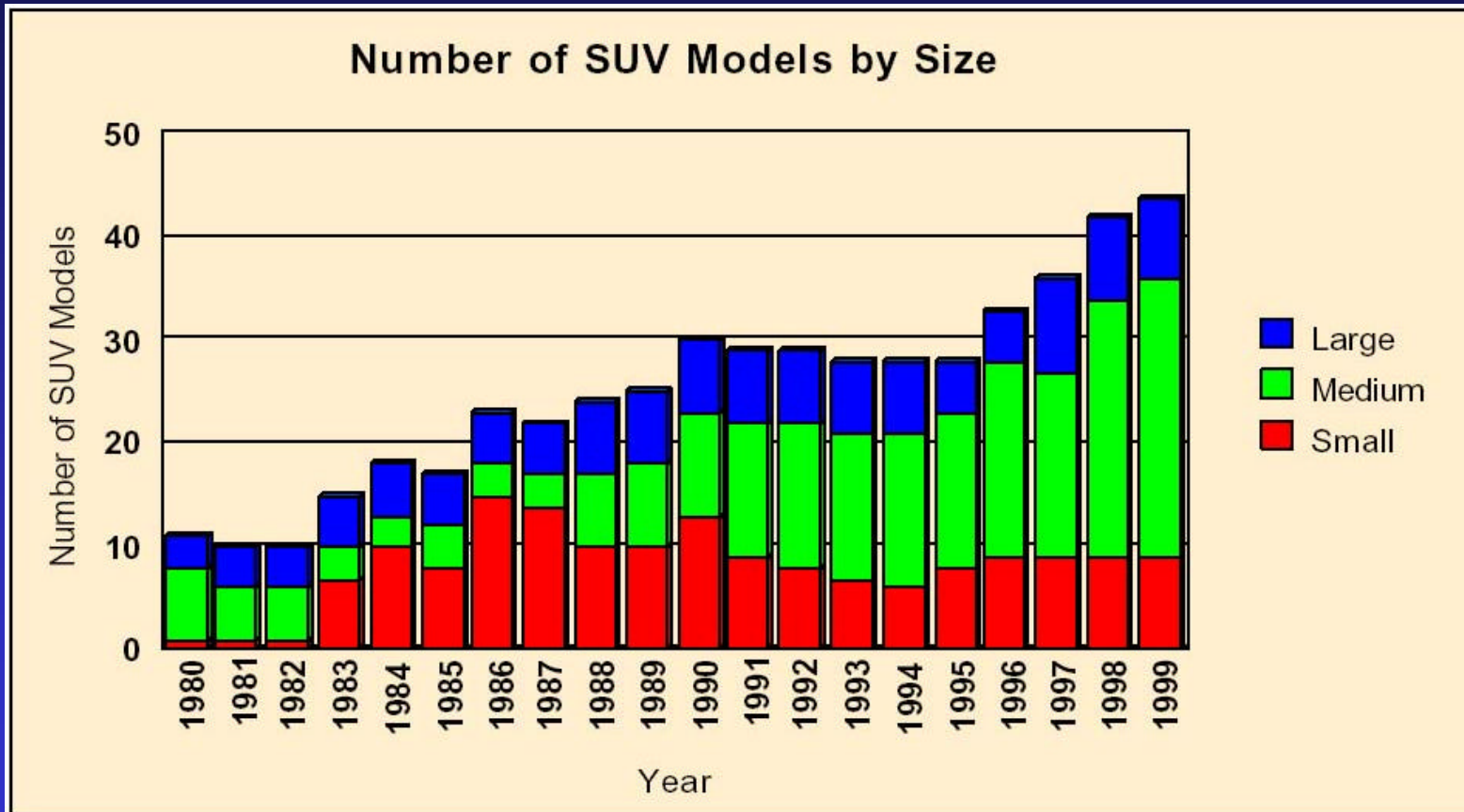

Pediatric Injuries in Mismatched Crashes

Martin R. Eichelberger, MD

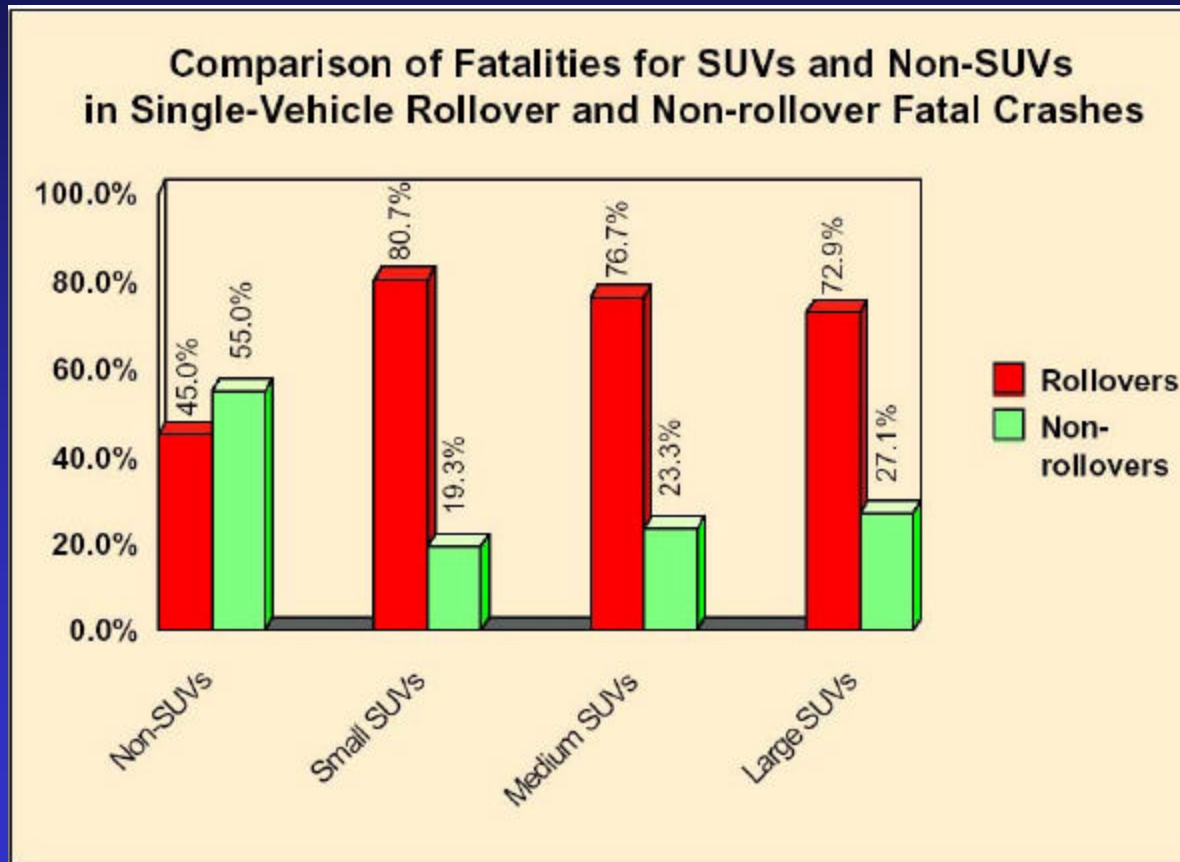
Kelly Orzechowski, MPH, Patrick McLaughlin, BS

Children's National Medical Center

United States Vehicle Fleet



Fatality Rates

