

Loss of lower extremity somatosensory evoked potentials during lumbar laminectomy and instrumented fusion: a case report

Abstract

The utilization of lower extremity somatosensory evoked potentials (SSEP) for monitoring of lumbar spine procedures remains controversial. The fact that multiple lumbar spinal nerve roots contribute to the SSEP prior to its transition into the posterior columns of the spinal cord may lead to reduced sensitivity in monitoring these potentials. We present a case of a patient undergoing a posterior open approach, lumbar laminectomy and instrumented fusion. The patient experienced an acute loss of both cortical and subcortical posterior tibial nerve (PTN) SSEPs during lumbar laminectomy (Figure 1-4). Continuous testing documented a full amplitude recovery of the attenuated evoked potentials forty minutes after loss of signal and completion of the decompression (Figure 5,6). An analysis of the literature, case review, and discussion on the merits of SSEP monitoring in below-the-conus medularis procedures is presented.

Keywords: SSEP, Somatosensory Evoked Potential, Lumbar Spine Surgery, Surgical Neurophysiology, IONM

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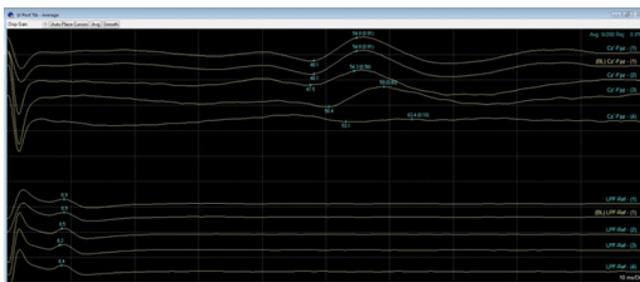


Figure 1 1043 there is a loss of the left cortical potential with stable popliteal fosa potential.

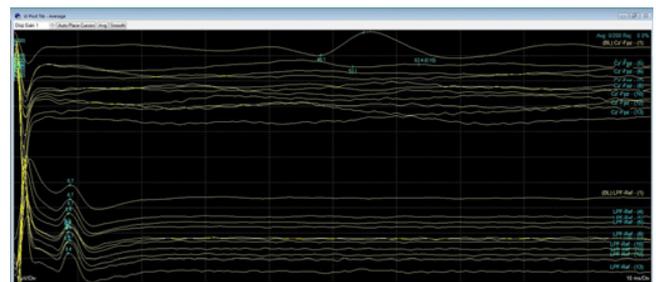


Figure 4 1119 There continues to be a loss of the post tibial cortical SSEPs with stable popliteal fosa potential.

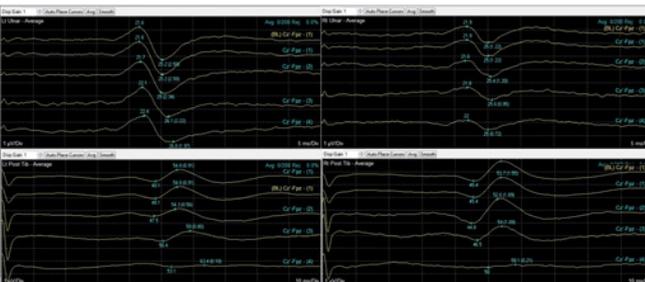


Figure 2 1043 there is a bilateral loss of the cortical SSEPs with stable cortical Ulnar SSEPs.

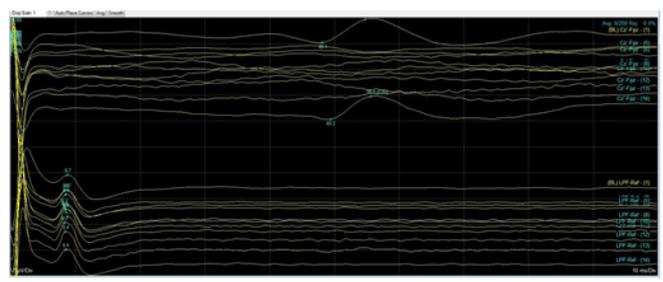


Figure 5 1123 surgeon tells technologist that decompression is done cortical SSEPs return bilaterally.

