

## Cervical Spine Injuries in Children Restrained in Forward-Facing Child

### Restraints: A Report of Two Cases

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#### FROM ABSTRACT:

A large proportion (up to 40%) of children's cervical spine injuries occur in motor vehicle collisions. (1)

Very young infants are seated facing the rear of the vehicle to protect the cervical spine. The current debate in North America lies in the appropriate age to turn children to face the front of the vehicle.

In Canada and the United States, the commonly accepted age to turn a child to face the front of the vehicle is 12 months (and 10 kg [22 lbs.] in Canada or 9 kg [20 lbs.] in the United States).

In Sweden, children remain facing the rear until they are 3 or 4 years old (up to 18 kg [40 lbs.]).

We present the cases of 2 children, aged 23 months and 35 months, who were restrained in forward-facing child restraints according to current Canadian guidelines, yet suffered cervical spine injuries when involved in head-on motor vehicle collisions.



#### CASE REPORTS

##### Case 1

A 23-month-old boy was riding in the rear center seat of a 1994 Honda Accord in a forward-facing shield-style child restraint which was attached to the vehicle using the locking tongue lap belt and the tether strap. "This restraint was appropriate for the age and size of the child."

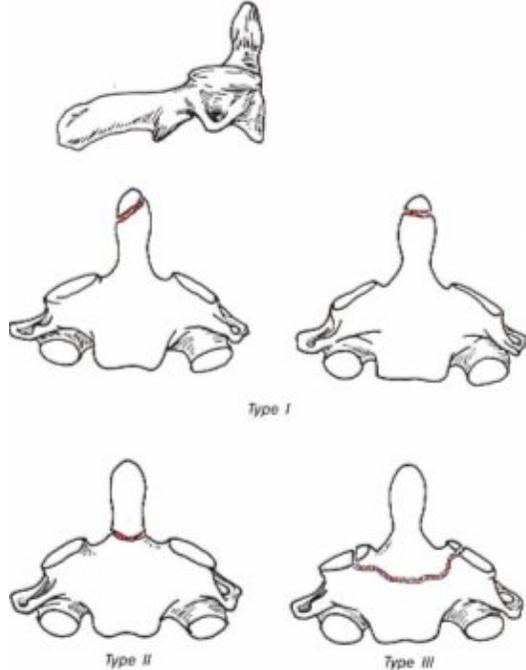
An oncoming minivan lost control and crossed the median, striking the Honda Accord, which sustained direct damage to the left portion of the front bumper. The change in velocity from pre- to post-impact speed

for the Honda Accord was calculated as 40 km/h [25 m/h], classifying this as a severe collision.

The driver of the vehicle was a 38-year-old male restrained with the available 3-point belt. His injuries included a pneumothorax, chest contusions, fractured right hand, and sprained ankle.

The front seat passenger was a 35-year-old woman who was 5 months pregnant and restrained with the 3-point seat belt. Neither she nor her fetus suffered any injuries in this collision.

The 23-month-old boy suffered a fatal occipitocervical dislocation, dying 3 days after hospital admission. (2)



The only external sign of injury was a small laceration on his tongue.

#### Case 2

A 35-month-old girl was riding in the rear passenger side seat of a Toyota 4Runner.

The child was seated in a forward-facing five-point child safety seat. This seat was properly restrained in the vehicle using the available three-point belt and a tether strap. This restraint was appropriate for the age and size of the child.

The 4Runner went off the road and hit a rock resulting with a change of velocity of 80 km/h [50 m/h].

The 30-year-old male driver of the vehicle was restrained using a 3-point belt and sustained hand lacerations.

The front seat passenger was a 35-year-old woman, restrained using a 3-point belt, who suffered bilateral ankle fractures.

"The 35-month-old girl was initially assessed at a small rural hospital. The only external sign of injury was a large abrasion to the chin and slight abdominal bruising.

Plain radiograph indicated evidence of a C2 fracture through the base of the odontoid process."

Management by halo vest immobilization resulted in an uneventful recovery.

#### DISCUSSION

"Motor vehicle collisions are the cause of 30% to 40% of all cervical spine injuries in children."

"Fifteen percent to 20% of childhood cervical spine injuries caused by motor vehicle collisions are fatal."

"Most fatalities occur among unrestrained or improperly restrained children."

