

# Efficacy and pitfalls of intra-operative spinal cord monitoring with Br-MsEP

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# Purpose

- To prevent paralysis after spine and spinal cord surgeries, It's necessary to perform intra-operative spinal cord monitoring.
- To assess both motor and sensory pathway, multimodality monitoring makes sense.
- Actually, multimodality monitoring is difficult regarding problems in manpower and/or facilities.
- What is efficacy and pitfalls on intra-operative spinal cord monitoring accomplished with only Muscle-evoked potential after electrical stimulation to the brain (Br-MsEP)

# Materials

- **44 cases**
  - 12 female and 32 male
  - Mean age 61.6 years
- **Diagnosis**
  - **Cervical spondylosis (CS)** **9 cases**
  - **Ossification of the longitudinal ligament (OPLL) in the cervical spine** **8 cases**
  - **Cervical disc herniation (CDH)** **5 cases**
  - **Cervical spondylotic amyotrophy (CSA)** **3 cases**
  - **Spinal cord tumor** **13 cases**
    - **Intra-medullary** **1 case**
    - **Intra-dural extradural** **12 cases**
  - **Others** **6 cases**
    - **Ossification of the ligamentum flavum (2 cases), Atrantaxial subluxation, Syringomyelia, Arachnoidal cyst, Fracture dislocation in the lumbar spine**

# Methods

## Intra-operative spinal cord monitoring

- Muscle-evoked potential after electrical stimulation to the brain (Br-MsEP)
    - Stimulation and Recording procedure
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Stimulus count	4~5 times
Stimulus interval	2ms
Stimulus voltage	450~630V
Recording time	100ms
Summation	20 times
Frequency	0.7~0.9Hz
Filtering	20~500Hz

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Recommended conditions by  
The Japanese Society for Spine Surgery and Related research (JSSR)

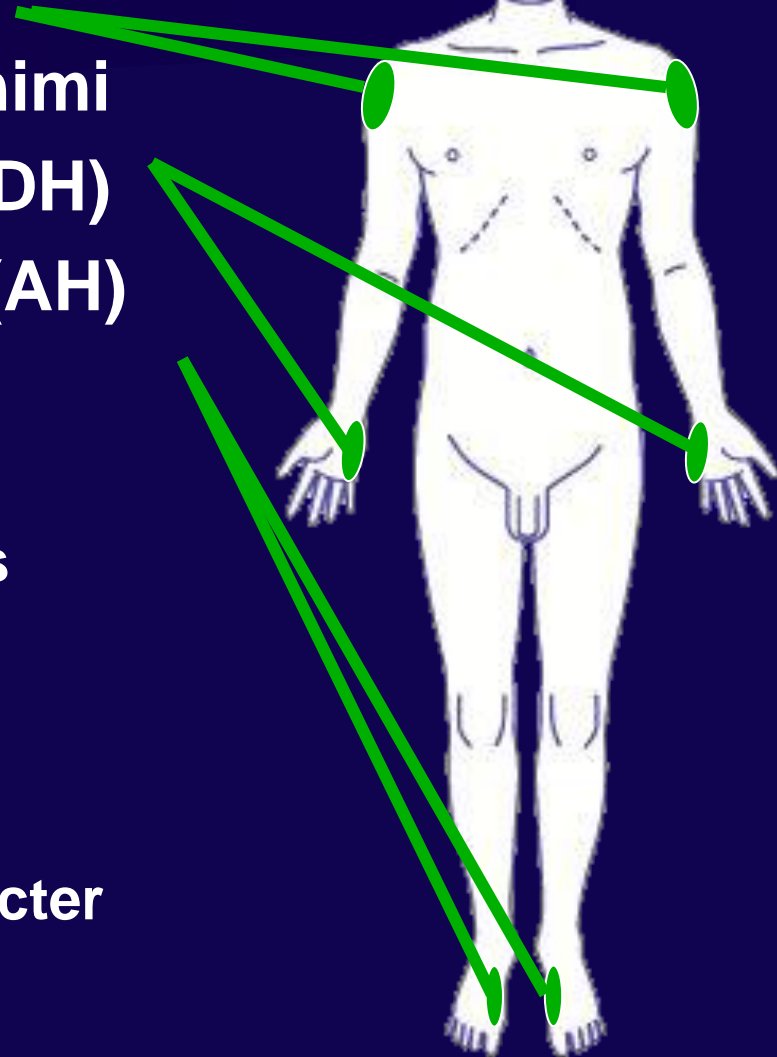
stimulation

## ■ Monitoring muscles

- Deltoid muscle
- Abductor digiti minimi (ADH)
- Abductor hallucis (AH)
- Other muscles
  - Biceps brachii
  - Quadriceps femoris
  - Biceps femoris
  - Tibialis anterior
  - Gastrocnemius
  - External anal sphincter