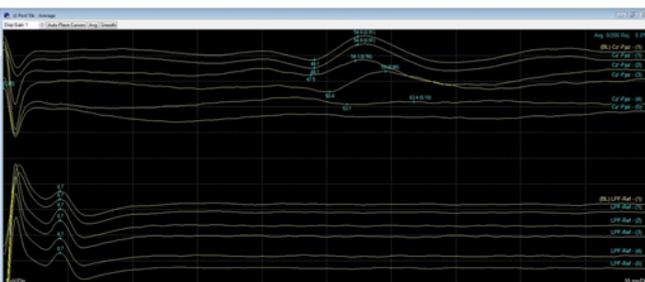


Figure 3 1046 The loss is confirmed and the surgeon is notified.

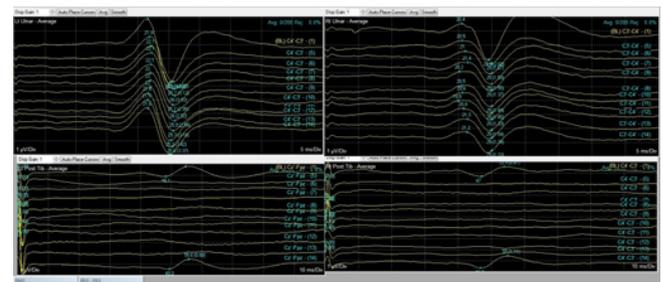


Figure 6 1123 cortical SSEPs return bilaterally.

Literature review

Dating back to the early 1970's the literature contains a variety of articles pointing to the value of Somatosensory Evoked Potentials. Initially their value was limited to recordings, primarily in spinal cord physiology with the earliest clinical reports related to scoliosis and related pathology.¹ Articles by Kurcaldi, Willis et al, Engler, Eisen, Brown and others, pointed to the value primarily as a spinal cord marker. In the early 1980s, literature began referencing the value with the addition of Electromyography in both spontaneous and ultimately triggered modalities (Herron).² It became common practice to use a variety of modalities in an effort to assure the greatest safety to the patient and subsequently give the surgeon the greatest likelihood of minimizing iatrogenic injury. With the advent of surgeon directed technology, less attention seemed to be paid to the value of somatosensory (and ultimately motor) evoked potentials and it seemed as though the use of other modalities was also coming into question by virtue of changes in the reimbursement. However, with patient care concerns as the primary cornerstone of Intraoperative Neurophysiology Monitoring and the actual reimbursement rates for additional modalities to be virtually nil in comparison to the overall monitoring charges, we and other centers continue to use the multimodal approach without concern for the ultimate reimbursement. In this report, we show the value of using the additional modality of Somatosensory Evoked Potentials to protect the patient's nervous system (Figure 7-9).³⁻⁷

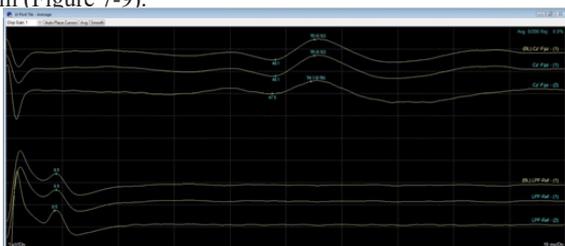


Figure 7 1015 Left post tibial SSEP 3rd trace run all is stable.

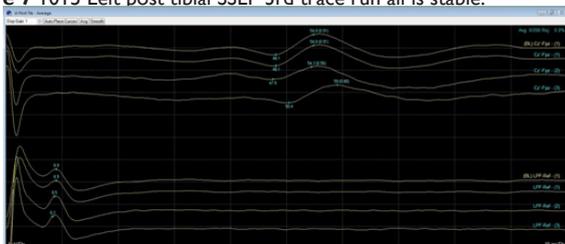


Figure 8 1031 Left post tibial SSEP slight shift in cortical response with stable popliteal fosa potential.

