Oscar Clinical Guideline: Intraoperative Neuromonitoring (CG045, Ver. 9)

# Intraoperative Neuromonitoring



## Summary

The Plan members undergoing certain high-risk surgeries may benefit from specialized monitoring, known as intraoperative neuromonitoring (IONM), to help identify and/or prevent damage to critical nerve, spine, and brain structures. IONM is a broad term that includes many different monitoring techniques where a technician or physician observes the function of at risk structures while a surgeon performs the desired procedure. Examples of IONM include brainstem auditory evoked potential (BAEP), visual evoked potential (VEP), electroencephalography (EEG), electromyography (EMG), motor evoked potential (MEP), or sensory evoked potential (SEP). Each of these techniques involves the use of stimuli to a certain part of the nervous system, and then the response is recorded to determine if that specific pathway is functioning properly. Not all surgical procedures require IONM. This guideline describes the criteria and medical necessity for intraoperative neuromonitoring specifically, and does not address non-operative neurologic testing.

## Definitions

"Intraoperative neuromonitoring (IONM)" refers to the use of various electrophysiologic methods of monitoring the function of the brain, spinal cord, and associated nerves during a surgical procedure.

- "Electroencephalography (EEG)" is used to monitor the electrical activity of the brain by using small electrodes placed on the scalp. This method can be used as its own form of IONM, but is also integral to detecting the brain response to stimuli in many of the other forms of IONM.

- "Brainstem auditory evoked potential (BAEP)" is a form of IONM used to monitor the function of the pathway from the auditory nerve to the brainstem. It is performed by delivering a loud, repetitive click noise inside the ear(s) and then recording the time it takes for brainstem electrical activity to change using electrodes placed on the scalp.
- "Visual evoked potential (VEP)" is a form of IONM used to monitor the function of the pathway from the eyes to the occipital lobe, the part of the brain responsible for vision. A light stimulus is shined in the eye(s) and the response is recorded with electrodes placed on the scalp.
- "Electromyography (EMG)" is a form of IONM used to monitor the function of skeletal muscles and the nerves controlling them. The nerve to a given muscle can be stimulated and the electrical activity of the target muscle is then measured.
- "Motor evoked potential (MEP)" is a form of IONM used to monitor the function of the motor cortex and outgoing motor tracts. The motor cortex is stimulated, either with direct electrical stimulation or with transcranial magnetic stimulation, and the resulting muscle activity is measured with small electrodes placed on the overlying skin.
- "Sensory/Somatosensory evoked potential (SEP/SSEP)" is a form of IONM used to monitor the function of the sensory cortex and incoming tracts. The target sensory region on the body is stimulated, and the resulting activity in the sensory cortex is recorded with electrodes placed on the scalp and/or spine.



## Medical Necessity Criteria for Clinical Review

### General Medical Necessity Criteria

The Plan requires ALL IONM procedures to meet ALL of the following general criteria to meet medical necessity:

1. Requested by the operating surgeon; *and*
2. The monitoring is performed by a physician (MD or DO) licensed in the state who is trained and experienced in IONM, a technologist under the supervision of a licensed physician, or a PhD-level neurophysiologist under the supervision of a licensed physician; *and*
3. The monitoring is interpreted in real time by a physician (MD or DO) licensed in the state for IONM, who is available either in-person or remotely, or a PhD-level neurophysiologist who is trained and experienced in IONM under the supervision of a licensed physician; *and*
4. The physician monitoring and interpreting is NOT the operating surgeon; *and*
5. The physician, PhD-level neurophysiologist, or licensed technician monitors no more than 3 cases simultaneously; *and*

6. The period of neuromonitoring includes intra-operative time only and should not exceed the documented operative period, which does not have to be continuous (e.g., can be 30 minutes of monitoring, with a break, and then another 30 minutes, which would be 1 hour total); *and*
7. Documentation of the monitoring includes ALL of the following:
    a. The necessity for IONM and justification for the technique(s) used; *and*
    b. The nerve(s) being tested/monitored; *and*
    c. The latencies at each testing point captured in software or explained narratively; *and*
    d. Interpretation of the results as normal or abnormal; *and*
    e. Any action or intervention taken as a result of the IONM.