## ■ Warning sign

- More than 70% amplitude loss



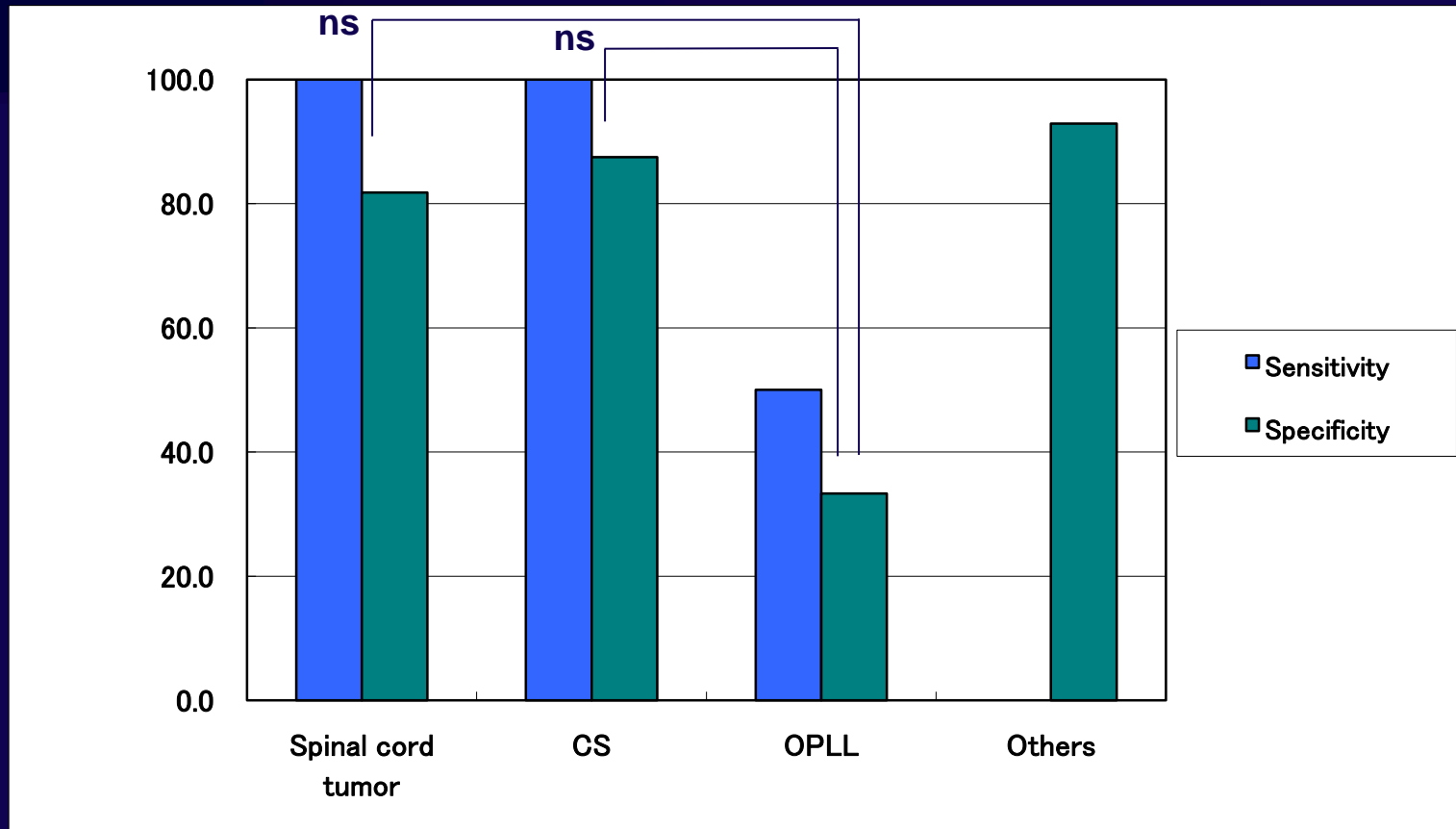
# Evaluations

- Rate of recordable muscles
- Incidence rate of motor paralysis
- Clinical findings of cases with motor paralysis
  - Pre-operative diagnosis
  - Type of motor paralysis
  - Clinical course of motor paralysis
- Sensitivity and specificity
  - Each pre-operative diagnosis

# Results

- **The number of monitored muscles (rate)**
  - 219/236 muscles (92.8%)
- **Incidence (rate) of post-operative paralysis**
  - 5 cases (11.4%)
    - **All cases**
      - Transient incomplete monoplegia of upper extremity
    - **Two of 5 cases**
      - Just after surgery
      - Spinal cord tumor
      - “true positive”
    - **Three of 5 cases**
      - A few days after surgery
      - OPLL; 2 cases and CS; 1 case
      - “false negative” 2 cases, “true positive” 1 case

- Sensitivity 80.0% , Specificity 79.5%
- Sensitivity and Specificity for each disease



A trend that sensitivity and specificity in OPLL were lower than spinal cord tumor and CS.

# Discussion

## Br-MsEP

- ✓ Advent in the mid-1990s
- ✓ Assess the functional integrity of motor pathways during intra-operative spine and spinal cord surgery
- ✓ The most appropriate monitor the functional integrity of motor pathways

### Merits

- Less invasive
- Sensitive monitor
- Multi-channel

### Demerits

- Anesthesia-sensitive
- Impossible to monitor dorsal funiculus

Incidence of post-operative motor paralysis: 5 cases

- Paralysis just after surgery: 2 cases
  - True positive
- Paralysis in a few days after surgery: 3 cases
  - false negative 2 cases, true positive 1 case



**Br-MsEP is an appropriate monitor for motor paralysis just after surgery**



- Br-MsEP have great promise for intra-operative injury
- Post-operative injury, such as C5 palsy, couldn't be detected on Br-MsEP

D. Fan, *et al. Spine* 2002

N. Tanaka, *et al. Spine* 2006

# Br-MsEP

## as intra-operative monitoring

### Efficacy

- Less invasive
- Sensitive monitor
- Multi-Channel
- Suitable for spinal cord tumor, cervical spondylosis (CS)
- Capable of monitoring paralysis just after surgery

### Pitfalls

- Anesthesia-sensitive
- Impossible to monitor dorsal funiculus
- NOT suitable for ossification of the posterior longitudinal ligament (OPLL)

# Conclusion

- Intra-operative spinal cord monitoring in 44 cases were recorded using Br-MsEP.
- There was a trend that sensitivity and specificity in OPLL were lower than spinal cord tumor and CS.
- Br-MsEP is a appropriate monitor for motor paralysis just after surgery.