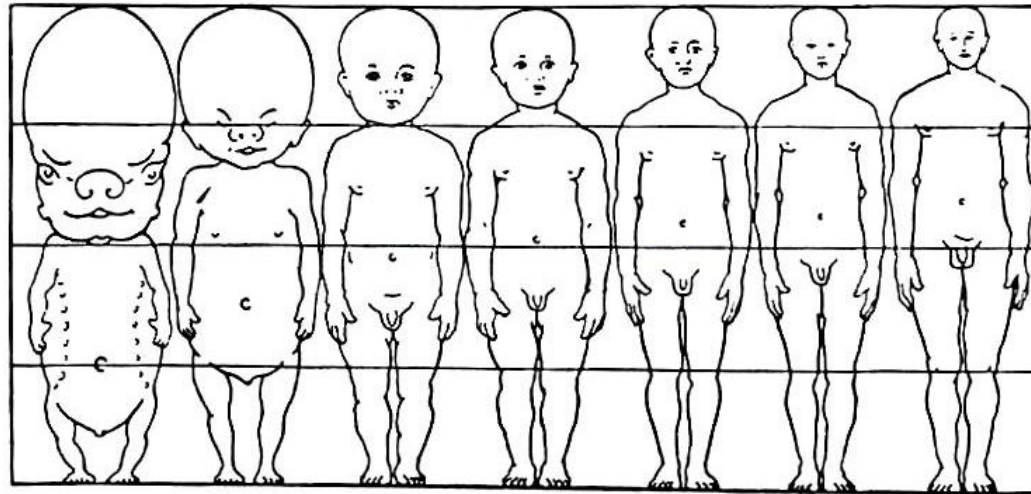


Vehicle-to-Vehicle Incompatibility



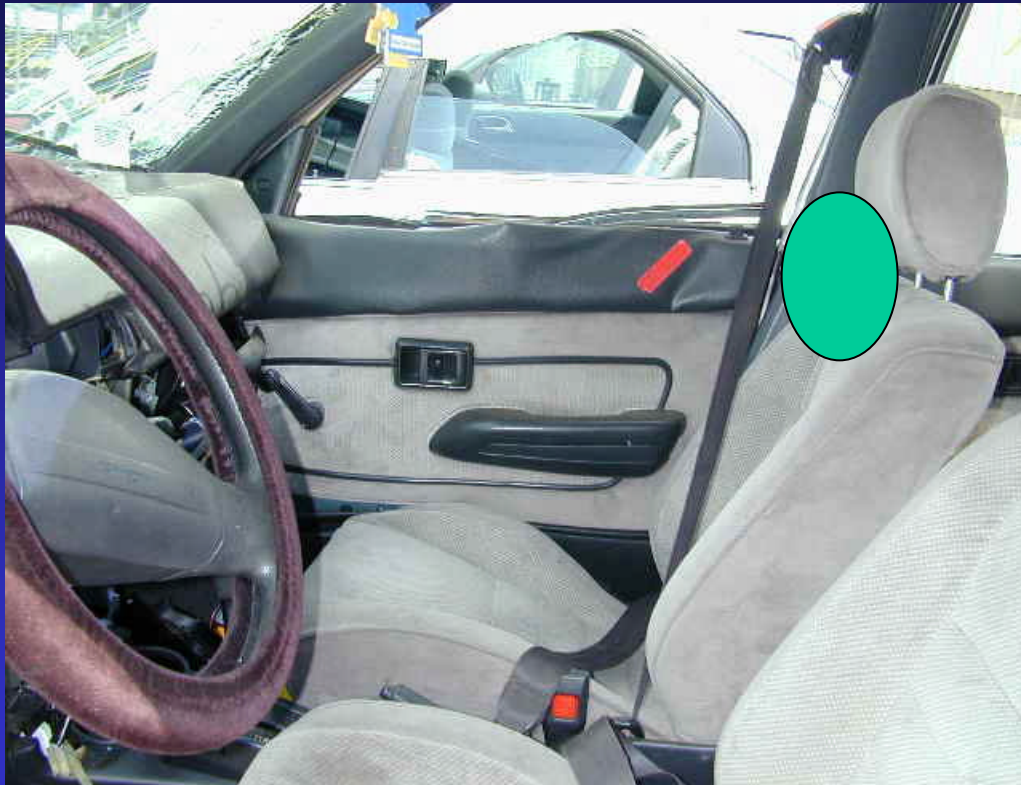
- Larger striking vehicles over-ride side impact barriers
- Increased risk of head & chest injury to near side occupant
- Head & chest injuries are more life threatening