Indication-Specific Criteria for Clinical Review

*Electroencephalography (EEG)*

When the General Medical Necessity Criteria outlined above are met, the Plan considers IONM using electroencephalogram (EEG) medically necessary when one of the following criteria are met:

1. Intracranial neurovascular surgeries, including but not limited to:
    a. AV malformation surgery; *or*
    b. Cerebral vascular aneurysm; *or*
2. Intracranial tumors:
    a. Supratentorial tumor resection; *or*
3. The following vascular surgeries:
    a. Arteriography requiring a temporary occlusion of the carotid artery; *or*
    b. Circulatory arrest requiring hypothermia (*note*: circulatory bypass surgeries such as CABG do not fall under this criteria); *or*
    c. Surgery of the thoracic aorta, aortic arch, aortic branching vessels, or carotid vessel surgeries when there is a risk of cerebral ischemia.

*Brainstem auditory evoked potential (BAEP)*

When the General Medical Necessity Criteria outlined above are met, the Plan considers IONM using brainstem auditory evoked potentials (BAEP) medically necessary for any one of the following indications:

1. Cerebral vascular surgery; *or*
2. Chiari malformation surgery; *or*
3. Microvascular cranial nerve decompression when performed via intracranial posterior fossa approach; *or*
4. Resection of chordoma; *or*
5. Odontoidectomy; *or*
6. Decompression of tumor from anterior brainstem or tumor above C2 in the spinal cord; *or*
7. Compressive brainstem tumor removal; *or*
8. Acoustic neuroma surgery

*Electromyography (EMG)*

When the General Medical Necessity Criteria outlined above are met, the Plan considers IONM using electromyography (EMG) medically necessary for any ONE of the following indications:

1. Procedures involving the facial nerve, including:
    a. Microvascular decompression for hemifacial spasm; *or*
    b. Acoustic neuroma surgery; *or*
    c. Congenital auricular lesions; *or*
    d. Skull base lesions; *or*
    e. Surgery for cholesteatoma; *or*
    f. Surgical removal of facial nerve neuroma; *or*
    g. Vestibular neurectomy for Meniere's disease; *or*
    h. Selective dorsal rhizotomy; *or*
2. Excision of neuromas involving ONE of the following:
    a. Oculomotor nerve (CN 3); *or*
    b. Trochlear nerve (CN 4); *or*
    c. Abducens nerve (CN 6); *or*
    d. Glossopharyngeal nerve (CN 9); *or*
    e. Spinal accessory (CN 11); *or*
    f. Hypoglossal nerve (CN 12); *or*
    g. Recurrent laryngeal nerve; *or*
    h. Superior laryngeal nerve; *or*
3. Intraoperative identification of ONE of the following nerves during high-risk skull base, posterior fossa, or brainstem surgeries:
    a. Oculomotor nerve (CN 3); *or*
    b. Trochlear nerve (CN 4); *or*
    c. Abducens nerve (CN 6); *or*
    d. Glossopharyngeal nerve (CN 9); *or*
    e. Spinal accessory (CN 11); *or*
    f. Hypoglossal nerve (CN 12)
4. Intraoperative monitoring of the recurrent laryngeal nerve during:
    a. Anterior neck surgery; *or*
    b. Thyroid or parathyroid surgery

*Sensory/Somatosensory Evoked Potential (SEP/SSEP)*

When the General Medical Necessity Criteria outlined above are met, the Plan considers IONM using SEP/SSEP with or without motor evoked potentials (MEP) medically necessary for any one of the following indications:

1. The following spinal surgeries:

    a. Surgery for scoliosis or other significant spinal deformity requiring traction of the spinal cord; *or*
    b. Removal of spinal cord tumors or tumors causing cord compression, including intramedullary tumors; *or*
    c. Traumatic injury to the spinal cord requiring surgery; *or*
    d. AV malformation of the spinal cord; *or*
    e. Cervical decompression if myelopathy is present; *or*
    f. Spinal corpectomy if myelopathy is present; *or*
    g. Tethered cord release surgery; *or*
2. The following intracranial surgeries:
    a. Chiari malformation surgery; *or*
    b. Cerebral vascular aneurysms; *or*
    c. Deep brain stimulation surgery, such as for Parkinson's disease; *or*
    d. Endolymphatic shunt for Meniere's disease; *or*
    e. Microvascular decompression of cranial nerves or removal of tumors involving cranial nerves; *or*
    f. Skull base or cavernous sinus tumor removal; *or*
    g. Oval or round window graft; *or*
    h. Resection of brain tissue near the primary motor cortex; *or*
    i. Resection of epileptogenic brain tissue or tumor; *or*
    j. Intracranial AV malformation surgery; *or*
    k. Surgery for movement disorders; *or*
    l. Vestibular section; *or*
3. The following vascular surgeries:
    a. Arteriography requiring a temporary occlusion of the carotid artery; *or*
    b. Circulatory arrest requiring hypothermia (*note*: circulatory bypass surgeries such as CABG do not fall under this criteria); *or*
    c. Distal aortic procedures where there is risk of spinal cord ischemia; *or*
    d. Surgery of the thoracic aorta, aortic arch, aortic branching vessels, or carotid vessel surgeries when there is risk of cerebral ischemia