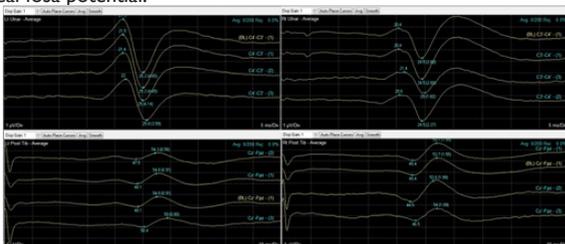


Figure 9 1031 Slight shift in post tibial cortical potentials with stable cortical ulnar potentials.

Case presentation

A 55 year old male had a past medical history of two level lumbar laminectomy and lumbar stenosis. The patient complained of unprovoked, progressive, low back pain with radiation to bilateral lower extremities. The back pain was described as aching and stabbing

in nature. The patient had difficulty standing for any significant time or walking any significant distance. The patient presented conscious and fully oriented in no acute distress. There were no gross trophic changes noted. Sensation was grossly intact to bilateral lower extremity light touch. Strength testing revealed 5/5 (full strength) to bedside examination from the

- a. Quadriceps,
- b. Tibialis anterior,
- c. Gastrocnemius, and
- d. Extensor hallucis longus, bilaterally.

There was no significant ankle clonus to acute dorsiflexion of either foot. The patient was scheduled for an L3/4 decompression and fusion with revision lamino-foraminotomies at the left L4/5 and bilateral L5/S1. Plain radiographs demonstrated a grade 1 spondylolisthesis at L3/4. Magnetic resonance imaging (MRI) revealed L3/4 spinal stenosis, left L3/4 and bilateral L5/S1 intervertebral foraminal narrowing. The conus medularis was noted at the L1 vertebral body level. The patient had no other significant medical history or allergies to food or medicine. Preoperative screening blood chemistry and lab results were unremarkable. Anesthetic regimen for this case included volatile gases, narcotics, benzodiazepines, and neuromuscular blocking agents only to facilitate orotracheal intubation and surgical exposure. Throughout the case, anesthesia was maintained with 1 mac of sevoflurane. The surgical neurophysiology montage included bilateral ulnar and posterior tibial nerve SSEP and spontaneous electromyography (spEMG). EMG was collected from the vastus lateralis, tibialis anterior and abductor hallucis which reflected innervation from the L2-S1 spinal nerve roots, bilaterally. A Jackson frame was utilized for the procedure. Post-prone positioning baselines showed symmetrical and monitorable waveform latencies and amplitudes with clearly defined and consistent cortical and subcortical depolarization waveform morphologies (Figure 10 & 11).

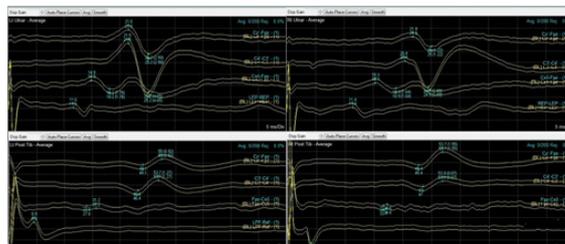


Figure 10 0953 Preoperative recording baselines showing symmetrical and monitorable waveform latencies and amplitudes with clearly defined and consistent cortical and subcortical depolarization waveforms.

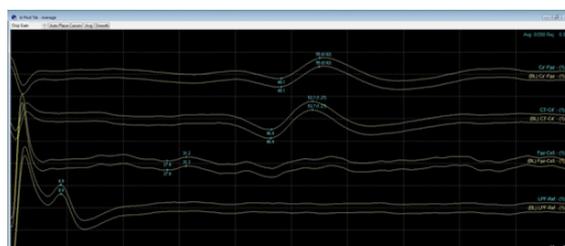


Figure 11 0953 Left preoperative post tibial SSEP showing symmetrical and monitorable waveform latencies and amplitudes with clearly defined and consistent cortical and subcortical depolarization waveforms.