Pediatric Anatomy



2 mo. (fetal) 5 mo. Newborn 2 yr. 6 yr. 12 yr. 25 yr.

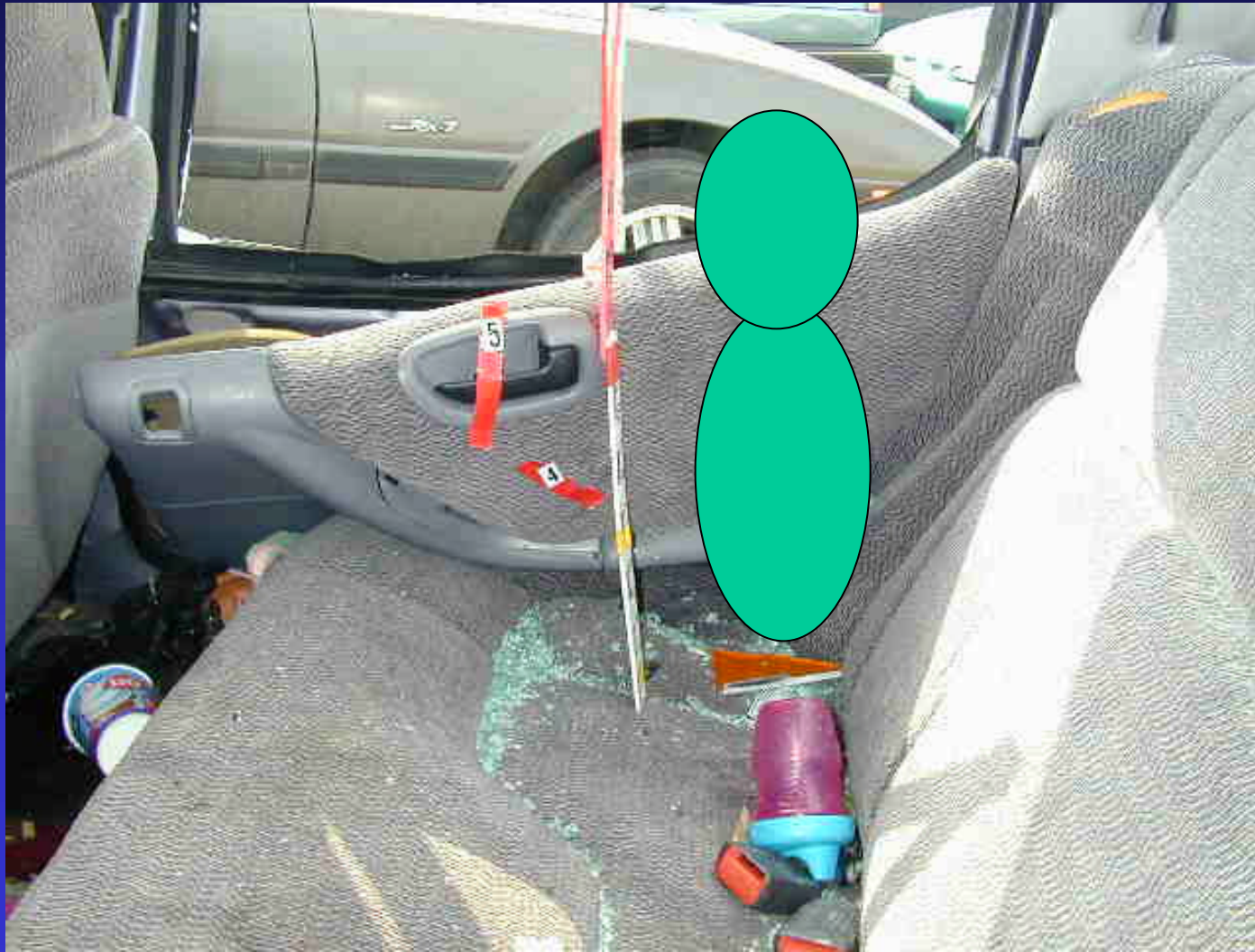
Pediatric Head Injury in Side Impact Crashes



Large Heads = More Surface Area Available for Contact

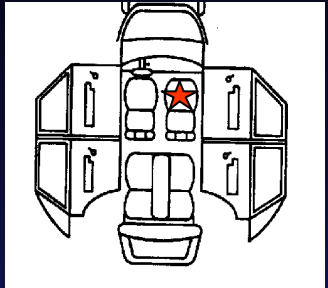
Head at Door Panel Level Increases Risk of Injury