*High-risk surgeries may also necessitate multiple IONM modalities. The specific IONM modalities used should be appropriate for the planned surgical intervention and are each subject to review.*

### Experimental or Investigational / Not Medically Necessary

IONM with the following procedures or indications have limited available data and/or have not shown a benefit in the available literature and are therefore considered experimental, investigational, or unproven:

- ANY procedure or indication not meeting the above inclusion criteria.
- IONM for pain management procedures, including but not limited to:

    - Epidural steroid injections
    - Radiofrequency ablation
    - Medial branch block
    - Facet joint injections
    - Selective nerve root block
- IONM with a technician alone (e.g., no physician), or automated IONM.
- ANY intraoperative spinal monitoring for surgeries below the level of the spinal cord, which typically ends at L1-L2 in most adult patients, with the exception of patients at risk for spinal cord injury due to spinal abnormality such as tethered cord or Chiari malformation.
- Intraoperative brainstem auditory evoked potentials (BAEP) for conductive hearing loss surgeries, including stapedectomy/stapedotomy, tympanoplasty, and ossicular reconstruction.
- Visual evoked potentials (VEP) for ANY intraoperative indication.
- Intraoperative motor evoked potentials (MEP) in ANY of the following situations:
    - When performed using transcranial magnetic stimulation
    - For spinal cord stimulator placement
    - When used without SSEP
- Intraoperative electromyography (EMG) for ANY of the following situations:
    - When used in combination with a complete neuromuscular blockade for anesthesia, as functioning neuromuscular junction is required for EMG monitoring
    - When performed as intraoperative surface EMG
    - Facial nerve (CN 7) monitoring for any of the following indications:
        - Cochlear implant surgery
        - Parotid gland surgery
        - Tympanoplasty without mastoidectomy
        - Maxillofacial surgery
    - Trigeminal nerve (CN 5) monitoring in:
        - Decompression
        - Neurectomy
        - Radiosurgery
        - Rhizotomy
    - Monitoring of peripheral nerves
    - Aortic aneurysm repair
    - Lower extremity joint surgeries, including but not limited to hip dysplasia surgery or hip replacement, knee arthroplasty, or total knee replacement.
    - Prostatectomy
    - Rectal cancer surgery
    - Rotator cuff surgery
    - Tibial neurectomy
    - Wrist arthroscopy
    - Dorsal column stimulator placement
    - Monitoring of the recurrent laryngeal nerve during anterior cervical spine procedures

    - Adjustment of vertical expandable prosthetic titanium rib (VEPTR)
    - Spinal procedures, including decompressive surgery, discectomy, fusion or other type of invasive spinal surgery.
    - Intracranial tumor surgeries; brainstem and motor-strip mapping with EMG
- Intraoperative SSEP for the following indications:
    - Monitoring the femoral nerve during transpsoas lumbar lateral interbody fusion
    - Monitoring the facial nerve during:
        - Submandibular gland excision
        - Parotid gland surgery
    - Lower extremity joint surgeries, including but not limited to hip dysplasia surgery or hip replacement, knee arthroplasty, or total knee replacement
    - Implantation of a spinal cord stimulator
    - Off-pump coronary artery bypass surgery
    - Thyroid surgery and parathyroid surgery
    - Cochlear implantation
    - Monitoring spinal injections (e.g., facet joint, interlaminar and transforaminal epidural)
    - Wrist arthroscopy repair or other surgical intervention for carpal tunnel or ulnar nerve entrapment
    - Prostate surgery
    - Pectus excavatum surgery
- IONM for uncomplicated single level spinal procedures, including:
    - ACDF (anterior cervical discectomy and fusion)
    - Lumbar fusion
    - Lumbar discectomy
    - Spinal decompressive surgery without myelopathy
    - Spinal corpectomy without myelopathy

Evidence

*Intraoperative Brainstem auditory evoked potentials (BAEP) for conductive hearing loss surgery:*

There is limited data demonstrating a potential benefit of BAEP for this indication. The data is primarily in the form of small, single institution, retrospective studies. One study by Hsu (2011), looked at 32 consecutive patients undergoing laser stapedotomy and determined that 23% of patients undergoing the procedure had intraoperative adjustments made. Another study by Selesnick et al in 1997 found a correlation between intraoperative BAEP and post-operative hearing outcomes. However, the size and number of existing studies limit conclusions regarding the clinical utility and benefit for this indication.

