

TITLE: Subcortical stimulation combining with multiple intraoperative neurophysiological modalities to identify the internal capsule during craniotomy of tumor resection (a case report)

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A 39-year old female who presented to the hospital with recurrent oligodendroglioma, progressive contrast enhancing tumor on the left frontal lobe status. She had a history of craniotomy back in 2007, left frontal craniotomy and subtotal resection following radiation therapy. At that time the pathology reported as grade 2 oligodendroglioma. She has been doing well until recently, now having more seizure activities and foginess and memory issues. She was admitted with normal walks without assist, normal gait pattern and good balance. Light touch was intact and strength in upper and lower extremities was 5/5 in musculoskeletal exam. A 26 series multiplanar multisequence brain MRI was done before and after 12 ml of MultiHance contrast using. MRI shows three distinct areas of contrast enhancement and some T2 changes with surrounding vasogenic edema; MRI is consistent with recurrent tumor.

Intra-operative course: The procedure was continuously monitored by the interpreting neurophysiologist and an intraoperative practitioner via a live on-line network connection. For subcortical stimulation, a paired subdermal needle electrodes were placed in contralateral side of orbicularis oris. The time base is 5ms/div for Orbicularis Oris, 10ms/div for other monitoring muscles. A single subdermal needle electrode was place on chest near top of sternum for stimulation return. The intraoperative neurophysiological monitoring consisted of bilateral upper and lower SSEPs and MEPs, with subcortical stimulation. Baseline SSEPs and MEPs showed good morphology and reproducibility.

Surgeon identified the cystic cavity from the previous resection, with help of Stealth neuronavigation, surgeon could identify the corpus callosum and removed tumor from posterior aspect and basal frontal lobe. SSEPs and MEPs were stable during whole procedure. While surgeon continued to dissect tumor on the lateral aspects, surgeon identified the basal nuclei. Subcortical stimulation was applied and abductor pollicis brevis responded at 8 milliamperes which indicated internal capsule at the posterior and lateral aspect around 8 mm. Surgeon was satisfied with the subcortical stimulation outcomes, then removed tumor in its entirety. The patient was slowly woken up and could move upper and lower extremities following commands, face was symmetric, and cranial nerves 2-12 were intact without sensory deficits.