Pediatric Head Injury in Side Impact Crashes

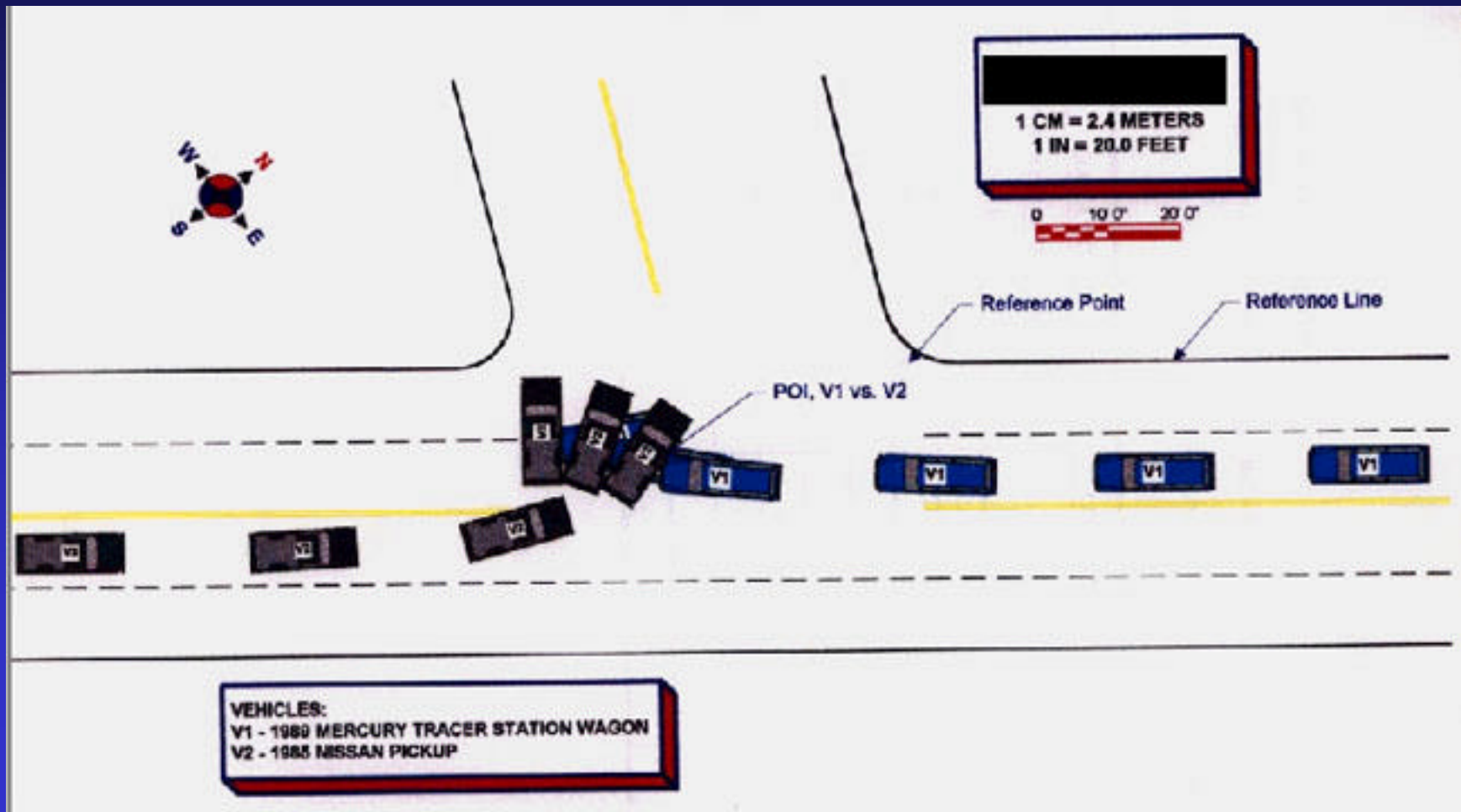


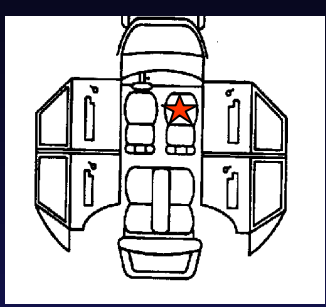
Case A. Frontal Impact Sedan Vs. SUV

- Frontal Impact
- 7 year-old female
- 57 pounds
- Right Front Passenger
- Lap portion of a 3-point restraint



Case A. Scene Diagram

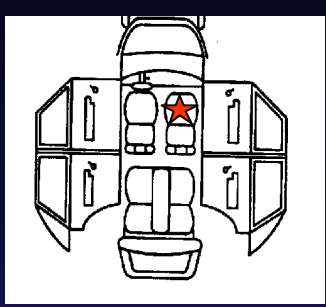




Case A. Case Vehicle



- V1: 1989 Mercury Tracer
- V2: 1985 Nissan Pickup
- Max Crush: 14.2 inches
- Delta V: 19 mph
- PDOF: 10 degrees