*Intraoperative Visual evoked potentials (VEP)*

VEPs have been historically used with variable success for the monitoring of lesions near the optic chiasm. However, the literature has shown that interpreting these signals may be difficult and subjective. A 2017 meta-analysis by Metwali et al demonstrated that intraoperative VEPs have a high predictive value but low sensitivity. Other studies have shown that VEPs are only feasible in 70-80% of patients. An

UpToDate review on the topic states, "Usefulness of VEP monitoring has not been established, and concerns have been raised that traditional stimulation methods do not produce responses that follow the pathway of useful vision. Also, VEPs are susceptible to effects from general anesthetics, and technical problems with stimulators make monitoring difficult." Further evidence regarding the clinical utility and potential benefit of intraoperative VEP is needed.

*Intraoperative Motor evoked potentials (MEP) with transcranial magnetic stimulation (TMS)*
Most procedures with MEP are performed using electrical, rather than magnetic stimulation. The existing literature for magnetic stimulation is limited to case reports and small retrospective series, and IONM using TMS has not yet received FDA approval.

*EMG when performed as intraoperative surface EMG*
Surface EMG has not yet been fully studied in the intraoperative setting and has not been approved for this indication, nor is it recommended by any consensus guidelines.

*Intraoperative EMG of the facial nerve for cochlear implant surgery*
Alzhrani et al (2016) evaluated rates of facial nerve palsy following cochlear implantation in 3403 surgeries, concluding that "Cochlear implantation entails only a minimal risk of FN palsy and that FN palsy is chiefly a transient problem". Other studies have found rates <1% of facial nerve palsy and felt that incidence was related to heating injury or viral reactivation. Given the rarity of this finding and the lack of data using IONM with EMG for this indication, further data is needed.

*Intraoperative EMG or SSEP of the facial nerve for parotid gland surgery*
A 2009 study by Grosheva et al prospectively looked at patients with EMG vs. no EMG to the facial nerve receiving parotid surgery, finding no difference in immediate post-operative outcome or permanent facial nerve function. EMG significantly reduced the duration of OR time for superficial parotidectomy. Another study by Shan et al in 2014 found no difference in the incidence of post-op facial paralysis in patients monitoring with EMG vs. those who were not, but found reduced surgical time (around 60 minutes) in patients with revision surgery who underwent IONM with EMG to the facial nerve. Further evidence is needed to confirm a potential benefit in clinical outcomes for this indication.

*EMG for intraoperative monitoring of the trigeminal nerve*
A 2004 study by Brock et al looked at IONM with EMG and BAEP for trigeminal neuralgia surgical decompression, and concluded "There were no correlations between the entity of the intraoperative EMG discharges and the postoperative facial and trigeminal function." Further evidence is needed to confirm if this technique should be used for this indication.

*EMG for intraoperative monitoring of peripheral nerves*

There has been no prospective or randomized data suggesting that IONM with EMG for surgical procedures involving peripheral nerves has any benefit or improvement in clinical outcomes. Further research is needed to define the role of EMG in this setting.

*EMG for intraoperative monitoring in any of the following settings has not been studied or there is not a clear, documented benefit in the literature:*

- *Aortic aneurysm repair*
- *Hip dysplasia surgery or hip replacement*: Data is limited to a small, 12-patient study showing a single patient where persistent postoperative muscle weakness may have been prevented.
- *Prostatectomy*: There are current clinical trials recruiting patients for intraoperative EMG with robot-assisted radical prostatectomy, however, the current evidence is limited for this indication.
- *Rectal cancer surgery:* Recent studies have begun examining intraoperative EMG for low anterior resection in rectal cancer (both robotic and non-robotic surgeries). Kauff et al conducted a randomized trial in 2016 (NEUROS) that looked at "Continuous intraoperative monitoring of pelvic autonomic nerves during TME to prevent urogenital and anorectal dysfunction in rectal cancer patients", however, the results have yet to be published.
- *Rotator cuff surgery*
- *Tibial neurectomy*
- *Wrist arthroscopy*

*EMG monitoring of the recurrent laryngeal nerve anterior cervical spine surgery:*

