

A Fatal Contradiction





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A Fatal Contradiction

The following presentation is based on a research project carried out by Dr Peter Gloyns and James Roberts of Vehicle Safety Consultancy Ltd on behalf of ANEC



A Fatal Contradiction

The project looked at the real world accident experience of forward and rearward facing child seats for children up to four years of age

The full report available at www.anec.eu

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Introduction

The Directive requires children up to 1.35 m or 1.50 m tall to use a suitable approved child restraint

Introduction

The UN ECE Regulation and availability of Universal child restraints on the majority of the European market implies that a child should travel rearward facing up to around 9 months/ 1 year

Mass Groups

UN ECE Regulation 44 Mass Groups 		
Seat mass group	Weight range	Approximate age range
Group 0	0-10kg (0-22lb)	from birth to about 9 months/1year
Group 0+	0-13kg (0-29lb)	from birth to about 15 months
Group 1	9-18kg (20-40lb)	about 9 months to 4 years
Group 2	15-25kg (33lb - 3st 13lb)	about 3 years to 7 years
Group 3	22-36kg (3st 7lb - 5st 9lb)	about 6 years to 12 years

Introduction

In Scandinavian countries normal practice for the last 20 years has been very different, with children carried rearward facing until they are around four years of age



Large rearward facing Scandinavian child seat – up to 3-4 years old



Conventional rearward facing European infant seat – up to 11-15 months (~ 9 months in practice)



Large rearward facing
Scandinavian child seat – up
to 3-4 years old



Conventional forward facing
European seat

Introduction

What is the
evidence about
the relative
merits of these
two very different
practices within
Europe?



Literature

Literature is unanimous about the benefits of keeping children rearward facing up to four years old

Literature

Literature cites a number of life threatening injuries to children in forward facing restraints in unexpected circumstances



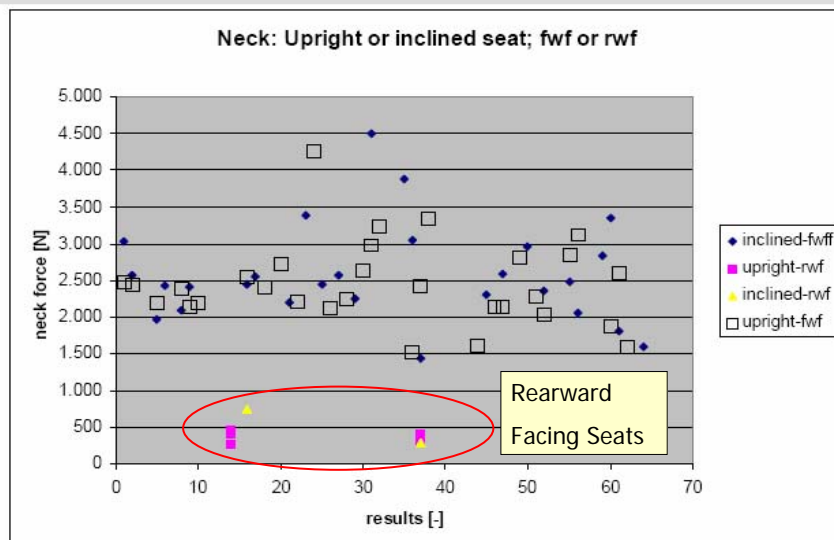
Literature

The implication is that the forward facing restraint, in some circumstances, can impose intolerably high loading, either induced, or directly, on the young child's body

Literature

Crash test loadings on child dummies are highly supportive of keeping children rearward facing for as long as possible

Frontal Impact: Modes of Installation (Neck Force)



Literature

In rearward facing seats loads are reduced and are spread well over the entire body. Importantly, the neck is not required to provide the forces to decelerate the head

Stiffer vehicles

The literature shows that vehicles both in Europe and the US are getting stiffer.

Stiffer Vehicles

This implies that the occupants are likely to be exposed to an increasing severity of impact in terms of vehicle deceleration as the vehicle fleet moves to more recent car designs

Stiffer Vehicles

Adult restraints have evolved to cope with this more severe deceleration environment, with pre-tensioned seat belts, load limiters and sophisticated airbags

Stiffer Vehicles

Children's restraints have not yet evolved in a similar way to optimise child protection in this new and more severe deceleration environment

Time for a Review

This is the time to examine this issue afresh and ensure that the legislative message and its implications for the consumer keep up with technical knowledge

Current Study

ANEC undertook the current study to evaluate the limits of protection offered by both forward and rearward facing restraints for children up to four years of age

Accident Databases

Three databases were examined for the current study....

