Advances in Neurophysiological Intraoperative Monitoring During Selective Dorsal Rhizotomy

Yinchen Song, PhD[1,2]*, Stephanie A. Ferri, CNIM[1], Erik J. Kobylarz, MD/PhD[1,2,3], George P. Thomas Jr., MD/PhD[1,2], David F. Bauer, MD[4,5]

[1]Department of Neurology, Dartmouth-Hitchcock Medical Center, Lebanon, New Hampshire; [2]Geisel School of Medicine, Dartmouth College, Hanover, New Hampshire; [3]Thayer School of Engineering, Dartmouth College, Hanover, New Hampshire; [4]Section of Neurosurgery, Department of Pediatrics, Dartmouth-Hitchcock Medical Center, Lebanon, New Hampshire; [5]Children's Hospital at Dartmouth-Hitchcock, Lebanon, New Hampshire

* Yinchen.song@Hitchcock.org

INTRODUCTION

For pediatric patients with spastic cerebral palsy, selective dorsal rhizotomy (SDR) could be performed on the lower spinal cord to reduce spasticity (Park et al., 2006). SDR is an irreversible neurosurgical procedure that targets and selectively destroys the spasticity-causing sensory nerves. However, it is not easy to differentiate the spasticity-causing sensory nerves from normal motor nerve roots practically in the operating room. Here, we are presenting a new method to facilitate the identification of sensory nerve roots for SDR.

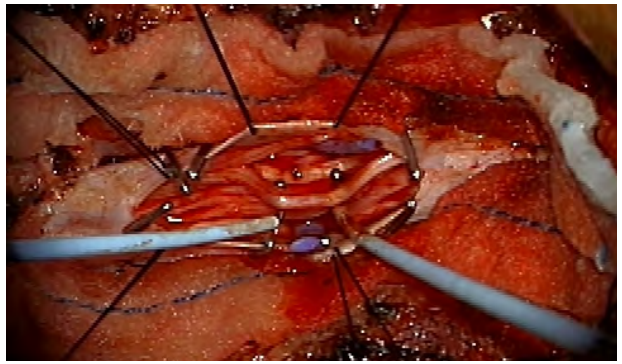
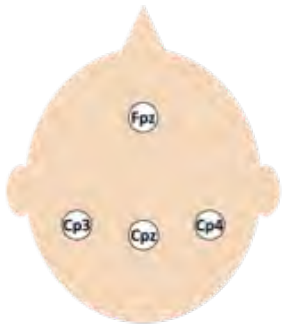


Fig. 1. Exposed L2-S2 nerve roots. Double hook electrodes were used to stimulated the nerve roots.



Muscle	Spinal Root
Iliopsoas (IL)	L1, L2
Adductor Longus/Magnus (AD)	L2, L3
Vastus Lateralis (QD)	L3, L4
Tibialis Anterior (TA)	L4, L5
Biceps Femoris – long head (BF)	L5, S1
Gastrocnemius medial (GST)	S1, S2
Abductor Hallucis (AHB)	S1, S2
External Anal Sphincter (AS)	S2

Fig. 2. Scalp electrode locations and monitored muscles.

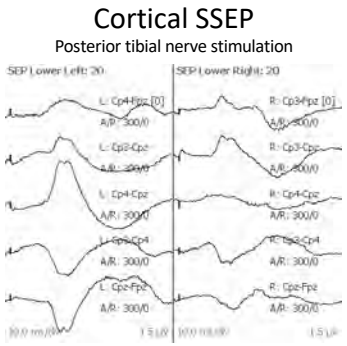


Fig. 3. Somatosensory evoked potential induced by posterior tibial nerve stimulation.