A study by Jellish et al (1999) looked at rates of adverse events involving the recurrent laryngeal nerve after anterior cervical spine surgeries, finding 38% experienced hoarseness and 15% had "severe" side effects. They found that a greater number of EMG activations was associated with adverse events; however, this study was limited by its non-randomized nature and lack of a control group to determine statistical differences. In 2009, Dimopoulos et al conducted a prospective study on 298 patients undergoing anterior cervical discectomy and fusion (ACDF) to evaluate the role of EMG in predicting post-operative outcomes. They found "Postoperative RLN injury occurred in 2.3% of our patients. The sensitivity of IEMG was 100%, the specificity 87%, the positive predictive value 16%, and its negative predictive value 97%." The low PPV and high NPV indicate that EMG may be a good tool at excluding injury to the RLN but is not a good predictor of injury in patients with positive EMG findings, limiting clinical utility. Another study by Chen et al (2014) looked at almost 2000 patients and found that only 0.16% of all patients undergoing anterior c-spine surgery experience long-term (>6 months) symptoms as a result of recurrent laryngeal injury, indicating that monitoring in this population may not be necessary. Further randomized, clinical evidence is required to determine the utility of this technique.

*EMG monitoring for spinal procedures*

A 2017 study by Ajiboye et al looked at almost 10,000 pedicle screw placements, finding no significant difference in outcomes between surgeries with EMG and those without. Another study by the same group looked at >26,000 patients undergoing anterior cervical spine surgeries, and concluded that "for

ACDFs, there is no difference in the risk of neurological injury with or without ION use." At the present time, there is insufficient evidence for EMG use in spinal procedures.

*IONM for adjustment of vertical expandable prosthetic titanium rib (VEPTR):*

A 2009 study by Skaggs et al examined 1736 VEPTR procedures for the efficacy of IONM. of the 1736 procedures, only 8 (0.5%) demonstrated any perioperative neurologic injury and only 1 of these 8 was permanent. The use of IONM in this setting should be further examined to determine whether there is a true clinical benefit to the procedure as the prevalence of injury during this surgery may be exceptionally low.

*SSEP for intraoperative monitoring of the femoral nerve during transpsoas lumbar lateral interbody fusion*

A study by Silverstein et al in 2014 looked at 41 consecutive procedures and found that 3/41 patients with post-operative symptoms after 5/41 had intraoperative SSEP findings, and no patients with normal SSEP findings experienced a deficit. Despite these findings, further data is needed to confirm any potential benefit for this indication.

*SSEP for intraoperative spinal cord monitoring for cervical, lumbar, or thoracic laminectomy or fusion*

As per 2019 systematic review by Martino et al., there were limitations in this study on the outcomes, sensitivity, and specificity of SSEP for degenerative cervical spinal stenosis. Furthermore, there were no RCTs available and the risk of bias were moderate to severe among prospective case studies, case studies, and retrospective case studies.

Overall, for lumbar, thoracic or thoracolumbar spinal procedures, there are limited studies available or outdated more than 10 years. Furthermore, as per 2020 narrative review, there are no prospective studies validating the efficacy of IONM. There are retrospective reviews supporting SEP/SSEP for cervical spinal procedures and cervical pathologies. As per 2023 Basu & Gohil, there were no prospective randomized control trials conducted for intraoperative neuromonitoring in spine surgery. Cervical spinal procedures without myelopathy is considered experimental, investigational, or unproven. The 2018 AANS/CNS Joint Section on Disorders of the Spine and Peripheral Nerves Updated Position Statement: Intraoperative Electrophysiological Monitoring states there is Level I evidence that IOM is a reliable diagnostic tool for assessment of spinal cord integrity during surgery. There is insufficient evidence (Level III) of a therapeutic benefit of IOM during spinal surgery. While IOM is generally regarded as integral to lateral spine surgery, there is insufficient evidence to support a therapeutic benefit.

As per 2017 American Association of Neurological Surgeons (AANS)/Congress of Neurological Surgeons (CNS), Multimodality intraoperative monitoring (MIOM), including somatosensory evoked potentials (SSEPs) and motor evoked potentials (MEPs) recording, during spinal cord/spinal column surgery is a reliable and valid diagnostic adjunct to assess spinal cord integrity and is recommended if utilized for this purpose. However, intraoperative monitoring for preventive or therapeutic benefit on improving postoperative neurological outcomes does not have sufficient evidence.

According to the American Association of Neuromuscular & Electrodiagnostic Medicine practice guidelines there is no proven benefit and American Clinical Neurophysiology Society does not have guidance on SSEP. In 2017, a retrospective case-control study of 121 patients who underwent spinal cord procedures with the combination of intraoperative neuromonitoring was found to have low sensitivity, false negatives, and poor positive predictive value of neurological injury.

