

Seat Belt Fit Ratings for Booster Seats

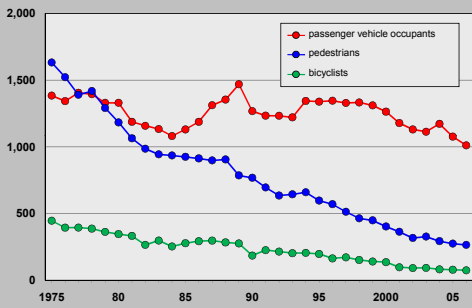
Lifesavers Conference 2009
Workshop - Latest Research on Belt-Positioning
Booster Seats

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Crash deaths among children younger than 13 1975-2006



2

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Abdominal Injuries to Booster Aged Children Nance et al., 2004

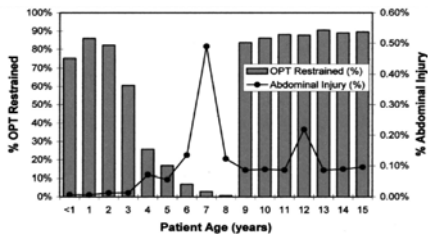
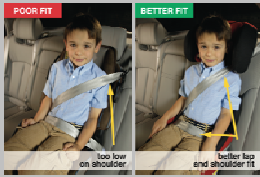


FIGURE 1. Percentage of child occupants optimally (OPT) restrained (left-hand y-axis) by age and percentage of children with an abdominal injury (right-hand y-axis) by age.

3

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How do boosters work?



- Raise the child
 - Move shoulder belt off neck → onto shoulder
 - Improve lap belt angle → improve lap belt fit
- Belt routing features further improve belt fit
- More comfortable → reduce belt misuse

4

Boosters reduce injury among 4-7 year-olds by 59% (CHOP)



5

Do all boosters work well?

Sept 27, 2001

Dec 7, 2007

Feb 8, 2003

6

Assessment of boosters

- Primary function is to position vehicle belts
- Not addressed in NHTSA FMVSS 213
 - Positioning of belts not assessed
 - Mid-range anchorage locations

7

Objectives

- Quantify belt fit of booster seat designs in real world vehicle lap/shoulder belt configurations
- Develop repeatable and reproducible method for measuring belt fit

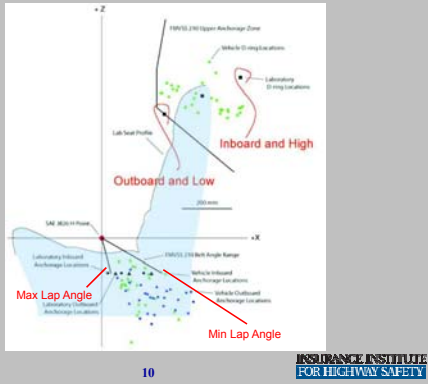
8



Matthew P. Reed
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9

Methods



10

- Construct test buck with range of anchorage locations
- Position booster according to manufacturer's instructions
- Position dummy representing 6 year-old in booster
- Place belt using range of configurations
- Record belt location relative to dummy's pelvis and chest



11



highback



combination

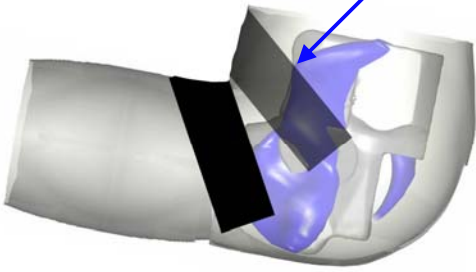


backless

12

Image courtesy of UMTRI

ASIS

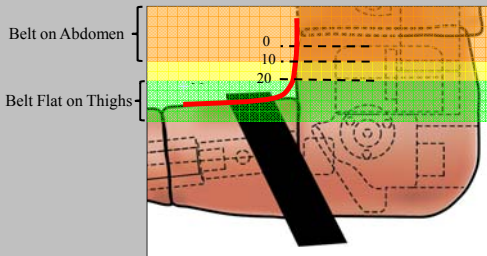


13

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Lap belt fit measurements

- 0 mm – ASIS in dummy
- 10 mm – predicted ASIS in children

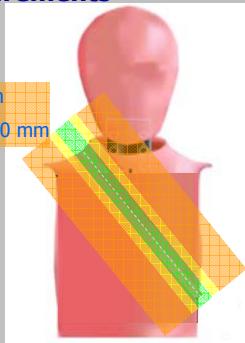


14

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Shoulder belt fit measurements

- Belt at midshoulder ± 10 mm
- Belt too close to neck ≤ -20 mm
- Belt too far out on shoulder ≥ 20 mm



15

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Proper belt fit



- Lap belt low across upper thigh
- Shoulder belt across center of shoulder

16

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Range of lap belt fit

too high on abdomen



engages pelvis



flat on upper thighs



17

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Range of shoulder belt fit

too close to neck



center of shoulder

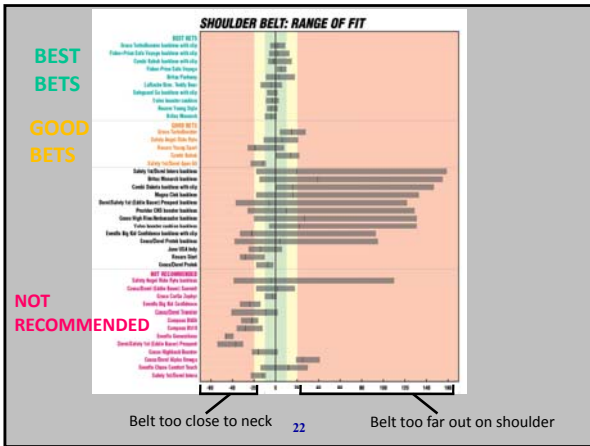


too far outboard



18

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Conclusions

- Boosters differ meaningfully in the lap and shoulder belt fit they provide
- Despite lap belt being top priority, many boosters provided poor lap belt fit

23

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Conclusions

- There are boosters which provide good lap and shoulder belt fit
 - 10 boosters Best Bets
- Dynamic performance
- Other child sizes/ages

24

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Future Plans

- Currently finalizing measurement procedure
- Updated ratings on available boosters

25

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26

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