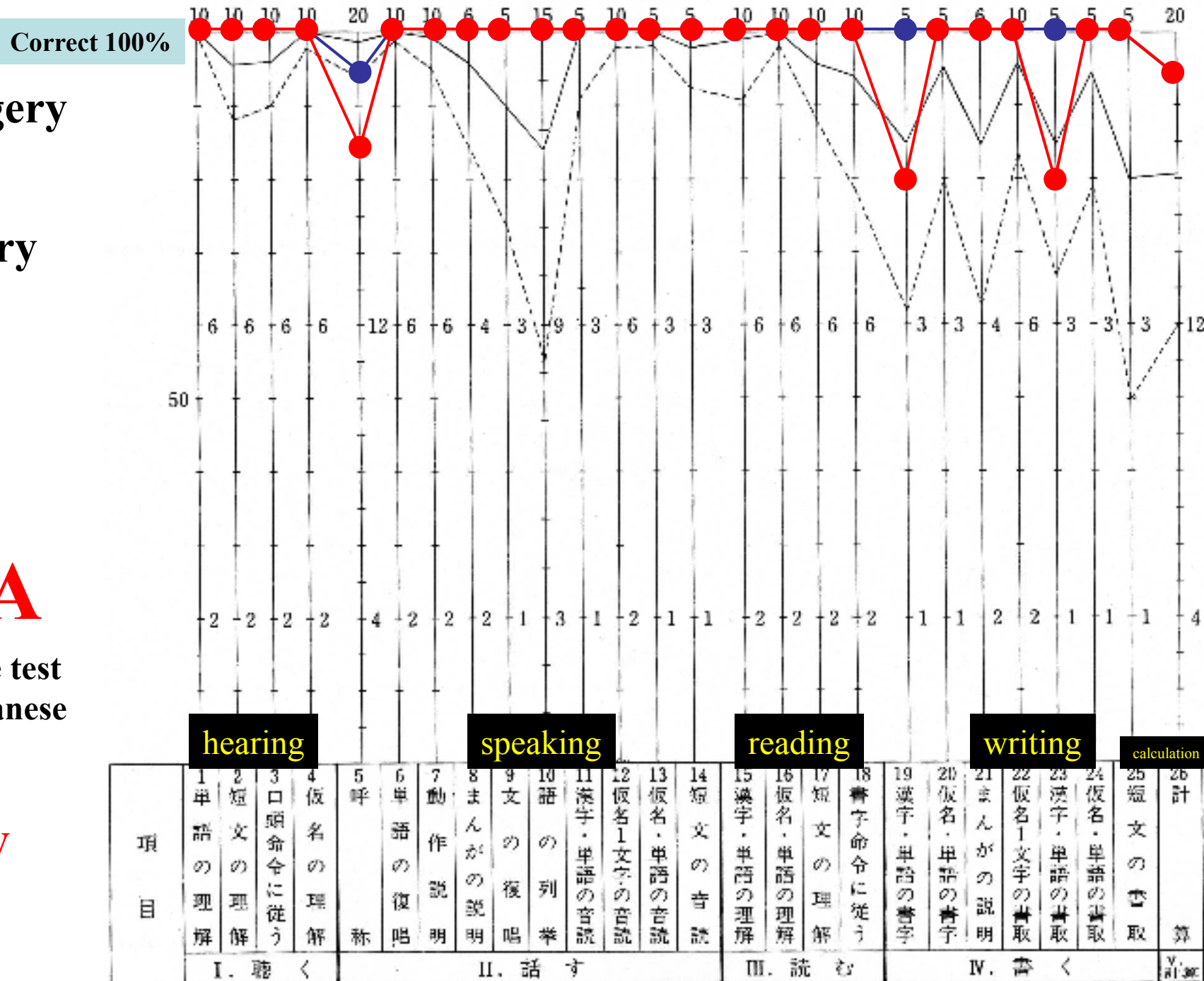


6m

SLTA

Standard language test
for aphasia in Japanese

Surgery
2008



Conclusions

★ If epileptogenic foci are extended to multiple lobes including LAs, the combination of MST and resective surgery can be useful to prevent postoperative seizure and preserve the language function.

★ Simultaneous MSTs within Broca's and Wernicke's LAs were safe and there was no permanent postoperative speech dysfunction.

★ Language function was impaired severely after MST within Broca's LA and the resected region surrounding language cortex for 1 postoperative month, and then gradually improved for the subsequent 6 months; finally, no marked deficits remained as compared with preoperative language function.

★ Validity of MST is dependent on whether precise epileptogenic foci are preoperatively detected.