MCMASTER CHILDREN’S HOSPITAL GUIDELINES FOR CLEARANCE OF PEDIATRIC CERVICAL SPINE AFTER TRAUMA

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Table of Contents

1 Title Page
2 Algorithm for cervical spine clearance in children after trauma
3 Written Recommendations for pediatric c-spine clearance
4 Appendix A: Reference neurosurgical literature
5 Appendix B: Overview of Nexus and Canadian C-spine Rule
6 Appendix B: Nexus summary and application in children
7 Appendix B: CCR summary
8 References
MCMASTER CERVICAL SPINE CLEARANCE PROTOCOL IN CHILDREN AFTER TRAUMA (in accordance with National Pediatric C-Spine Evaluation Pathway 2009)

Unable to assess, i.e. non-communicative or < 3 yrs old

Meets ALL of NEXUS/CCR criteria below:
1. Normal level of alertness
2. No evidence of intoxication, no sedating drugs
3. No posterior midline cervical-spine tenderness
4. No focal neurologic deficit
5. No painful distracting injuries.
6. No dangerous mechanism of injury - see list below *
7. Moves head in flex/ ex and 45 degrees to both sides without pain

Abnormal

Neurosurgery Consult

C SPINE X-RAYS: 3 VIEWS **

Inadequate or child requires other CT (see below) #

CT C-SPINE (see below) #

Normal

Neurological Exam

Limited

Neurosurgery Consult

Abnormal

C SPINES CLEAR D/C collar

Normal, but persistent neck pain

Re-examine: Check Range of Motion

Normal

Consider Flexion/ Extension X-Rays

Normal

Neurosurgery Consult

Inadequate

Leave in collar +, f/u neurosurgery clinic in 1 week

C SPINES CLEAR D/C collar

* A dangerous mechanism is considered to be a fall from an elevation ≥3 ft or 5 stairs; an axial load to the head (e.g., diving); a motor vehicle collision at high speed (>100 km/hr) or with rollover or ejection; a collision involving a motorized recreational vehicle; or a bicycle collision. A low-risk factor that allows for safe assessment of range of motion includes simple rear-end collision, sitting up in ER, or ambulatory at any time.

+ Switch to long-term cervical spine collar such as Aspen or Philadelphia collar ASAP.

** 3 views of c-spine are adequate if C1-T1 are visualized and open-mouth odontoid view visualizes dens and C1 lateral masses

# CT of cervical spine (occiput to T1) is performed if ANY ONE of 3 views of c-spine are inadequate or 3 views cannot be obtained, or if child is already undergoing CT of other body parts.

## Films must be read by staff radiologist within appropriate timeline.
1. As per NEXUS and CCR, child must be conscious, awake, alert, and communicative > 3 years old to be assessed for C-spine clearance by trauma team. No drugs/ intoxication.
   * If child is <3 yrs, crying/ fearful/inconsolable or with distracting injury, unconscious, or presents with motor or sensory neurological deficit, may proceed directly to neuroimaging (C spine X-rays if hemodynamically unstable, CT C spine if stable) and pediatric neurosurgery consult.
2. If child is stable, conscious and communicative and no high-risk/ dangerous mechanism or distracting injury as per CCR, TTL may assess for midline posterior c-spine tenderness and ROM of c-spine. If painless and full, as per CCR, and neurologically intact, TTL may clear without X-rays. If child is crying, moving all limbs and moving neck, they may have "cleared themselves", in absence of painful distracting injury.
   *If dangerous or high risk mechanism of injury, torticollis in small child, neurological deficit or midline tenderness, place child in Aspen collar, and proceed with neuroimaging and pediatric neurosurgery consult.
3. If child has neurological deficit, spinal shock or evidence on neuroimaging of c-spine injury, child must be immobilized with c-spine collar and standard c-spine precautions used to transport child to PICU.
   *All children with c-spine injury should be managed in PICU, for consideration of traction, sedation for MRI and for aggressive fluid management to maintain CPP, MAP and BP for spinal cord perfusion.
4. For children who are not awake, cooperative or conscious, or for infants < 2 yrs, removal of C-spine collar will require CT C-spine to rule out bony injury, and MRI to rule out ligamentous injury: also pediatric neurosurgery consult. All children, especially those <3 yrs, involved in high-risk mechanism of injury warranting CT HEAD should preferentially get CT C-Spine rather than x-rays; for infants, O-C2 mandatory.
5. All efforts should be made by TTL or ER MD to clear trauma patients at low risk for C-spine injury, as defined by Nexus and CCR. Any patient at higher risk for C-spine injury, as defined above in bold, warrants pediatric neurosurgery consult.
APPENDIX A: C-Spine clearance in children: Neurosurgical Guidelines

