background

- C2 is the most commonly involved vertebra in young children being uniquely susceptible to injury for a variety of reasons. C2 experiences strain, particularly in the cervical region, where it is involved in both the occipitoatlantal and cervicomedullary junctions, and may be at risk of injury even in infants [1].
- Children can have an incompletely fused C2 vertebra, which serves as points of structural weakness even in infants [2].
- A developing C2 vertebra consists of 5 subchondral ossification centra, the 2 neural arches, body mass, and posterior vertebral elements [3]. These 5 ossification centers usually fuse to form a single bone, with the exception of the odontoid process [4].
- The synchondrosis between the odontoid and the body of C2 is a transient cartilaginous plate that serves as a site for the development of the odontoid process on C2 [5]. C2 synchondroses are present in 90% of children by age 3 years, but are not yet ossified in all children by 12 years [6].
- C2 fractures are separate by 6 C2 synchondroses. Type I fractures represent the mild end of the spectrum of C2 synchondroses.

methods

- An institutional review board-approved retrospective review of the imaging and hospital records of children with suspected C2 fractures at our institution was conducted.
- A cross-sectional imaging database keyword search for odontoid fracture, C2 fracture, C2 synchondrosal fracture, C2 synchondrosal slip fracture, C2 synchondrosal shoulder fracture, C2 synchondrosal spiral fracture, and C2 fracture was performed using the search terms: C2, odontoid, C2 fracture, C2 synchondrosal, C2 synchondrosal fracture, C2 synchondrosal slip fracture, C2 synchondrosal shoulder fracture, C2 synchondrosal spiral fracture, and C2 fracture. The keywords were also used in addition to the search terms: C2, odontoid, C2 fracture, C2 synchondrosal, C2 synchondrosal fracture, C2 synchondrosal slip fracture, C2 synchondrosal shoulder fracture, C2 synchondrosal spiral fracture, and C2 fracture. The keywords were also used in addition to the search terms: C2, odontoid, C2 fracture, C2 synchondrosal, C2 synchondrosal fracture, C2 synchondrosal slip fracture, C2 synchondrosal shoulder fracture, C2 synchondrosal spiral fracture, and C2 fracture.

results

<table>
<thead>
<tr>
<th>Fracture Type</th>
<th>Fracture Location</th>
<th>Fracture Pattern</th>
<th>% of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I</td>
<td>Right &amp; Left</td>
<td>Subchondrosal</td>
<td>2</td>
</tr>
<tr>
<td>Type II</td>
<td>Right &amp; Left</td>
<td>Right-Left</td>
<td>1</td>
</tr>
<tr>
<td>Type III</td>
<td>Right &amp; Left</td>
<td>Right-Left</td>
<td>1</td>
</tr>
<tr>
<td>Type IV</td>
<td>Subchondrosal</td>
<td>Subchondrosal</td>
<td>2</td>
</tr>
<tr>
<td>Type V</td>
<td>Subchondrosal</td>
<td>Subchondrosal</td>
<td>3</td>
</tr>
<tr>
<td>Type VI</td>
<td>Subchondrosal</td>
<td>Subchondrosal</td>
<td>2</td>
</tr>
</tbody>
</table>

relevant images

new c2 sync ondrosal fracture classification system

New C2 Synchondrosal Fracture Classification System
Jerome Rusin MD, Lynne Ruess MD, Robert Daulton (OSU ’15)
Division of Radiology at Nationwide Children’s Hospital

Discussion

- We report a spectrum of C2 synchondrosal fractures, including 2 new fracture patterns. These fractures involve the 5 central synchondroses in various combinations and cannot be effectively classified using other published systems for C2 or odontoid fractures.
- The spectrum of injury for Types I, II, and III fractures ranged from less severe to more severe according to the degree of displacement by subtypes.
- These subtypes were classified according to the degree of displacement of the odontoid fracture segment [4]. Our classification system uses Gore’s terminology for the synchondroses [5] allowing for an anatomic description of more synchondrosal fracture patterns (Types IV-VI) and it incorporates Harrington et al.’s classification for odontoid fractures, which we found to correlate with treatment and outcomes.
- We propose a new classification system for C2 fractures based on central synchondrosal injuries and its clinical utility for describing and reporting C2 fractures.

references


Acknowledgements

- Department of Radiology at Nationwide Children’s Hospital
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