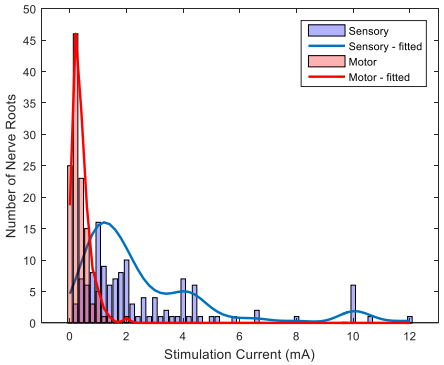


Fig. 4. Stimulation current distribution for sensory and motor nerve roots.

METHODS

The surgical procedure was performed as described in Park et al (2006). Hook electrodes were used to stimulate the nerve roots (Fig. 1). Scalp electrodes were placed for monitoring SSEP and twisted pair electrodes were placed in muscles that cover the L1-S2 nerve roots (Fig. 2).

RESULTS

We performed the SDR on six pediatric patients. Posterior tibial nerve SSEPs were used to verify the correct anesthetics being used (Fig. 3). In general, we need a relatively high stimulation current for sensory nerve roots to induce EMG responses. However, due to the overlap of the distributions the stimulation current cannot be used as a criteria to differentiate the sensory nerve roots from motor nerve roots (Fig. 4). With direct stimulation of the nerve root and monitoring the stimulated EMG and cortical SSEP simultaneously, we were able to identify the spasticity-causing sensory nerve roots even at an ambiguous stimulation current level (Fig. 5). All six patients are doing well post-operatively in terms of their motor and sensory function.

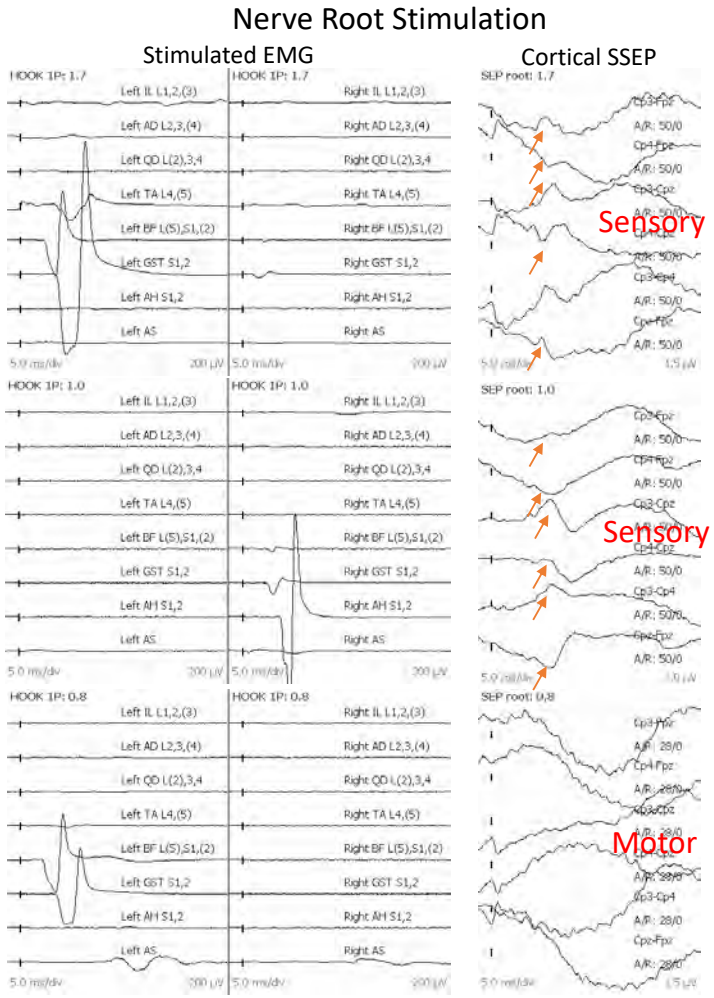


Fig. 5. Recorded stimulated EMG responses and corresponding cortical SSEP responses from stimulation on the nerve roots

Ref: Park et al., 2006, Neurosurg Focus