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Original research article

Treatment of the dens fractures in children

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ARTICLE INFO

Article history:
Received 4 January 2018
Accepted 15 August 2018
Available online 1 September 2018

Keywords:
Dens fractures
Treatment
Children
Spinal cord
Halo-Vest

ABSTRACT

The anatomical and biomechanical features of the immature cervical spine make the upper segments at C1–3 especially susceptible to injury.

Material and method: From 2000 to 2016, 10 patients (3 boys, 7 girls) with C2 dens fractures were treated. The average age of each child was 11 years (3–17). According to the Anderson classification, there were 6 patients with a type III fracture and 4 with a type II. 4 patients were treated conservatively using the Minerva cervical brace for 75 days (66–125) and 6 patients by means of the Halo-Vest for 79 days (64–87) and followed by the Schantz collar for 17 days (2–35).

Results: The follow up lasted 78 months (12–180). The NDI (Neck Disability Index) score was calculated for each patient, except for section 8 (driving the car). The scores ranged from 1/45 (2.22%) to 20/45 (44.44%). The mean score for 9 out of the 10 patients (one patient died) was 4.77 (10.61%).

Conclusion: The C2 dens fracture is a rare injury in children. The classification system of dens fractures developed by Anderson is useful in choosing the mode of treatment of dens fractures.

1. Background

Upper cervical spine injuries are associated with high energy and are frequently fatal. Children appear to be at increased risk of injury at this site [1–4]. The injury frequently leads to severe cord and brain-stern injury, causing respiratory arrest. Increasingly, however, there have been reports of patients surviving this injury and even patients with upper cervical fractures with intact neurological function have been documented [5]. 2–3% of all cervical spinal injuries are in children. They are more likely to occur in the upper cervical region and fractures of odontoid are the most common [6]. The same management algorithms that are used for adult injuries often do not apply to children however appropriate algorithms for evaluation and management are therefore essential in order to take proper care of these injured children [4]. Deformity, instability, post-traumatic stenosis, and neurological complications may be prevented through the early recognition and appropriate management of

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https://doi.org/10.1016/j.pjnns.2018.08.007
0028-3843/

those risks. The anatomical and biomechanical features of the immature cervical spine make the upper segments at C1–3, especially C2 susceptible to injury [2,3,7]. There are several physiological differences between the cervical spine of children and adults. For instance, children have increased neck motion, which is due to the ligament laxity, relative muscle weakness, and incomplete ossification of the cartilaginous elements of the pediatric cervical spine. The treatment of C2 dens fractures in children and adolescents without neurological damage depends on the type of the fracture and displacement [2,8].

2. Material and method

From 2000 to 2016, 10 patients with C2 dens fractures were treated. It is a retrospective work consisting in the data analysis of the dens fractures treatment in children, the approval of the ethical committee was not required for this study. The parents have been informed that their child's disease will be included in scientific paper. There were 3 boys and 7 girls. The mean age was 11 years (3–17).

The fractures were caused by a traffic accident in 4 of the cases, a fall in 3 cases and sport accidents in 3 cases. In 6 patients, cervical fractures were accompanied by multiple trauma, 3 by head injuries and 1 patient required neurosurgical procedure for subdural hematoma. In 1 case, the ulnar and radial fracture was treated surgically (Figs. 1 and 2).

When a child had a known or suspected spine injury, the cervical spine was initially immobilized with a rigid cervical orthosis, specifically designed and appropriate for children. Each patient in the emergency ward was examined by a pediatric medical team (an orthopedic surgeon, a neurologist, and a pediatrician). Any limitation of motion, paraspinal muscle spasm, or torticollis suggested the need for additional investigation. The back was inspected in a log-roll fashion with gentle in line cervical traction until all screening

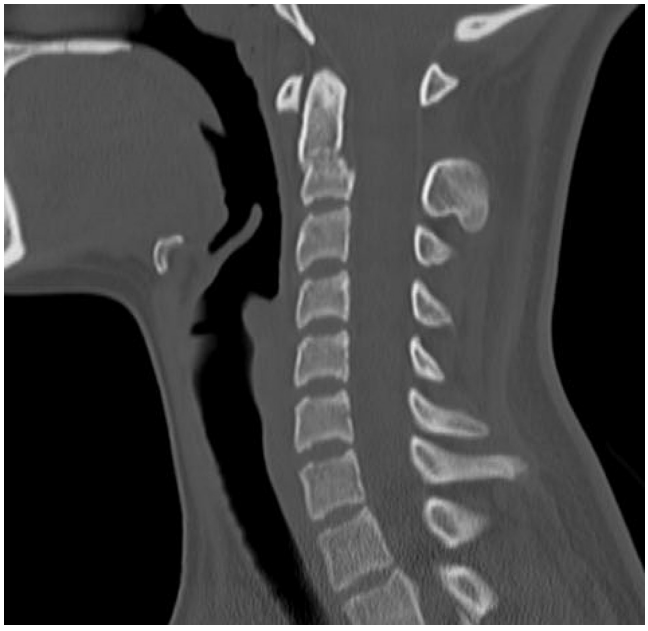

Fig. 1 – CT fracture type II.

Fig. 2 – MRI fracture type II.

anteroposterior and lateral radiographs of the cervical spine as well as an open mouth radiograph of the odontoid process were reviewed. The cervical spine remained immobilized until either initial radiographs were made and evaluated and injury was ruled out or definitive treatment was rendered.

After accommodation to the hospital X-ray according to Harris method in 10 patients, CT in 10 patients and MRI in 9 were used. No bony abnormalities of the upper cervical spine were found in our series. After X-ray, CT and MRI, all fractures of the C2 dens were classified according to Anderson classification. There were 6 patients with a type III fracture and 4 with a type II. The fractures were without displacement in 4 patients, with small displacement (less than 5 mm, angulation <11 degrees) in 5 patients, and with important displacement in 1 patient. The radiological examinations were carried out by an orthopedic surgeon and a radiologist and only in accordance with their assessment of the fracture stability was the orthopedic treatment started.

4 patients were treated conservatively using the Minerva cervical brace for 75 days (66–125) and 6 patients by means of the Halo-Vest for 79 days (64–87) and followed by the Schantz collar for 17 days (2–35). The Halo-Vest had been used since the day of admission in 4 cases and 2 days after hospital admission in 1 patient. The fractures with a small displacement were treated with Halo-Vest, the X-ray after reposition showed that the fracture displacement was less than 0–2 mm in the lateral view in 4 patients, in 1 patient the control X-ray showed that the displacement in the lateral view was 5 mm and in the anteroposterior view was 4 mm, 7 days after trauma the fracture was corrected to 1 mm in the lateral view and 0 mm in the anteroposterior view. The patient with an important displacement presented in the control X-ray a