Case A. Seating Position

Right Front Seat



Instrument Panel Contact



Case A. External Injuries



Abdominal Ecchymosis

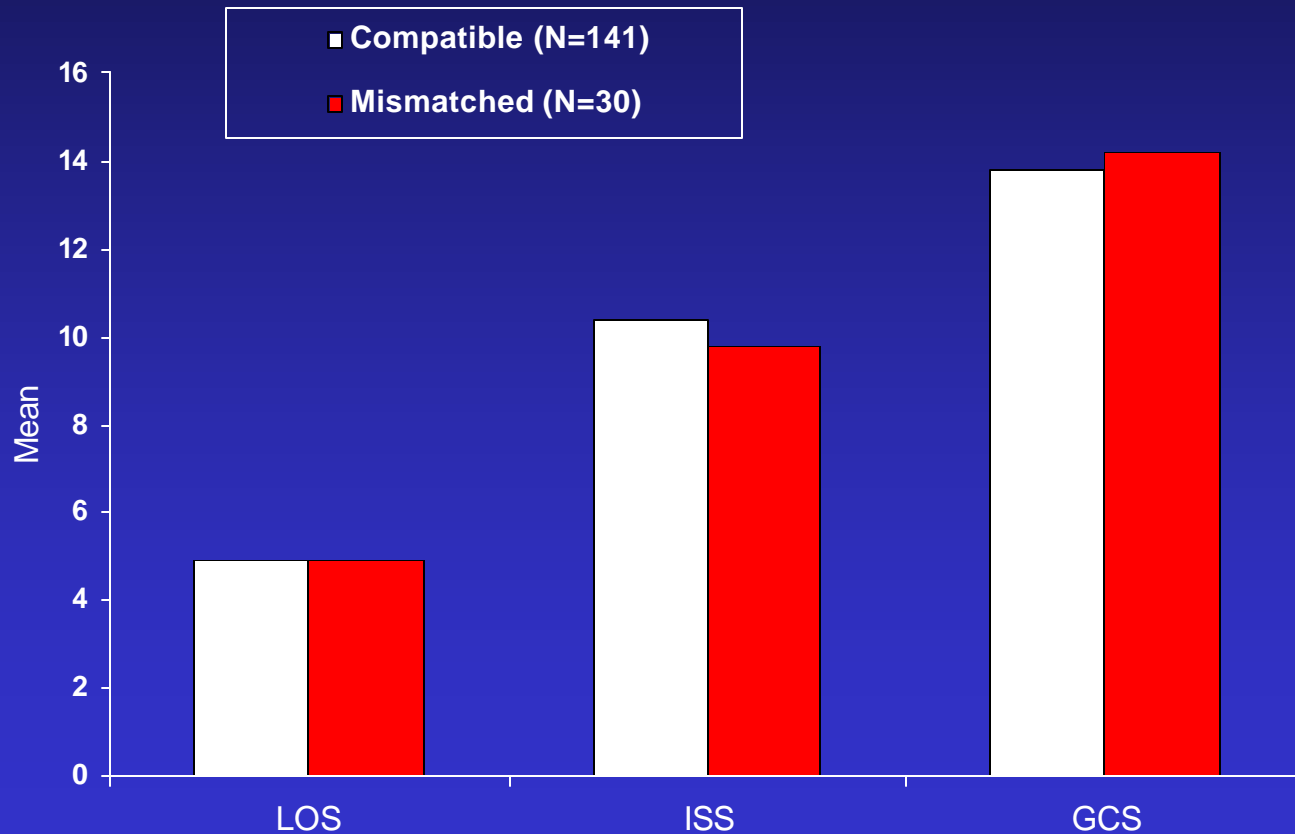