**Cervical spine clearance after trauma in children**

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**Object.** Currently, no diagnostic or procedural standards exist for clearing the cervical spine in children after trauma. The purpose of this study was to determine if reeducation of nonneurosurgical personnel and initiation of a new protocol based on the National Emergency X-Radiography Utilization Study criteria could safely increase the number of pediatric cervical spines cleared of suspected injury without a neurosurgical consultation.

**Methods.** Data regarding cervical spine clearance in children (ages 0–18 years) after trauma protocol activation at Primary Children’s Medical Center between 2001 and 2005 were collected and reviewed. Radiographic and clinical methods of clearing the cervical spine as well as the type and management of injuries were determined for two time frames. Between 2001 and 2003, 95% of 936 cervical spines were cleared of suspected injury by the neurosurgical service. Twenty-one ligamentous injuries (2.2%) and 12 fracture–dislocations (1.3%) were detected, with five patients requiring surgical stabilization (0.5%). Between January 2004 and July 2005, 507 (68%) of 746 cervical spines were cleared by nonneurosurgical personnel. Six ligamentous injuries (0.8%) and 10 fracture–dislocations (1.3%) were identified, with three patients (0.4%) requiring surgical stabilization. No late injuries were detected in either period.

**Conclusions.** The protocol used has been effective in enabling detection of cervical spine injuries in children after trauma, with the new protocol increasing by more than 60% the number of cervical spines cleared by nonneurosurgical personnel. Reeducation with establishment of the new protocols can safely facilitate clearance of the cervical spine by nonneurosurgical personnel after trauma.
APPENDIX B: Decision rules to guide C-Spine x-ray application in trauma patients: CCR and NEXUS

The Canadian C-Spine Rule versus the NEXUS Low-Risk Criteria in Patients with Trauma

Ian G. Stiell, M.D., M.Sc., Catherine M. Clement, R.N.,
R. Douglas McKnight, M.D., Robert Brison, M.D., M.P.H.,
Michael J. Schull, M.D., M.Sc., Brian H. Rowe, M.D., M.Sc.,
James R. Worthington, M.B., B.S., Mary A. Eisenhauer, M.D., Daniel Cass, M.D.,
Gary Greenberg, M.D., Iain MacPhail, M.D., M.H.Sc., Jonathan Dreyer, M.D.,
Jacques S. Lee, M.D., Glen Bandiera, M.D., Mark Reardon, M.D.,
Brian Holroyd, M.D., Howard Lesiuk, M.D., and George A. Wells, Ph.D.

**background**
The Canadian C-Spine (cervical-spine) Rule (CCR) and the National Emergency X-Radiography Utilization Study (NEXUS) Low-Risk Criteria (NLC) are decision rules to guide the use of cervical-spine radiography in patients with trauma. It is unclear how the two decision rules compare in terms of clinical performance.

**methods**
We conducted a prospective cohort study in nine Canadian emergency departments comparing the CCR and NLC as applied to alert patients with trauma who were in stable condition. The CCR and NLC were interpreted by 394 physicians for patients before radiography.

