

Best Practice Guidelines

Response to Intraoperative Neuromonitoring Events in High-risk Spinal Deformity Surgery

IONM Alert* ELEVATE MAP

If signals return: Refer to Stable Spine Checklist‡

If signals DO NOT return: 1. Gain attention of room 2. Optimize systemically 3. Determine pattern/timing of signal change 4. Proceed below

Stage 2 Alert

During/Immediately After

Osteotomy/Destabilization

Stage 1 Alert[§] Prior to Osteotomy/ Destabilization Stage 1a Alert Stage 1b Alert Post-incision Pre-incision

CONSIDER EACH OF THE FOLLOWING:

- Reduce/remove traction unless necessary for spinal stability
- Adjust patient positioning
- Flip back supine and reassess signals
- WUT(s)
- Abort surgery and return at a later date

Potential Contributing Factors

- Poor/absent baseline signals related to preoperative neurological status
- Patient positioning (e.g. spinal cord impingement due to prone positioning)
- Spinal instability

CONSIDER EACH OF

- THE FOLLOWING: Reduce/remove traction unless necessary for
- Adjust patient positioning
- Evaluate screws (palpation. x-ray, intraoperative CT) and remove as indicated
- Assess for dural compression/tension (e.g. possible pedicle fracture impinging on neural elements) and decompress as indicated (e.g. laminectomy, apical pediculectomy)
- If available, perform DSCM with DNEPs to assess level of dysfunction
- WUT(s)

Potential Contributing Factors

- latrogenic factors
- Patient positioning (e.g. spinal cord impingement due to prone positioning)
- Spinal instability

- spinal stability
- Stabilize with temporary rod(s)/fixation
 - Assess for dural compression/tension and decompress as indicated (e.g. laminectomy, apical pediculectomy, 3CO)
 - If available, perform DSCM with DNEPs to assess level of dysfunction

Stage 2a Alert

Posterior Column Osteotomy

CONSIDER EACH OF

THE FOLLOWING:

Reduce/remove traction

unless necessary for

spinal stability

- WUT(s)
- In kyphoscoliosis, posterior column shortening (e.g. convex temporary rod. hook-rod construct)
- In lordoscoliosis, dorsal decompression

Stage 2b Alert 3-Column Osteotomy

CONSIDER EACH OF THE FOLLOWING:

- Reduce/remove traction unless necessary for spinal stability
- Ensure adequate stabilization with appropriate temporary rod(s)/fixation
- Evaluate for subluxation via inspection of dura and/or intraoperative imaging
- Assess for dural compression/tension circumferentially and decompress as indicated (e.g. laminectomy, apical pediculectomy, 3CO)
- If available, perform DSCM with DNEPs to assess level of dysfunction
- WUT(s)
- In kyphoscoliosis, posterior column shortening (e.g. convex temporary rod, hookrod construct) ± anterior column lengthening to prevent/manage buckling
- In lordoscoliosis, dorsal decompression ± anterior column shortening

CONSIDER EACH OF THE FOLLOWING:

Stage 3 Alert

After Osteotomy Closure/

During Correction/During Closure

- Reduce/remove traction unless necessary for spinal stability
- Evaluate for subluxation via inspection of dura and/ or intraoperative imaging; restore alignment as indicated
- Reverse corrective maneuver (e.g. reopen osteotomy site, release distraction/ compression, restore original alignment)
- Assess for dural compression/tension circumferentially and decompress as indicated (e.g. laminectomy, apical pediculectomy, 3CO)
- If available, perform DSCM with DNEPs to assess level of dysfunction
- WUT(s)
- In kyphoscoliosis, posterior column shortening (e.g. convex temporary rod, hook-rod construct) ± anterior column lengthening to prevent/manage buckling
- In lordoscoliosis, dorsal decompression ± anterior column shortening

Stage 4 Neurological Deficit[†]

Stage 4a In Operating Room

If possible, consider end-ofcase WUT or neurological exam prior to leaving OR

CONSIDER EACH OF THE FOLLOWING:

- Optimize systemically:
- Elevate MAP
- Reverse anemia
- Intraoperative imaging prior to exploration
- Re-explore and perform possible decompression. hematoma evacuation, shortening, DSCM if exam is disparate with IONM
- IV steroids

Stage 4b In Intensive Care Unit

Consider performing frequent neurological examinations as the patient recovers

CONSIDER EACH OF THE FOLLOWING:

- Optimize systemically:
- Elevate MAP
- Reverse anemia
- If loss is progressive. ascending, or complete, return to OR emergently for exploration and possible decompression, hematoma evacuation, shortening, DSCM
- If loss is incomplete, stable, or resolving, proceed with advanced imaging prior to exploration
- Maintain elevated MAP goal for 48-72 hours
- IV steroids

ALWAYS CONSIDER CONSULTATION WITH A COLLEAGUE PRIOR TO PROCEEDING

Reference: Lenke, L., Fano, A., Iyer, R., Matsumoto, H., Sucato, D., Samdani, A., Smith, J., Gupta, M., Kelly, M., Kim, H.J., Sciubba, D., Cho, S., Polly, D., Boachie-Adjei, O., Lewis, S., Angevine, P., Vitale, M. Development of consensusbased best practice guidelines for response to intraoperative neuromonitoring events in high-risk spinal deformity surgery. Spine Deformity. In press 5 February 2022. DOI: 10.1007/s43390-022-00485-w

*IONM alert: signal change (MEP/SSEP) that meets warning criteria per institution <u>and</u> signifies spinal cord dysfunction, not nerve root injury

†Postoperative neurologic deficit: significant change from expected based on preoperative neurologic status/IONM data or less than anti-gravity strength in one or both lower extremities when full strength is expected

‡Stable Spine Checklist: Vitale et al., Spine Deformity 2014 \$Classification adapted from: Jarvis et al., Spine 2013

IONM = intraoperative neuromonitoring; MAP = mean arterial pressure; WUT = wake-up test; CT = computed tomography; DSCM = dynamic spinal cord mapping; DNEP = descending neurogenic evoked potential; 3CO = 3-column osteotomy; OR = operating room; IV = intravenous