Left Upper Thigh Contusion

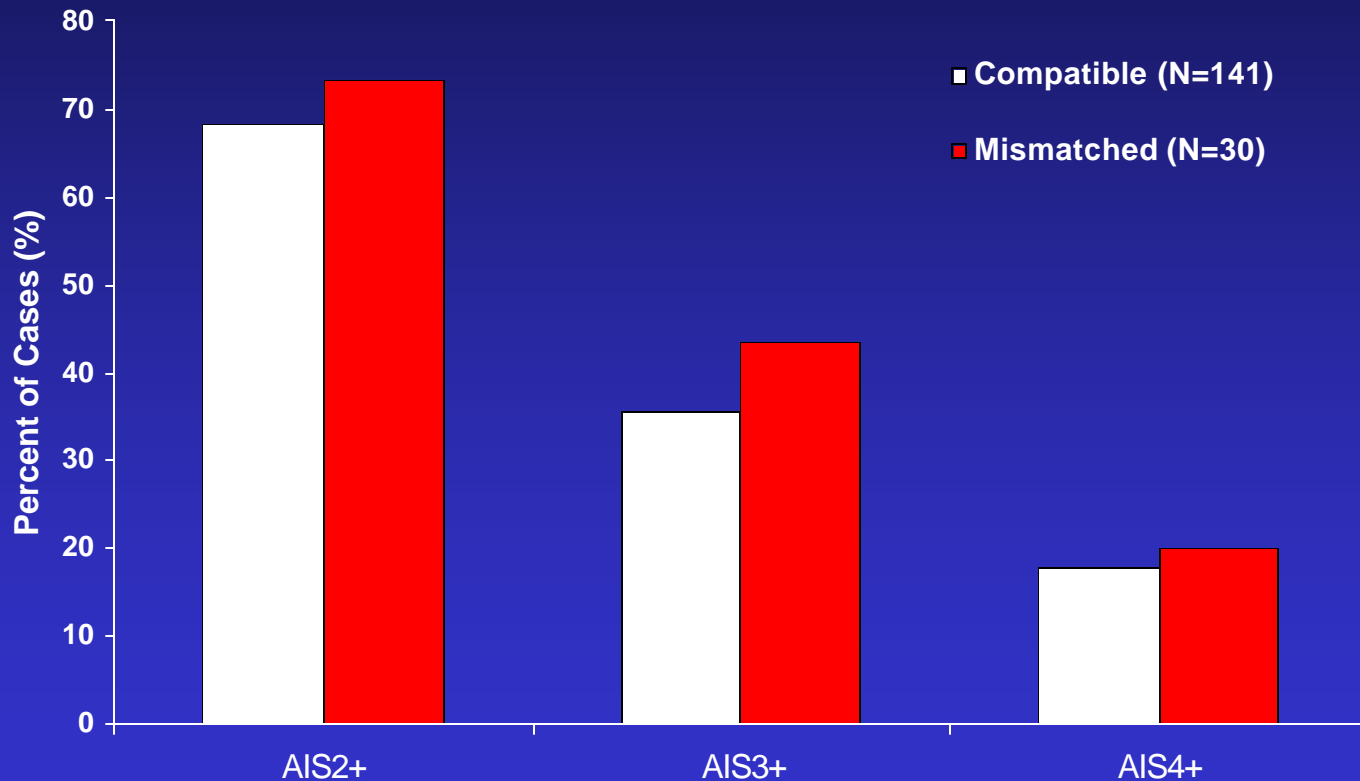


Right Arm Abrasion

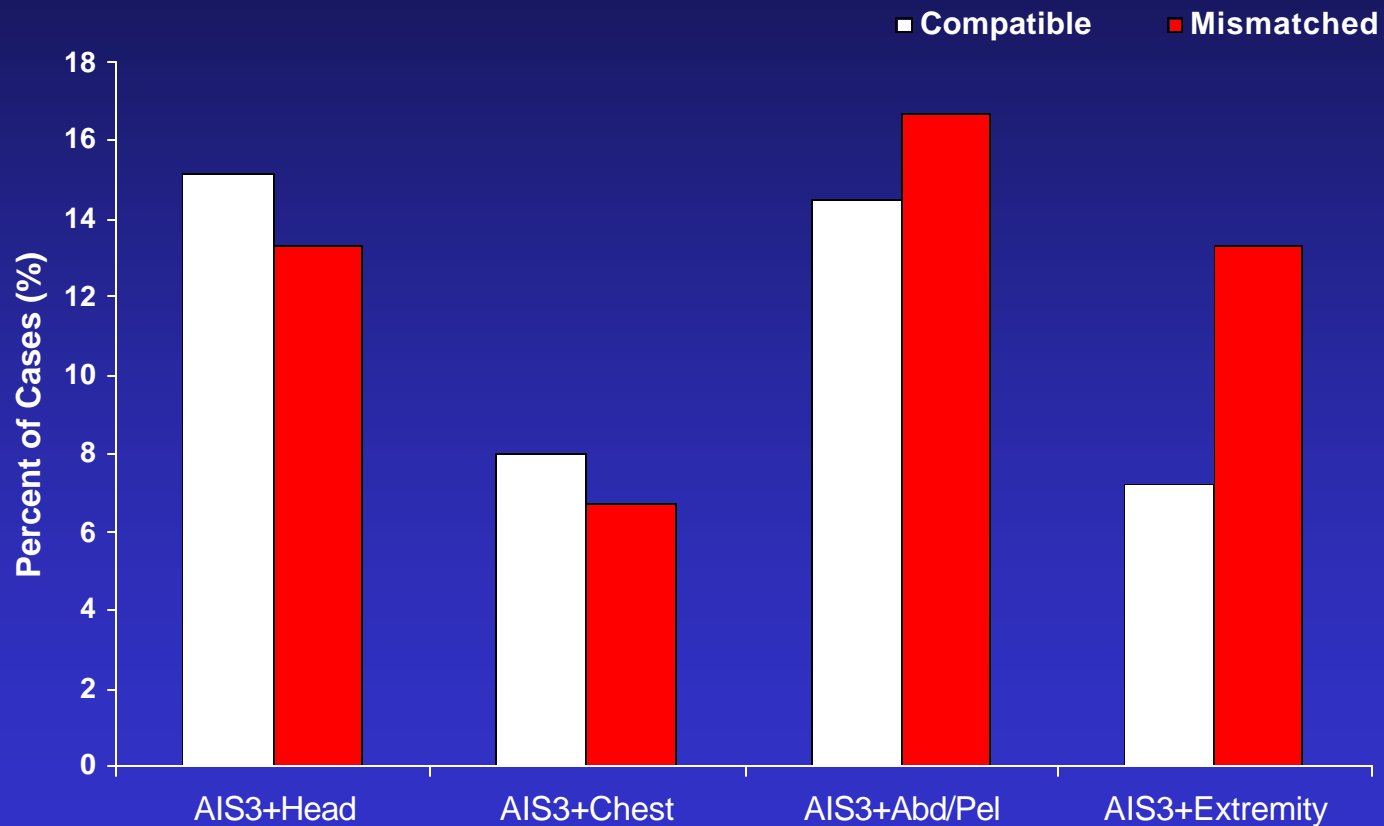
Injury Severity in Mismatched Frontal Impacts