*IONM for uncomplicated single level spinal procedures:*
Hayes, Inc., (2023) provides a D2 rating for intraoperative neuromonitoring (IONM) for detection and prevention of nerve damage due to lumbar spinal discectomy or fusion surgery in adult patients based on the available body of evidence reflecting very low quality and insufficient to draw evidence. Cole et al (2014) conducted a retrospective review of 85,640 patients undergoing single-level spinal procedures. 12.66% of the reviewed procedures utilized intraoperative neuromonitoring.
"Lumbar laminectomies had reduced 30-day neurological complication rate with neuromonitoring (0.0% vs. 1.18%, P=0.002). Neuromonitoring did not correlate with reduced intraoperative neurological complications in ACDFs (0.09% vs. 0.13%), lumbar fusions (0.32% vs. 0.58%), or lumbar discectomy (1.24% vs. 0.91%)". The authors concluded that "with intraoperative neurological monitoring in single-level procedures, neurological complications were decreased only among lumbar laminectomies. No difference was observed in ACDFs, lumbar fusions, or lumbar discectomies". Another retrospective study by Ajiboye et al (2017) looked at 15,395 patients undergoing an ACDF, where patients received IONM with "SSEPs only (48.7%), MMEPs only (5.3%), and combined SSEPs and MMEPs (46.1%). Neurological injuries occurred in 0.23% and 0.27% of patients with and without ION, respectively (P=0.84)." The authors concluded that "Use of ION does not further prevent the rate of postoperative neurological complications for ACDFs as compared with the cases without ION. The utility of routine ION for ACDFs is questionable."

## Applicable Billing Codes

| Table 1 | |
|---|---|
| CPT/HCPCS codes considered medically necessary if clinical criteria are met: | |
| *Code* | *Description* |
| 92652 | Auditory evoked potentials; for threshold estimation at multiple frequencies, with interpretation and report |
| 92653 | Auditory evoked potentials; neurodiagnostic, with interpretation and report |
| 95829 | Electrocorticogram at surgery (separate procedure) |
| 95865 | Needle measurement and recording of electrical activity of muscles of voice box |
| 95867 | Needle electromyography; cranial nerve supplied muscle(s), unilateral |

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| 95868 | Needle electromyography; cranial nerve supplied muscles, bilateral |
| 95925 | Short-latency somatosensory evoked potential study, stimulation of any/all peripheral nerves or skin sites, recording from the central nervous system; in upper limbs |
| 95926 | Short-latency somatosensory evoked potential study, stimulation of any/all peripheral nerves or skin sites, recording from the central nervous system; in lower limbs |
| 95927 | Short-latency somatosensory evoked potential study, stimulation of any/all peripheral nerves or skin sites, recording from the central nervous system; in upper and lower limbs |
| 95938 | Short-latency somatosensory evoked potential study, stimulation of any/all peripheral nerves or skin sites, recording from the central nervous system; in upper and lower limbs |
| 95940 | Continuous intraoperative neurophysiology monitoring in the operating room, one on one monitoring requiring personal attendance, each 15 minutes (List separately in addition to code for primary procedure) |
| 95941 | Continuous intraoperative neurophysiology monitoring, from outside the operating room (remote or nearby) or for monitoring of more than one case while in the operating room, per hour (List separately in addition to code for primary procedure) |
| 95955 | Electroencephalogram (EEG) during nonintracranial surgery (eg, carotid surgery) |
| 95999 | Unlisted neurological or neuromuscular diagnostic procedure<br>● Due to the broad nature of this code and lack of specificity in certain scenarios, clarification is provided below:<br>● When this code is billed for Train of four testing which allows measurement of the extent of the NMB, it is medically necessary. The measurement of the degree of neuromuscular blockade, which may be integral to the procedure, is not separately reimbursable. |
| G0453 | Continuous intraoperative neurophysiology monitoring, from outside the operating room (remote or nearby), per patient, (attention directed exclusively to one patient) each 15 minutes (list in addition to primary procedure) |
| Table 2 | |
| ICD-10 codes considered medically necessary with Table 1 codes if criteria are met: | |
| *Code* | *Description* |
| C70.1 | Malignant neoplasm of spinal meninges |
| C71.7 | Malignant neoplasm of brain stem |
| C71.9 | Malignant neoplasm of brain, unspecified |
| C72.0 | Malignant neoplasm of spinal cord |