Discussion

While the value of including SSEPs for Lumbar cases can be

debated based upon a lack of literature to support the practice, there is no question that the financial costs of a bad outcome can be astronomical. Hence, an important question to assess is how to value an “additional” modality in a patient already being monitored. Since SSEPs would most always be done as an additional modality in lumbar cases, what is its additional cost? If we look at national reimbursement databases, we see the added Medicare 2014 reimbursed rate for a lower extremity SSEP is \$27.42. {Ingenix database} From one of the most frequently cited legal axioms we find the “Learned Hand” Rule or simply the “Hand Rule” (1947) stipulates that if the cost of providing a good or service is less than the cost of damage from not providing the good or service, then the good or service must be provided. Simply put, the cost of added SSEPs in lumbar cases is far less than the cost of care for patients with a bad outcome! In another example, when we are clipping an aneurysm and a temporary clip is placed, if we lose the cortical potentials, we have about 8 minutes or less before there is any permanent neurological damage to the patient. Conversely, if monitoring a total hip and there is retraction of the iliac artery with resulting loss of the cortical potentials, there is a several (5-7) hour buffer. In the lumbar region, the danger here is that it is unknown how long the nerves can remain compressed before there is any permanent neurological damage. Subsequently, our “tools” can help offset the unknowns of “time” effect on underlying neural structures, and “time” may be the biggest enemy of iatrogenic injury. The present case shows an acute loss of both cortical and subcortical posterior tibial nerve (PTN) SSEPs during lumbar laminectomy presumably due to the severe nerve root compression at the L3 level just below the conus-medularis (Figure 1-4).⁸⁻¹¹ Thus, the importance of monitoring Post Tibial SSEPs on below-the-conus medularis procedures can be validated both by anecdotal evidence as well as cost/benefit review (Figure 12 & 13). The nerve roots are at risk when there is a severe lumbar spinal stenosis and the EMG may show no firing as in this case. Having a recording channel below the lesion as well as above the lesion, provides additional safety to the patient, the exclusive raison d’être of our profession. In the present case, the loss occurred during the exposure and the patient was relaxed with 0x4 twitches and had there not of been a below the lesion recording channel (pop fosa) we could not of been really sure the stimulus was working (Figure 1,3,4). We believe that this case documents the significant importance of SSEP monitoring along with EMG on all these lower lumbar cases (Figure 1,2,7-9).

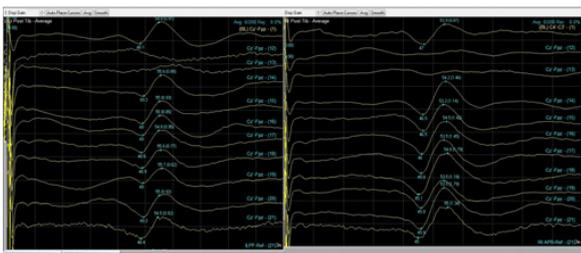


Figure 12 I202 Post Tibial SSEPs remain stable.

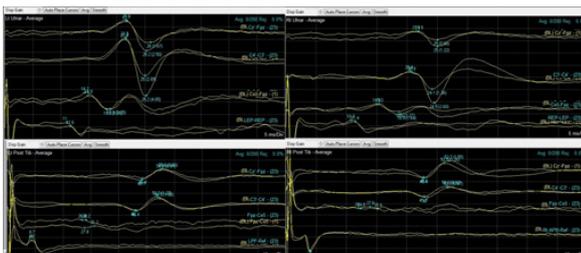


Figure 13 I221 Closing last traces all stable.

Conclusion

This case demonstrates the value of recording additional modalities even below and seemingly out of the normal anatomy of the surgical site. The marginal extra cost is minimal compared to the potential benefit. In this case, the loss occurred during the exposure while the patient was still relaxed (0x4 twitches) from initial anesthetics. Without the recording from the popliteal fossa, valuable time would have been lost trying to assess the viability of the stimulus. In spinal cases such as this, decision making time is minimal and the sooner we confidently provide appropriate details to the surgeon, the greater likelihood of a successful quality outcome. This case further points to the value of having skilled technologists watching the screen at all times. With surgeon self-guided systems, the value of using the additional modality of SSEPs has been somewhat lost. Having a multi-modality approach to neuro-monitoring has shown to be of greater value. The combination of multi-modality monitoring with skilled professionals interpreting the data, provides another method available to the surgeon for minimizing iatrogenic injury.

Acknowledgments

None.

Conflicts of interest

None.

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