Cervical Spine Radiography in Pediatric cervical spine injury

- The A+ criteria for pediatric blunt cerebrovascular injury: An ATOMAC+ multicenter study
- Reducing Computed Tomography in Pediatric Cervical Spine Clearance: A Quality Improvement Study
- Nazheng stretch-rotation manipulation in the treatment of atlantoaxial subluxation in children: A case report
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Cervical Spine Radiography in Pediatric cervical spine injury can be very challenging due to the wide range of normal anatomic variants and synchondroses, combined with various injuries and biomechanical forces that are unique to children.

Features such as hypermobility between C2 and C3, the pseudo spread of the atlas on the axis, pseudo subluxation, the absence of lordosis, anterior wedging of vertebral bodies, pseudo widening of prevertebral soft tissue, and incomplete ossification of synchondrosis can be mistaken for traumatic injuries. The interpretation of a plain radiograph of the pediatric cervical spine following trauma must take into account the age of the child, the location of the injury, and the mechanism of trauma. Comprehensive knowledge of the specific anatomy and biomechanics of the childhood spine is essential for the diagnosis of suspected cervical spine injury. With it, the physician can, on one hand, differentiate normal physes or synchondroses from pathological fractures or ligamentous disruptions and, on the other, identify any possible congenital anomalies that may also be mistaken for an injury [1)].

Although a child can be defined radiographically as an individual with open epiphyses, this definition is not applicable in the cervical spine. By the time a child is 8–10 years old, the cervical spine reaches adult proportions [2) 3)].

After the age of 10–12 years, the clinical sequelae of pediatric and adult trauma are similar [4)].

Lateral view

Optimizing the diagnostic accuracy of the lateral view requires attention to detail; the external auditory canals and the lower cervical facets should be superimposed. Careful evaluation of the intraspinous distances, disk spaces, and neuroforamina is necessary at each level. The anterior and posterior cervical and spinolaminar lines should be assessed for subtle ligamentous disruption,

recognizing that pseudosubluxation, which is a normal variant, can cause apparent disruption of the anterior and posterior cervical lines. Pseudosubluxation is seen as anterior subluxation of C2 on C3, which can occur at a progressively lower level in the older child. The amount of subluxation is typically less than 2 mm. The spinolaminar line should not be disrupted, and the C2 line, which is a line drawn tangential to the posterior margin of C2, should contact, not intersect, the upper corner of C3 [5) 6)].

The younger the child, the more likely the upper cervical spine or craniovertebral junction will be affected; distraction and ligamentous injuries are more common than bony injury. Subtle, but significant, injury to the subchondral synchondrosis may escape diagnosis. Although dorsal tilting of the dens is normal, ventral tilting is not.

The Wackenheim line is defined as a line along the posterior cortical margin of the clivus, which should normally intersect the posterior one third of the dens. The Powers ratio is calculated by dividing the distance between the basion and posterior arch of C1 by the distance between the opisthion and anterior arch of C1. A line along the posterior dens and the perpendicular measurement from that line to the basion determines the basion axial interval [7)].

The basion dens interval, measured from the basion to tip of the dens, is the most easily obtained measurement on conventional radiographs.

Significant ligamentous injury can occur without marked prevertebral soft-tissue swelling. Hypertrophied retropharyngeal lymphoid tissue in young children should measure less than one half of the vertebral body at the C2–C3 level [8) 9) 10)].

Oblique radiograph

Oblique radiographs add little to increase the sensitivity of conventional radiographs in the pediatric population [11)].

Flexion-extension radiography

FE radiography following the initial MRI did not have a significant effect on reducing time to cervical collar removal or overall hospital length of stay. In addition, in 3 of 6 cases (50.0%) in which surgical fixation was required, MRI detected ligamentous and/or bony injury while FE radiography was normal [12)]

Flexion-extension radiography is not indicated in the setting of an acutely traumatized young child. The dynamic evaluation of cervical stability is best performed with an active range of motion, and the traumatized child suspected of having CSI should not be subjected to passive flexion and extension in the acute setting. The examination is usually limited by the presence of muscle spasm and pain and places the patient at risk for spinal cord injury in the setting of an unstable spine, resulting in appropriate avoidance by many pediatric radiologists and trauma physicians of passively manipulating the cervical spine of an acutely injured child. Ralston et al. [13)] and Dwek et al. [14)] found that flexion-extension radiographs offer no additional information when anteroposterior and lateral radiographs are normal or show straightening of the normal cervical lordosis. However, flexion-extension images are useful in the follow-up evaluation of the child previously found to have

ligamentous injury associated with instability.

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