

# Acute Neurological Deficits in Instrumented Pediatric Cervical Spine Fusions

Bram P. Verhofste, MD<sup>1</sup>; Michael P. Glotzbecker, MD<sup>2</sup>; M. Timothy Hresko, MD<sup>2</sup>; Patricia Miller, MS<sup>1</sup>; Craig M. Birch, MD<sup>1</sup>; Michael Troy, BS<sup>1</sup>; Nora P. O'Neill, BA<sup>1</sup>; Lawrence I. Karlin, MD<sup>2</sup>; John B. Emans, MD<sup>2</sup>; Mark R. Proctor, MD<sup>2</sup>; Daniel J. Hedequist, MD<sup>2</sup>

<sup>1</sup>Boston Children's Hospital, Boston, MA; <sup>2</sup>Boston Children's Hospital, Harvard Medical School, Boston, MA

**Recipient: Bram P. Verhofste, MD**

**Introduction:** Pediatric cervical deformity is a complex disorder often associated with neurological deterioration requiring cervical spine fusion. However, little literature exists on new perioperative neurologic deficits in children. This study describes new perioperative neurologic deficits in pediatric cervical spine instrumentation and fusion.

**Methods:** A single-center review of pediatric cervical spine instrumentation and fusion during 2002-2018 was performed. Demographics, surgical characteristics, and neurological complications were recorded. Perioperative neurologic deficits were defined as the deterioration of preexisting neurologic function or the appearance of new neurologic symptoms.

**Results:** A total of 184 cases (160 patients, 57% male) with an average age of 12.6 ±5.30 years were included. Instability (n=63) and deformity (n=41) were the most frequent indications. Syndromes were present in 39% (n=71). Eighty-seven (48%) children presented with preoperative neurologic deficits (16 sensory, 16 motor, and 55 combined deficits). A total of 178 (96.7%) cases improved or remained neurologically stable. New

Case	Age (years) Sex	Etiology	Presentation	Neurologic Complication	Neurologic Outcome
1	7.6 F	Jarcho-Levin syndrome	Myelopathy	Quadriparesis	Progressive improvement of strength within 3 months
2	18.7 F	Down syndrome	Myelopathy	Left hemiparesis	Full recovery within 6 months
3	13.9 F	NF 1	Myelopathy	Quadriplegia	Death secondary to a trachea-aortic fistula
4	13.6 F	Tumor	Neck mass	Right hemiparesis	Full recovery within 3 months
5	13.0 M	Noonan-like, uncharacterized syndrome	Asymptomatic	Left hemiplegia	Persistent left hemiplegia
6	14.4 M	NF 1	Pain and paresthesia's	Right hemiparesis	Full recovery to within 6 months

Table 1: M, male; F, female; NF, neurofibromatosis.

**Table 1. Case Descriptions of Neurologic Deficits**

neurologic deficits occurred in six (3.3%) cases: three hemiparesis, one hemiplegia, one quadriplegia, and one quadriparesis (Table 1, Figure 1). Preoperative neurologic compromise was seen in four (67%) of these new deficits (three myelopathy, one sensory deficit) and five had complex syndromes. Three new deficits were anticipated with intraoperative neuromonitoring changes (p=0.025). Three (50.0%) patients recovered within 6 months and the child with quadriparesis is expected to make a complete recovery. Hemiplegia persisted in one patient and one child died due a complication related to the tracheostomy. No association was found between etiology (p=0.46), preoperative neurological symptoms (p=0.65), age (p=0.56), halo (p=0.41), EBL (p=0.09), levels fused (p=0.09), approach (p=0.07), or fusion location (p=0.37).



**Figure 1.** Case 3: Lateral MRI of a 13-year-old female with neurofibromatosis, severe cervical kyphosis (85°), and myelopathy (intrinsic hand weakness and myelopathic reflexes). A combined anterior-posterior occiput to T4 fusion was performed.

**Conclusion:** An improvement of the preexisting neurologic deficit or stabilization of neurologic function was seen in 96.7% of children after cervical spine fusion. New or progressive neurologic deficits occurred in 3.3% of the patients and occurred more frequently in children with preoperative neurologic symptoms. Patients with syndromic diagnoses are at higher risk to develop a deficit, likely due to the severity of deformity and the degree of cervical instability. Long-term outcomes of new neurologic deficits are favorable and 50% experienced complete neurologic recovery within 6 months.

*The Mission of the AAP Section on Orthopedics is to foster the health of children through the AAP by mentorship, education, advocacy, and research. The AAP Section on Orthopedics has also collaborated with POSNA in joint leadership meetings creating shared strategic plans. Through these shared visions and collaborations our organizations have collectively partnered with the 50,000 pediatricians within the AAP to advocate for injured and ill children throughout the world.*