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| C72.20 - C72.22 | Malignant neoplasm of olfactory nerve |
| C72.30 - C72.32 | Malignant neoplasm of optic nerve |
| C72.40 - C72.42 | Malignant neoplasm of acoustic nerve |
| C72.50 - C72.59 | Malignant neoplasm of other and unspecified cranial nerves |
| C73 | Malignant neoplasm of thyroid gland |
| C79.31 - C79.32 | Secondary malignant neoplasm of brain and cerebral meninges |
| D32.1 | Benign neoplasm of spinal meninges |
| D33.0 | Benign neoplasm of brain, supratentorial |
| D33.1 | Benign neoplasm of brain, infratentorial |
| D33.2 | Benign neoplasm of brain, unspecified |
| D33.3 | Benign neoplasm of cranial nerves |
| D33.4 | Benign neoplasm of spinal cord |
| D42.0 - D42.9 | Neoplasm of uncertain behavior of meninges |
| D43.0 - D43.9 | Neoplasm of uncertain behavior of brain and central nervous system |
| D49.6 | Neoplasm of unspecified behavior of brain |
| D49.7 | Neoplasm of unspecified behavior of endocrine glands and other parts of nervous system |
| E04.2 | Nontoxic multinodular goiter |
| I60.00 - I60.02 | Nontraumatic subarachnoid hemorrhage from carotid siphon and bifurcation |
| I60.10 - I60.12 | Nontraumatic subarachnoid hemorrhage from middle cerebral artery |
| I60.30 - I60.32 | Nontraumatic subarachnoid hemorrhage from posterior communicating artery |
| I60.4 | Nontraumatic subarachnoid hemorrhage from basilar artery |
| I60.50 - I60.52 | Nontraumatic subarachnoid hemorrhage from vertebral artery |
| I60.6 | Nontraumatic subarachnoid hemorrhage from other intracranial arteries |
| I60.7 | Nontraumatic subarachnoid hemorrhage from unspecified intracranial artery |
| I60.8 | Other nontraumatic subarachnoid hemorrhage |

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| I60.9 | Nontraumatic subarachnoid hemorrhage, unspecified |
| I65.21 - I65.29 | Occlusion and stenosis of carotid artery |
| I67.1 | Cerebral aneurysm, nonruptured |
| M41.00 - M41.08 | Infantile idiopathic scoliosis |
| M41.112 - M41.119 | Juvenile idiopathic scoliosis |
| M41.122 - M41.129 | Adolescent idiopathic scoliosis |
| M41.20 - M41.27 | Other idiopathic scoliosis |
| M41.30 - M41.35 | Thoracogenic scoliosis |
| M41.40 - M41.47 | Neuromuscular scoliosis |
| M41.50 - M41.57 | Other secondary scoliosis |
| M41.80 - M41.87 | Other forms of scoliosis |
| M41.9 | Scoliosis, unspecified |
| M43.21 | Fusion of spine, occipito-atlanto-axial region |
| M43.22 | Fusion of spine, cervical region |
| M43.23 | Fusion of spine, cervicothoracic region |
| M43.8X1 | Other specified deforming dorsopathies, occipito-atlanto-axial region |
| M43.8X2 | Other specified deforming dorsopathies, cervical region |
| M43.8X3 | Other specified deforming dorsopathies, cervicothoracic region |
| M47.11 | Other spondylosis with myelopathy, occipito-atlanto-axial region |
| M47.12 | Other spondylosis with myelopathy, cervical region |
| M47.13 | Other spondylosis with myelopathy, cervicothoracic region |
| M47.22 | Other spondylosis with radiculopathy, cervical region |
| M47.811 | Other spondylosis with myelopathy, occipito-atlanto-axial region |
| M47.812 | Other spondylosis with myelopathy, cervical region |
| M47.813 | Other spondylosis with myelopathy, cervicothoracic region |
| M47.892 | Other spondylosis, cervical region |

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| M48.02 | Spinal stenosis, cervical region |
| M50.00 | Cervical disc disorder with myelopathy, unspecified cervical region |
| M50.02 | Cervical disc disorder with myelopathy, mid-cervical region |
| M50.022 | Cervical disc disorder at C5-C6 level with myelopathy |
| M50.023 | Cervical disc disorder at C6-C7 level with myelopathy |
| M50.10 | Cervical disc disorder with radiculopathy, unspecified cervical region |
| M50.122 | Cervical disc disorder at C5-C6 level with radiculopathy |
| M50.123 | Cervical disc disorder at C6-C7 level with radiculopathy |
| M50.20 | Other cervical disc displacement, unspecified cervical region |
| M50.22 | Other cervical disc displacement, mid-cervical region |
| M50.221 | Other cervical disc displacement at C4-C5 level |
| M50.222 | Other cervical disc displacement at C5-C6 level |
| M50.223 | Other cervical disc displacement at C6-C7 level |
| M50.30 | Other cervical disc degeneration, unspecified cervical region |
| M50.322 | Other cervical disc degeneration at C5-C6 level |
| M50.323 | Other cervical disc degeneration at C6-C7 level |
| M50.820 | Other cervical disc disorders, mid-cervical region, unspecified level |
| M50.821 | Other cervical disc disorders at C4-C5 level |
| M50.822 | Other cervical disc disorders at C5-C6 level |
| M50.823 | Other cervical disc disorders at C6-C7 level |
| M50.83 | Other cervical disc disorders, cervicothoracic region |
| M54.12 | Radiculopathy, cervical region |
| Q04.4 | Septo-optic dysplasia of brain |
| Q04.5 | Megalencephaly |
| Q04.6 | Congenital cerebral cysts |
| Q04.8 | Other specified congenital malformations of brain |
| Q04.9 | Congenital malformation of brain, unspecified |