Injury Severity in Mismatched Frontal Impacts

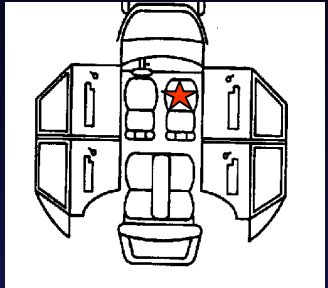


Injury Patterns in Mismatched Frontal Impacts

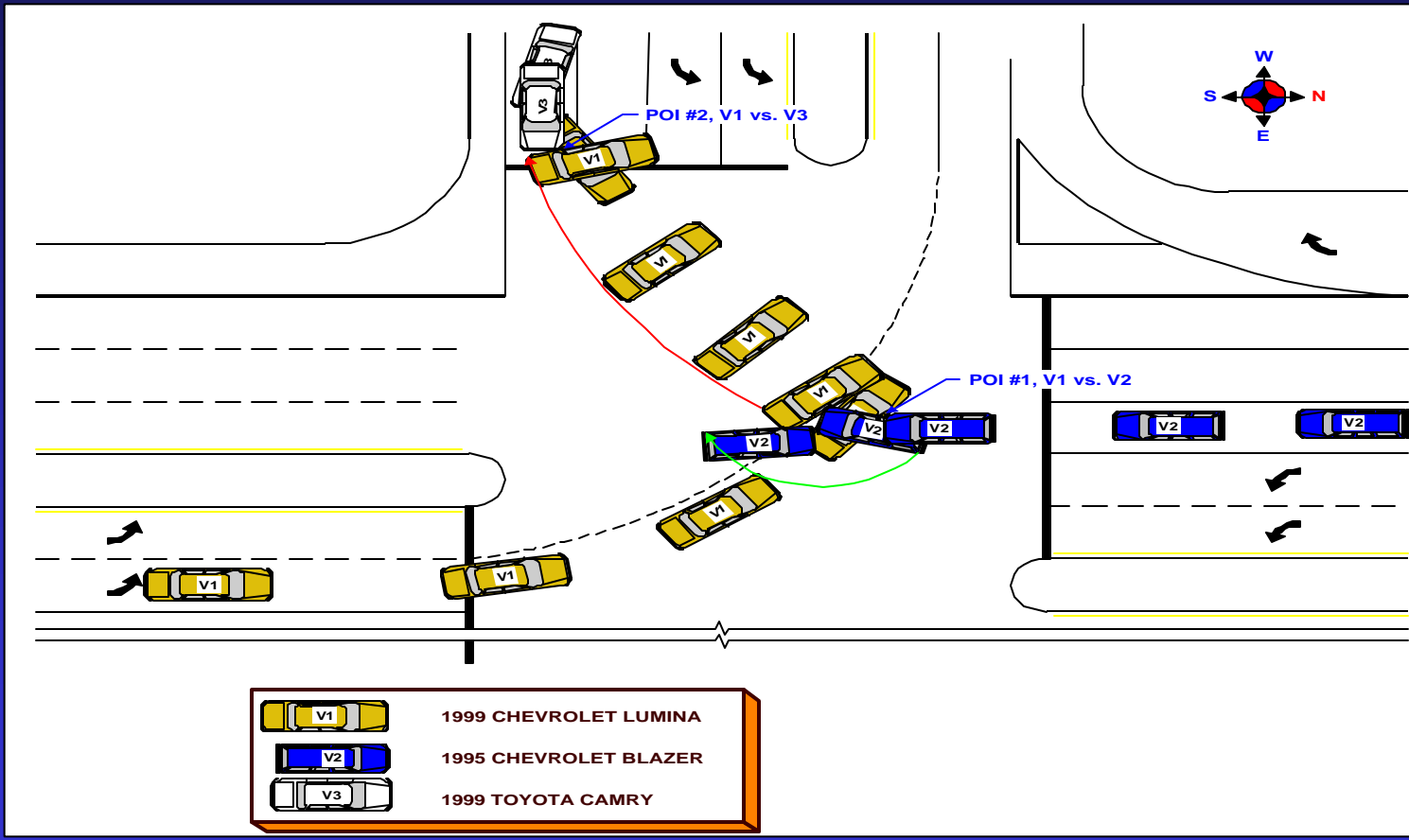


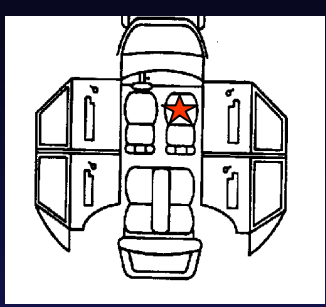
Case B: Side Impact Sedan Vs. SUV

- Lateral Impact
- 8 year-old male
- 79 lbs.
- Right Front Passenger
- 3-pt. Belt & Air bag



Case B. Scene Diagram

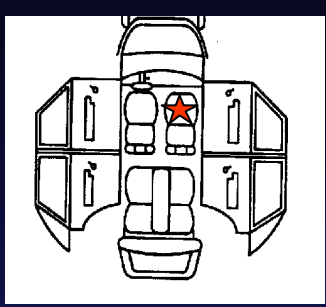




Case B. Case Vehicle



- V1: 1999 Chevy Lumina
- V2: 1995 Chevy Blazer
- Max Crush: 18.1 in.
- Delta V: 23 mph
- PDOF: 050