Fig2. Baseline MEPs

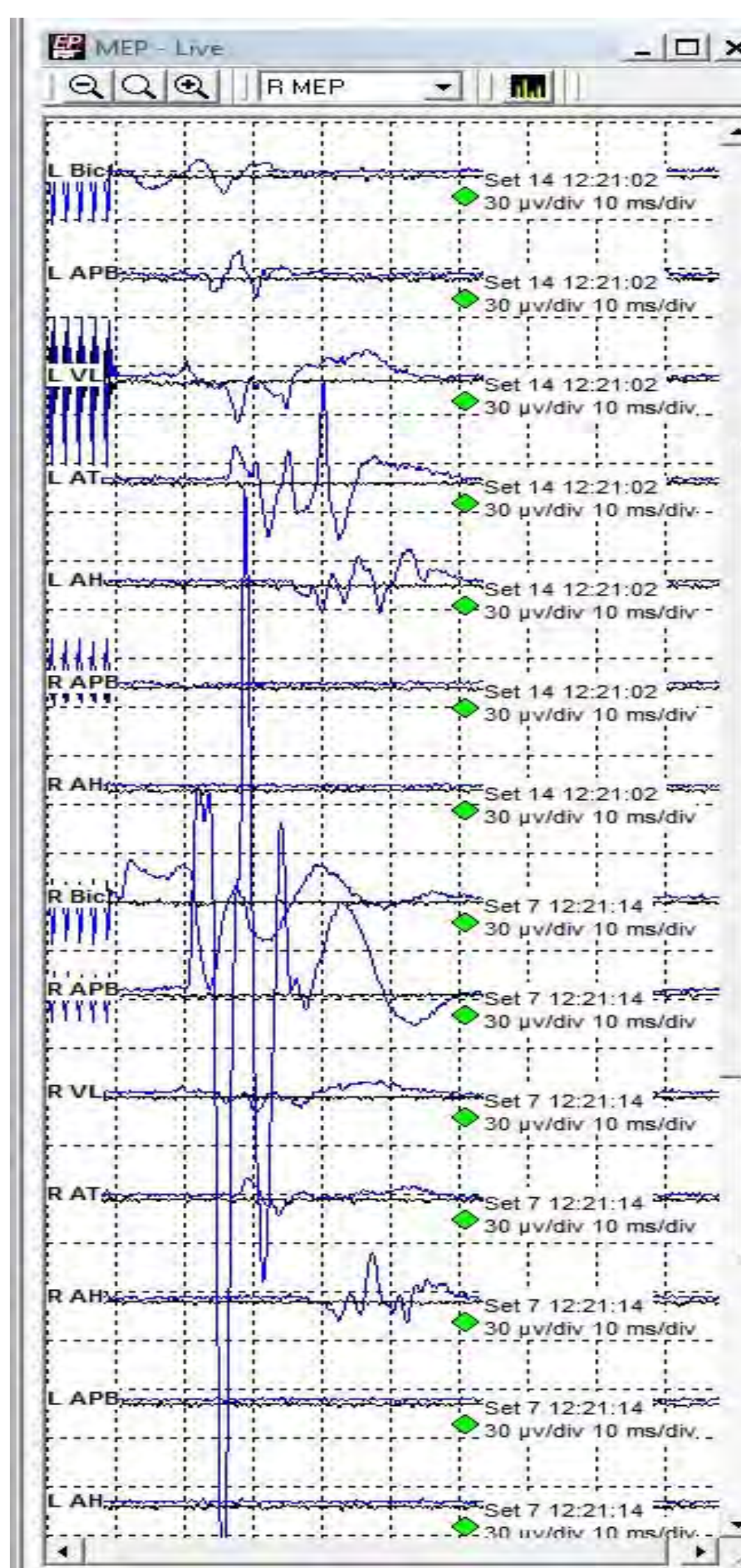


Fig 1. Baseline SSEPs

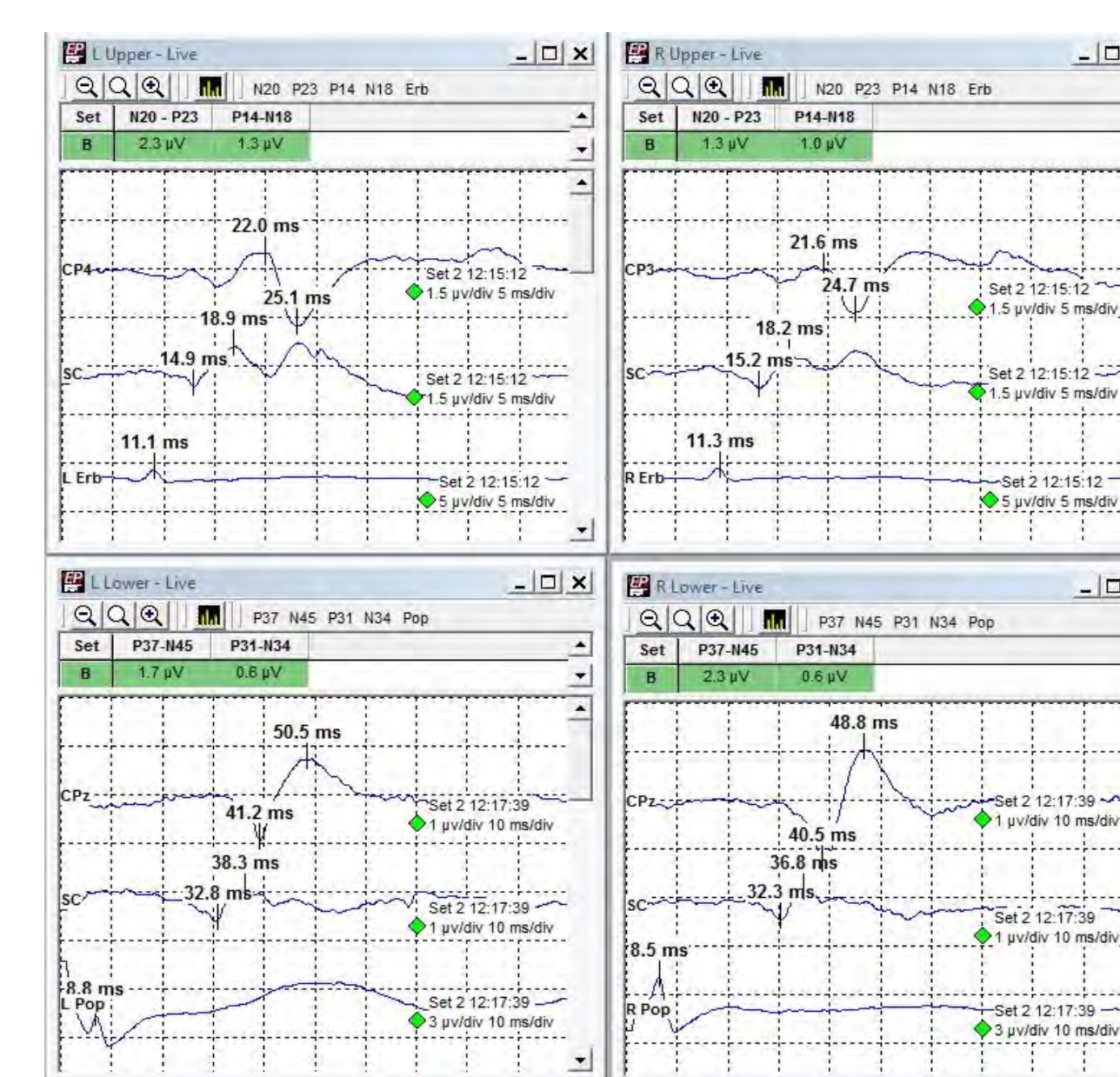


Fig 3. subcortical stimulation at 5 mA

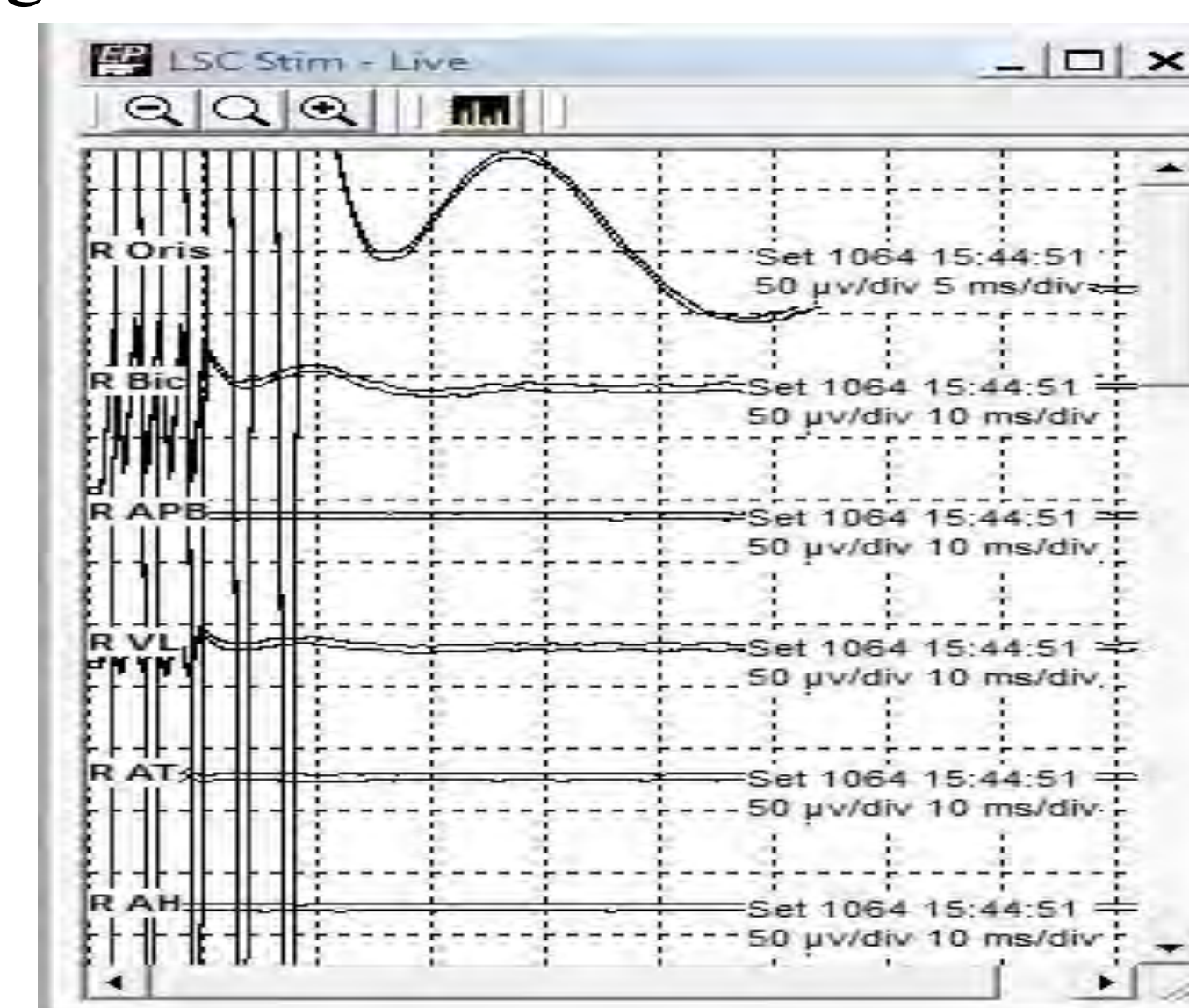
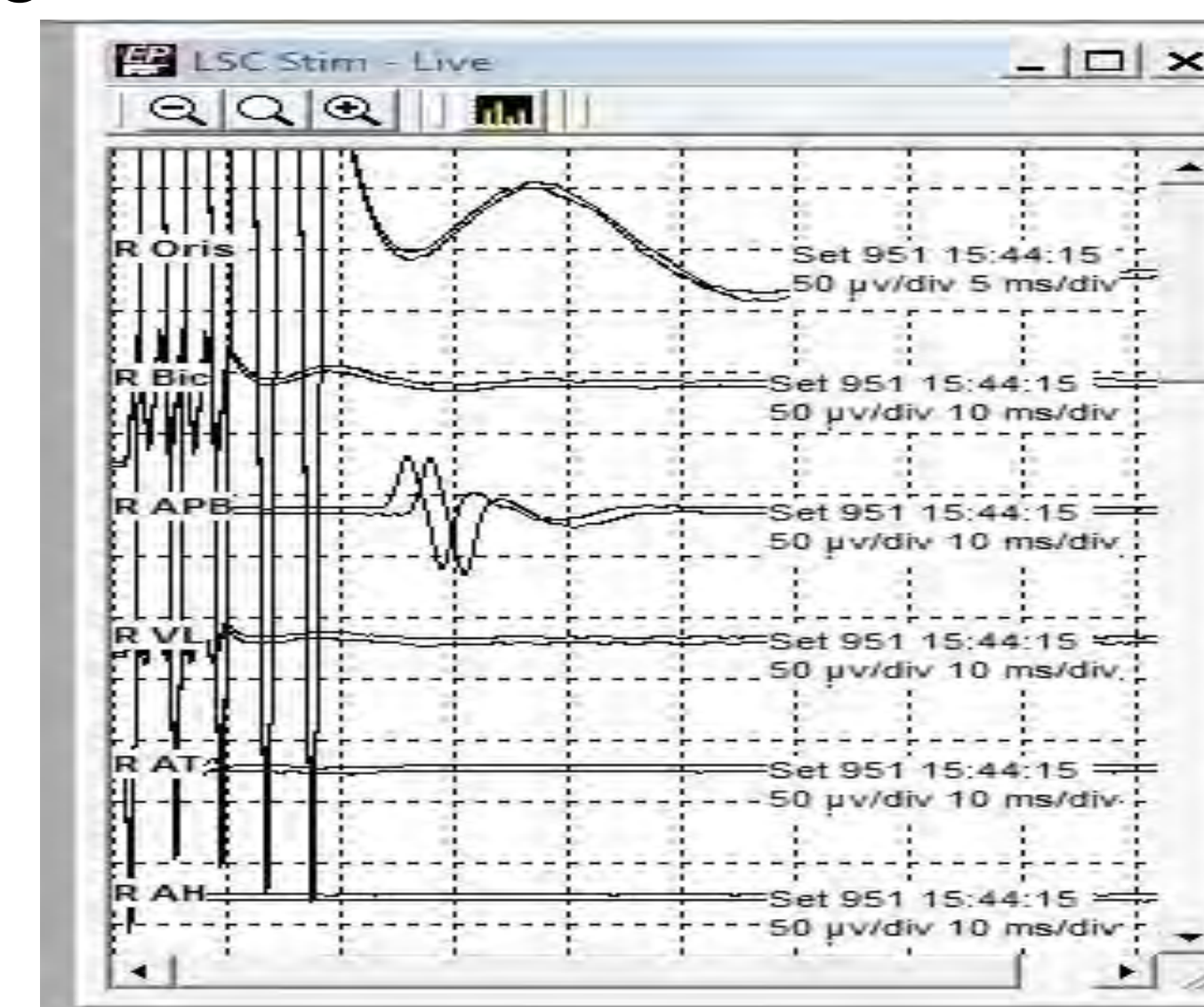


Fig 4. subcortical stimulation at 8 mA



Discussion: To identify tumor margins and the distance to internal capsule are the critical step for tumor resection. Imaging study such as MRI provides anatomical structures and help to find residual tumor location. Due to lack a clear margin, frequently infiltrate brain tissues and distort anatomical landmarks, electrical cortical and subcortical stimulation provide a powerful tool to define brain functional area margin during tumor resection (1,2,3,4). We used SSEPs to monitoring sensory tract integrity (SSEPs can be used to localize the central sulcus as well) in this case, and monitoring tract integrity was monitored through MEPs. In addition, subcortical stimulation was used to evaluate the distance from eth stimulation site to the internal capsule (cortical spinal tract). A linear correlation between the subcortical stimulation threshold and the distance to the cortical spinal tract that each 1 mA of stimulation threshold is corresponded to about 1 mm of distance (1,2). The distance of greater than 5 mm (5 mA for subcortical stimulation threshold) was shown to be safe. Once functional boundaries are defined, surgeon could maximally dissect tumor and reduce the risk of neurological deficit in motor function.

References:

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