Belts, Bodies and Boosters

Amy Teddy
Injury Prevention Program Manager
THE PROBLEM
Optimal Restraint vs. Age: % Abdominal Injury

Nance ML, Lutz N, Arbogast KB, Cornejo RA, Kallan MJ, Winston FK, Durbin DR. Department of Surgery, Children's Hospital of Philadelphia
Figure 14: Child Restraint Use by Age and Year

- Age 0-12 Months: 98% (2009), 98% (2011)
- Age 1-3 Years: 96% (2009), 96% (2011)
- Age 4-7 Years: 87% (2009), 90% (2011)
- Age 8-12 Years: 85% (2009), 88% (2011)
Restraint Use for 4-7 Year Olds

Figure 2: Restraint Use for Children 4 to 7 Years Old

- Car Seat: 14% (2009), 18% (2011)
- Booster Seat: 41% (2009), 47% (2011)
- Seat Belt: 32% (2009), 25% (2011)
- Unrestrained: 13% (2009), 10% (2011)

National Highway Traffic Safety Administration
Report on the 2011 National Survey of the Use of Booster Seats
No Booster vs. Booster

http://youtu.be/eINHnuysp08
http://youtu.be/htOKYOmWvs0
THE CHILD'S BODY
Female (2-20 yrs) Growth Chart

Age (years)
Average 8 year old female = 50 inches
HOW OLD IS AN AVERAGE FEMALE THAT IS 57 INCHES?
Average 11 year old female = 57 inches
THE RESEARCH – BELTS AND BODIES
Seat Belt Geometry vs. Anthropometry

- “Geometry of rear seats and child restraints compared to child anthropometry”
  - Bilston & Sagar – October 2007

- Study Design:
  - Measured belt path (outboard/rear seat) in 50 vehicles
  - Compared to child body size
30% of shoulder belts will fit an average 6-8 year old
Vehicle Seat Cushions

- “Comparison of Child Body Dimensions with Rear Seat Geometry”
  - Huang & Reed - 2006

Buttock Popliteal Length

Seat Cushion Length

Thigh Line

H-Point

Vehicle Floor
### Vehicle Seat Cushions

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Second Row</th>
<th>Third Row</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cars ((n=27))</td>
<td>470.9</td>
<td></td>
</tr>
<tr>
<td>SUV’s ((n=21))</td>
<td>465.4*</td>
<td>422.8*</td>
</tr>
<tr>
<td>Minivans ((n=8))</td>
<td>460.1</td>
<td>452.5</td>
</tr>
</tbody>
</table>

- Median 2nd row seat cushion: 455 mm
  - Longer than BPL of:
    - 24% of adult rear-seat occupants
    - 83% of children
CASE STUDIES
Case Study: A.H.

- Patient: 9 yo female – 88 lbs
- Crash: car vs. tree
- Restraint: restrained, lap only belt?, back seat
- LOS: 8 days
- Other occupants:
  - Passenger: 8 yo – backseat – booster (no injuries)
  - Driver: broken ankles
Multiple facial and jaw fractures

Broken teeth
15 cm laceration

Detached lip

Degloving
Positive seatbelt sign along left flank/back

Abdominal muscle rupture
Case Study: K.K.

- Patient: 4 yo male – 44 lbs
- Crash: rollover
- Restraint: restrained, booster?, back seat
  - found “hanging upside down and he wiggled free”
  - patient reports placing shoulder belt behind back
- LOS: 4 days (re-admitted 7 additional days)
- Other occupants:
  - Passenger: 17 month old – backseat – FF infant seat**
  - Driver – hospitalized - intoxicated
Broken ribs

Kidney laceration

Seatbelt sign extending up laterally
Crash Investigation Photos
Crash Investigation Photos
Vehicle is upside down

- Booster seat
- Forward facing infant seat
- Belts still buckled
Vehicle is right side up

infant seat installed forward facing

belt still buckled
Case Study: R.S.

- Patient: 4 yo male – 49 lbs
- Crash: frontal impact
- Restraint: restrained, booster, back seat
  - Mom reports shoulder belt under arm
- LOS: 3 days
- Other occupants:
  - Passenger: sister, 8 yrs
  - Driver: treated & released
Left Iliac wing fracture
Case Study: E.S.

- Patient: 8 yo female – 92 lbs
- Crash: frontal impact
- Restraint: restrained, backless booster, back seat
- LOS: 3 days
- Other occupants:
  - Passenger: brother, 4 yrs
  - Driver: treated & released
Lip laceration
Left superior pubic ramus fracture
Case Study: B.G.

- Patient: 8 yo female – lbs
- Crash: frontal
- Restraint: restrained, backless booster, back seat
- LOS: 4 days
- Other occupants:
  - Passengers:
    - 5 yr old female – restrained – convertible
    - 10 yr old male – restrained – backless booster
    - 6 yr old male – restrained – HB booster
  - Driver – treated and released
ICAM Case # 2013-11_14

V1 - 2001 Jeep Grand Cherokee

private driveway

Tree #1 - 30 cm diameter

Tree #2 - 55 cm diameter
L5 Compression Fracture