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| Q05.5 | Cervical spina bifida without hydrocephalus |
| Q05.6 | Thoracic spina bifida without hydrocephalus |
| Q05.7 | Lumbar spina bifida without hydrocephalus |
| Q05.8 | Sacral spina bifida without hydrocephalus |
| Q05.9 | Spina bifida, unspecified |
| Q06.1 | Hypoplasia and dysplasia of spinal cord |
| Q06.3 | Other congenital cauda equina malformations |
| Q06.8 | Other specified congenital malformations of spinal cord |
| Q06.9 | Congenital malformation of spinal cord, unspecified |
| Q28.0 | Arteriovenous malformation of precerebral vessels |
| Q28.2 | Arteriovenous malformation of cerebral vessels |
| Q28.3 | Other malformations of cerebral vessels |
| Q67.5 | Congenital deformity of spine |
| Q76.3 | Congenital scoliosis due to congenital bony malformation |
| Q76.411 | Congenital kyphosis, occipito-atlanto-axial region |
| Q76.412 | Congenital kyphosis, cervical region |
| Q76.413 | Congenital kyphosis, cervicothoracic region |
| Q76.49 | Other congenital malformations of spine, not associated with scoliosis |
| S14.111A - S14.111S | Complete lesion at C1 level of cervical spinal cord |
| S14.121A - S14.129S | Central cord syndrome of cervical spinal cord |
| S14.131A - S14.139S | Anterior cord syndrome of cervical spinal cord |
| S14.141A - S14.149S | Brown-Sequard syndrome of cervical spinal cord |
| S14.151A - S14.159S | Other incomplete lesions of cervical spinal cord |
| S14.2xxA - S14.2xxS | Injury of nerve root of cervical spine |

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|---|---|
| S24.111A - S24.119S | Complete lesion of thoracic spinal cord |
| S24.131A - S24.139S | Anterior cord syndrome of thoracic spinal cord |
| S24.141A - S24.149S | Brown-Sequard syndrome of thoracic spinal cord |
| S24.151A - S24.159S | Other incomplete lesions of thoracic spinal cord |
| S24.2xxA S24.2xxS | Injury of nerve root of thoracic spine |
| S34.111A - S34.119S | Complete lesion of lumbar spinal cord |
| S34.121A - S34.129S | Incomplete lesion of lumbar spinal cord |
| S34.21xA - S34.21xS | Injury of nerve root of lumbar spine |

| Table 3 | |
|---|---|
| CPT/HCPCS codes not considered medically necessary or considered experimental or investigational: | |
| *Code* | *Description* |
| 51784 | Electromyography studies (EMG) of anal or urethral sphincter, other than needle, any technique |
| 51785 | Needle electromyography studies (EMG) of anal or urethral sphincter, any technique |
| 95860 | Needle electromyography; 1 extremity with or without related paraspinal areas |
| 95861 | Needle measurement and recording of electrical activity of muscles of arms or legs |
| 95863 | Needle electromyography; 3 extremities with or without related paraspinal areas |
| 95864 | Needle electromyography; 4 extremities with or without related paraspinal areas |
| 95869 | Needle electromyography; thoracic paraspinal muscles (excluding T1 or T12) |

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| 95870 | Needle electromyography; limited study of muscles in 1 extremity or non-limb (axial) muscles (unilateral or bilateral), other than thoracic paraspinal, cranial nerve supplied muscles, or sphincters |
| 95928 | Central motor evoked potential study (transcranial motor stimulation); upper limbs |
| 95929 | Central motor evoked potential study (transcranial motor stimulation); lower limbs |
| 95930 | Visual evoked potential (VEP) checkerboard or flash testing, central nervous system except glaucoma, with interpretation and report |
| 95939 | Central motor evoked potential study (transcranial motor stimulation); in upper and lower limbs |
| 0333T | Visual evoked potential, screening of visual acuity, automated with report |
| S3900 | Surface electromyography (EMG) |

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