**results**
Among the 8283 patients, 169 (2.0 percent) had clinically important cervical-spine injuries. In 845 (10.2 percent) of the patients, physicians did not evaluate range of motion as required by the CCR algorithm. In analyses that excluded these indeterminate cases, the CCR was more sensitive than the NLC (99.4 percent vs. 90.7 percent, P<0.001) and more specific (45.1 percent vs. 36.8 percent, P<0.001) for injury, and its use would have resulted in lower radiography rates (55.9 percent vs. 66.6 percent, P<0.001). In secondary analyses that included all patients, the sensitivity and specificity of CCR, assuming that the indeterminate cases were all positive, were 99.4 percent and 40.4 percent, respectively (P<0.001 for both comparisons with the NLC). Assuming that the CCR was negative for all indeterminate cases, these rates were 95.3 percent (P=0.09 for the comparison with the NLC) and 50.7 percent (P=0.001). The CCR would have missed 1 patient and the NLC would have missed 16 patients with important injuries.

**conclusions**
For alert patients with trauma who are in stable condition, the CCR is superior to the NLC with respect to sensitivity and specificity for cervical-spine injury, and its use would result in reduced rates of radiography.
The NEXUS Low-Risk Criteria.
Cervical-spine radiography is indicated for patients with trauma unless they meet all of the following criteria:
1. No posterior midline cervical-spine tenderness
2. No evidence of intoxication
3. A normal level of alertness
4. No focal neurologic deficit, and
5. No painful distracting injuries.


A Prospective Multicenter Study of Cervical Spine Injury in Children
Peter Viccellio, MD*; Harold Simon, MD‡; Barry D. Pressman, MD§; Manish N. Shah, MDi;
William R. Mower, MD, PhD¶; and Jerome R. Hoffman, MA, MD¶, for the NEXUS Group

There were 3065 patients (9.0% of all NEXUS patients) who were younger than 18 years in this cohort, 30 of whom (0.98%) sustained a CSI. Included in the study were 88 children who were younger than 2, 817 who were between 2 and 8, and 2160 who were 8 to 17. Fractures of the lower cervical vertebrae (C5–C7) accounted for 45.9% of pediatric CSIs. No case of spinal cord injury without radiographic abnormality was reported in any child in this study, although 22 cases were reported in adults. Only 4 of the 30 injured children were younger than 9 years, and none was younger than 2 years. Tenderness and distracting injury were the 2 most common abnormalities noted in patients with and without CSI. The decision rule correctly identified all pediatric CSI victims (sensitivity: 100.0%; 95% confidence interval: 87.8%–100.0%) and correctly designated 603 patients as low risk for CSI (negative predictive value: 100.0%; 95% confidence interval: 99.4%–100.0%).

Conclusions. The lower cervical spine is the most common site of CSI in children, and fractures are the most common type of injury. CSI is rare among patients aged 8 years or younger. The NEXUS decision instrument performed well in children, and its use could reduce pediatric cervical spine imaging by nearly 20%. However, the small number of infants and toddlers in the study suggests caution in applying the NEXUS criteria to this particular age group.
The Canadian C-Spine Rule


For patients with trauma who are alert (as indicated by GCS of 15) and in stable condition and in whom cervical-spine injury is a concern, the determination of risk factors guides the use of cervical spine x-rays.

1. Any high-risk factor that mandates radiography?
   Age ≥65 yr or dangerous mechanism or paresthesias in extremities.
   A dangerous mechanism is considered to be a fall from an elevation ≥3 ft or 5 stairs; an axial load to the head (e.g., diving); a motor vehicle collision at high speed (>100 km/hr) or with rollover or ejection; a collision involving a motorized recreational vehicle; or a bicycle collision.

2. Any low-risk factor that allows safe assessment of range of motion?
   Simple rear-end motor vehicle collision or sitting position in the emergency department or ambulatory at any time or delayed (not immediate) onset of neck pain or absence of midline cervical-spine tenderness. If no, x-rays required.

3. Able to rotate neck actively?
   45° left and right – If no, x-rays required.

* If answers are 1. No 2. Yes 3. Yes then NO X-RAYS REQUIRED.
REFERENCES