- **NASS Database** – NHTSA in US
- **UK Fatal Accidents** – Police records held at TRL
- **Swedish Fatal Accidents** – Police records held by SRA

Research

The following examples are drawn from UK, US and Swedish databases

UK Case 1

Low severity frontal

Five and three-quarter month old child
Weight = 9.5 kg (21 lbs), crown to heel = 69 cm,
crown to rump = 43 cm
2-way seat with integral harness used forward facing
Rear left seat equipped with seat belt
No intrusion around the child
Note: mass groups and child seat instructions imply that the child was in a permitted forward orientation > 20 lbs



Child Injuries

5³/₄ month old (forward facing with integral five point harness)

- Large diffuse subdural haematoma
- Brain intensely oedematous
- No apparent head contact
- No fracture of skull

The child died after three days

Lessons

This is a very surprising outcome in a low severity impact with no intrusion around the child's seating position. Had the child been seated in a rearward facing seat it is anticipated that she would have survived without any serious injury.



NASS Case 1

Low severity frontal

Two year old child – 14 kg (31 lbs) 91 cm (3 ft) tall
Forward facing harness and shield type seat
Right rear third row seat equipped with seat belt
No intrusion around the child

11 month old child – 11 kg (24 lbs) 61 cm (2 ft) tall
Rearward facing integral harness child restraint
Left rear second row seat equipped with seat belt
No intrusion around the child







Child Injuries

Two year old (forward facing -
harness and shield)

- Cervical spine dislocation (AIS 2) – no head contact
- The child survived the injury

11 month old (rearward facing –
integral harness)

- Bruise to forehead



Lessons Learned

Forward facing shield and harness seat

- Excessive loads on the neck without any apparent head contact
- Suggests that travelling forward facing was not appropriate for this child at this age

Rearward facing integral harness seat

- This is an example of a rearward facing child seat providing superior restraint to the forward facing child seat in this impact



NASS Case 2

Modern bodyshell

Three year old child

17 kg (37 lbs) 99 cm (3 ft 3") tall

Forward facing booster seat

Rear left seat equipped with pretensioned seat belt

No intrusion around the child







Child Injuries

- Neck injury (AIS 2)
- Deceleration injuries to the brain (AIS 3) – no head contact
- Haemo-thorax, without rib fracture (AIS 3)
- Ileum and jejunum contusion (AIS 2)

The child died at the accident scene



Lessons Learned

- Adult seat belts are too stiff to directly restrain a three year old child in this severity of accident putting excessive loads on the neck and chest
- The lap section of the belt requires better redirection to avoid loading the vulnerable abdomen. The belt guides are too high relative to the seat base and so, by design, guide the belt onto the abdomen

Swedish Case 1

Two and a half year old female
Forward facing child restraint
Right rear seating position

Injuries: lung contusion, ruptured liver,
spleen, diaphragm, haemo-peritoneum





Lessons Learned

- Again we see injuries to the chest and abdomen induced via direct loading from the restraint.

ANEC Research

- The use of the three databases has increased the knowledge of the limits of protection of child restraints
- 17 cases have been documented in depth illustrating the limits of protection provided by forward-facing restraints

ANEC Research

Of the 17 cases where the limit of protection for forward facing restraints had been reached, use of a Scandinavian style rearward facing seat would have positively transformed the outcome in 13 cases (76%)

ANEC Research

The remaining four cases would need a Scandinavian style child seat in conjunction with improved restraint of luggage for the best protection to be realised



Swedish Experience

The project included an evaluation of the circumstances in which restrained children in Sweden had died for the years 1999-2006

Swedish Experience

Children that died in rearward facing seats were in accidents where the child's life was ended by circumstances that no restraint could cope with - such as, overwhelming intrusion, fire or drowning

Swedish Experience

Notably in Sweden those children that died unexpectedly, in potentially survivable circumstances, did so in forward facing seats

Study Conclusions

The US, Swedish and UK data showed that children in forward facing seats suffered head, neck, chest and abdominal injuries in circumstances in which a rearward facing restraint should have provided good protection for them

Study Conclusions

The problems were common to both harness and booster type seats

Study Conclusions

We conclude, in common with all other investigators who have examined this topic, that the rear facing restraints offer advantages over the forward facing restraints at least up to the age of four years

Study Conclusions

It is clear that a wide gulf has developed between the conclusions of the technical community, based on accident and test experience, and the guidance provided to consumers via legislation.

Study Conclusions

Through the Mass Group classification, European legislation implies that it is safe for a child to travel forward facing from 9 kg onwards.

Study Conclusions

The consumer is not receiving the best technical advice via the current mass group approach within legislation.

Conclusions

GRSP is the forum in which this apparent anomaly can be corrected

C I Recommendations

The new Regulation should be structured so that parents get the clear message that rearward facing is best until the child is four years old.

C I Recommendations

The new Regulation should encourage (require) manufacturers to develop RWF CRS for children up to 4 years (or length equivalent).

C I Recommendations

Engage with CLEPA to ensure that:

- parents throughout Europe get very clear advice on how best to restrain their young children
- the supply of rearward facing seats throughout Europe allows parents to enjoy the benefits currently confined to parents and children in the Scandinavian countries

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