"Many reported cases of restrained children with cervical spine injuries involve children younger than 12 months of age who were placed prematurely in forward-facing child restraints." (3)

"In many cervical spine injury reports in children both older and younger than 12 months, the child is either unrestrained or improperly restrained." "There are cases reported in the literature in which properly restrained

children older than 12 months of age sustain cervical spine injuries, although none of these children suffered a fatal cervical spine injury."

"There have been no documented cases in the literature of catastrophic cervical spine injury to children in rear facing child safety seats."

**[Very Important]**

In frontal crashes involving children: 38.6% of crashes have a change in velocity of 20 km/h [12mph] or more 10.4% of crashes have a change in velocity of 30 km/h [17 mph] or more 2.2% of crashes have a change in velocity of 40 km/h [25 mph] or more National databases from police-reported traffic crashes involving a towed passenger car, van, or truck, indicate that adult occupants of the vehicles have "less severe injuries than did children restrained in child safety seats in the rear."

**[Very Important]**

"In both cases [above], the children were the furthest occupants from the point of impact. Injuries received were caused by the relative anatomic vulnerability of the child's upper cervical spine. The cervical vertebrae of the infant and small child are more cartilaginous, with shallow, horizontally oriented facet joints and neck ligaments and extensor muscles that are relatively weaker than those of adults. These factors, along with the child's greater head to body ratio, can lead to vertebral or spinal cord injury." **[Very Important]**

"This vulnerability of the child's cervical spine is the rationale for continuation of rear-facing seating." **[Very Important]**

"Prolonging rear-facing seating for as long as possible, and definitely beyond 10 kg [22 lbs.] or 12 months, may protect children from the type of injury described in this paper."

These authors recommend that children remain rear-facing until at least 14 – 16 kg [31 –35 lbs.].

### KEY POINTS FROM DAN MURPHY

- 1) 40% of children's cervical spine injuries occur in motor vehicle collisions.
- 2) 20% of childhood cervical spine injuries caused by motor vehicle collisions are fatal.
- 3) "Most fatalities occur among unrestrained or improperly restrained children."
- 4) Very young infants are seated facing the rear of the vehicle to protect the cervical spine.
- 5) "There have been no documented cases in the literature of catastrophic cervical spine injury to children in rear facing child safety seats." **[Very Important]**
- 6) The accepted age to turn a child to face the front of the vehicle is 12 months (and 10 kg [22 lbs] in Canada or 9 kg [20 lbs] in the United States).

7) In Sweden, children remain facing the rear until they are 3 or 4 years old (up to 18 kg [40 lbs]).

8) Properly restrained children in forward-facing child restraints can suffer serious, even fatal cervical spine injuries when involved in head-on motor vehicle collisions.

9) "Many reported cases of restrained children with cervical spine injuries involve children younger than 12 months of age who were placed prematurely in forward-facing child restraints."

10) "In many cervical spine injury reports in children both older and younger than 12 months, the child is either unrestrained or improperly restrained."

11) Properly restrained children older than 12 months of age can sustain cervical spine injuries.

12) In traffic crashes involving a towed vehicle, adult occupants sustain "less severe injuries than did children restrained in child safety seats in the rear."

**[Very Important: This indicates that children are more injured than adults in such collisions]**

13) Children are more injured in collisions, especially when restrained while facing forward, because of relative anatomic vulnerability of the child's upper cervical spine:

A)) The cervical vertebrae of the infant and small child are more cartilaginous, with shallow, horizontally oriented facet joints and neck ligaments and extensor muscles

that are relatively weaker than those of adults.

B)) Children have "greater head to body ratio, which can lead to vertebral or spinal cord injury." **[Very Important]**

C)) "This vulnerability of the child's cervical spine is the rationale for continuation of rear-facing seating." **[Very Important]**

14) Children should be in rear-facing seating for as long as possible, at least until 14 – 16 kg [31 –35 lbs.].

**[The contention by some insurance companies and their representative that properly restrained children cannot be injured in a motor vehicle collision is ridiculous.]**

#### KEY POINTS FROM DR. SHETLIN

- 1) Smaller children and infants have a head much larger in proportion to their body than adults. (1/3 their body size) That is why rear restraints are much safer in forward impact collisions. Rear end collisions are completely different.
- 2) Remember any collision over 10 mph is considered a "high-speed collision." Thus, kids should also always get checked by a specialist after an accident of any speed.
- 3) More people are injured in "low-speed" collisions than "high-speed" collisions. The child above was killed from an impact with a change in velocity of only 12 mph. 12 mph change in velocity is not fast but classifies as a "high-speed collision."