Using a subdural strip to define functional sensory nerves and the most inferior functional portion of the conus medullaris during detethering surgeries for tethered cord syndrome

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Clinicians have traditionally focused more on preserving motor functions during detethering surgeries by monitoring the presence of electrically stimulated compound muscle action potentials. However, sensory functions of the S2-4 nerves are also critical due to their role in bowel, bladder, and sexual functions. It is very difficult to record cortical somatosensory evoked potentials (SSEPs) from lower lumbosacral nerves in young children due to greater sensitivity to anesthetics and the immaturity and incomplete myelination of the childhood nervous system. In this presentation, we show that a subdural strip placed rostral to the surgical field allows the recording of SSEPs evoked with a concentric electrode at the surgical field and the locating of functional sensory structures.

Six patients, with ages of 6 months to 16 years, underwent detethering surgery due to tethered cord syndrome. Four of the cases were myelomeningocele-related, one was lipomyelomeningocele, and the other was diastematomyelia-related. Apart from routine preparations for intraoperative functional mapping and monitoring, a 1×4 strip was placed and secured rostral to the surgical field for SSEP recordings (Fig. 1). The surgeon then used a concentric stimulating electrode to identify any functional sensory nerves and the most inferior functional portion of the conus medullaris at the placode (Fig. 2). We typically used a 6- to 8-mA stimulus to identify the functional conus medullaris and a 2- to 4-mA stimulus to identify sensory nerves, and monitorable responses could usually be obtained by fewer than ten averagings. The SSEP amplitudes ranged from 4 to 400 μV, and the responses to sensory nerve stimulation were frequently much larger than those to conus stimulation. These SSEPs were used to define the safe margin for detethering with placode severed caudally to the most inferior functional portion of the conus medullaris (Fig. 3, 4), which would preserve sensory functions while achieving maximal detethering. The patients exhibited no substantial postoperative functional deterioration.

Although we could not precisely check sensory functions in each case due to their young age, our procedure should provide better sensory function preservation during detethering than current clinical practices do, as the current practices are mainly focused on preserving motor functions. Larger recording surface provided by the strip and less interference due to the shorter distance between stimulating and recording electrodes are another advantages which resulted in less averaging needed and in turn, less time consuming during signal acquisition.

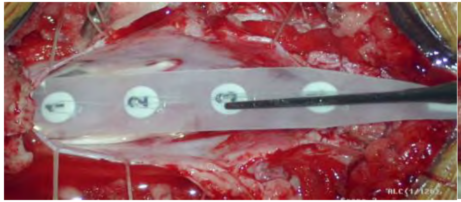

Figure 1. A 1×4 strip placed in the subdural space immediately rostral to the surgical field.

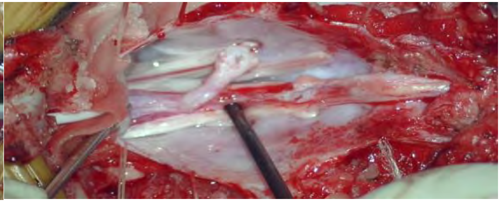

Figure 2. A concentric stimulating electrode is used to identify any functional sensory nerves and the most inferior functional portion of the conus medullaris at the placode.

Figure 3. SSEPs recorded with a subdural strip during stimulation at the left (left, amplitude: 400 μV) and right (right, amplitude: 70 μV) placodes in a 4-year-old girl with myelomeningocele and tethered cord syndrome. No SSEPs were recordable inferior to the S4 root level on either side.

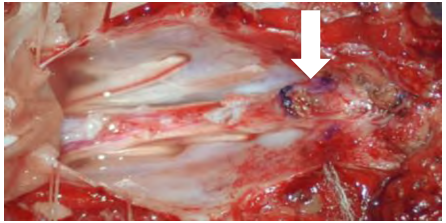

Figure 4. Using both motor and sensory mapping, the placode was severed caudally to the most inferior functional portion of the conus medullaris (i.e., inferior to the S4 root level).