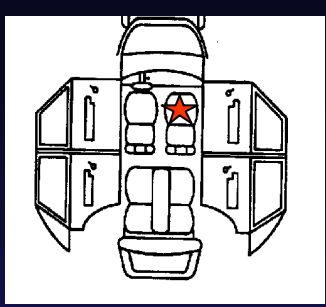
Case B. Vehicles

Case Occupant Seat



Opposing Vehicle





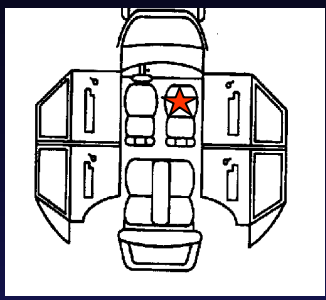
Case B. Vehicle Intrusion

Case Occupant Seat



Seat Intrusion

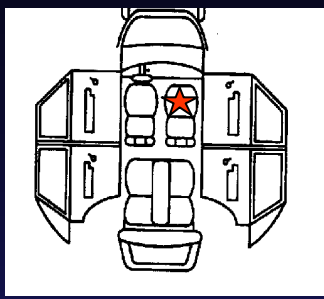




Case B. External Injuries

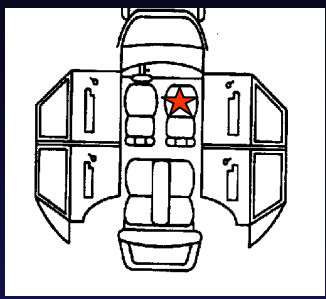


Right Knee Contusion



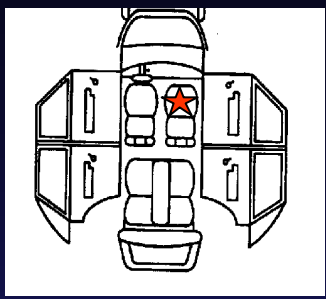
Case B. Brain Injuries

- Cerebellar Ischemia
 - Hydrocephalus
- Petechial Cerebellar Hemorrhage
- Tentorial Subdurals



Case B. Skull Fractures

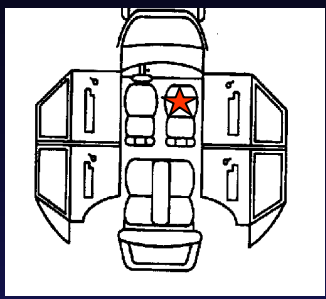
Multiple Occipital Fractures



Case B. Abdominal Injuries

Adrenal Hemorrhage

Liver Laceration



Case B. Internal Injuries

Blood in Morrison's Pouch

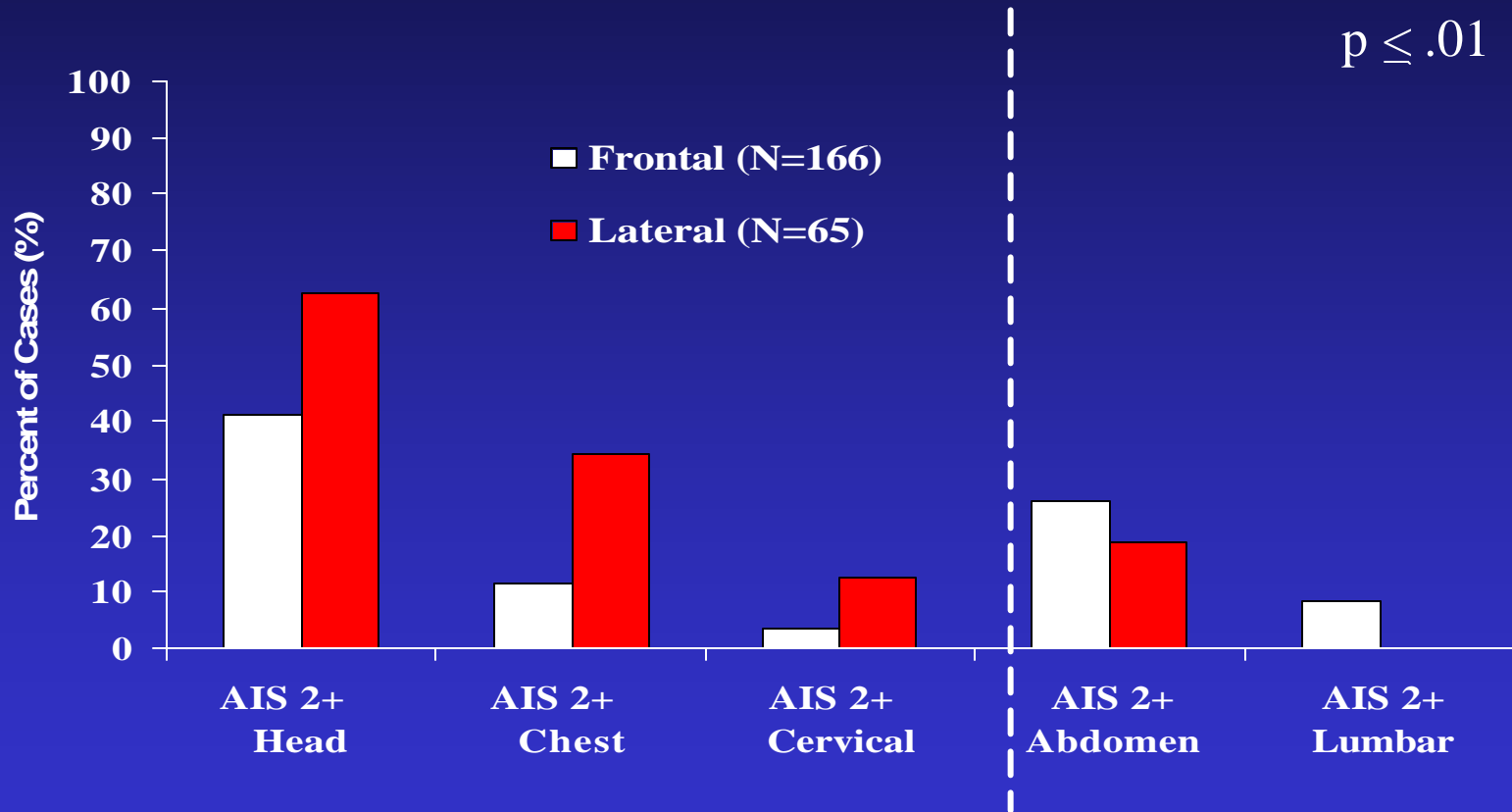
Lung Contusions

Side Impact Syndrome

Risk of Injury for Children in Side Impact Crashes

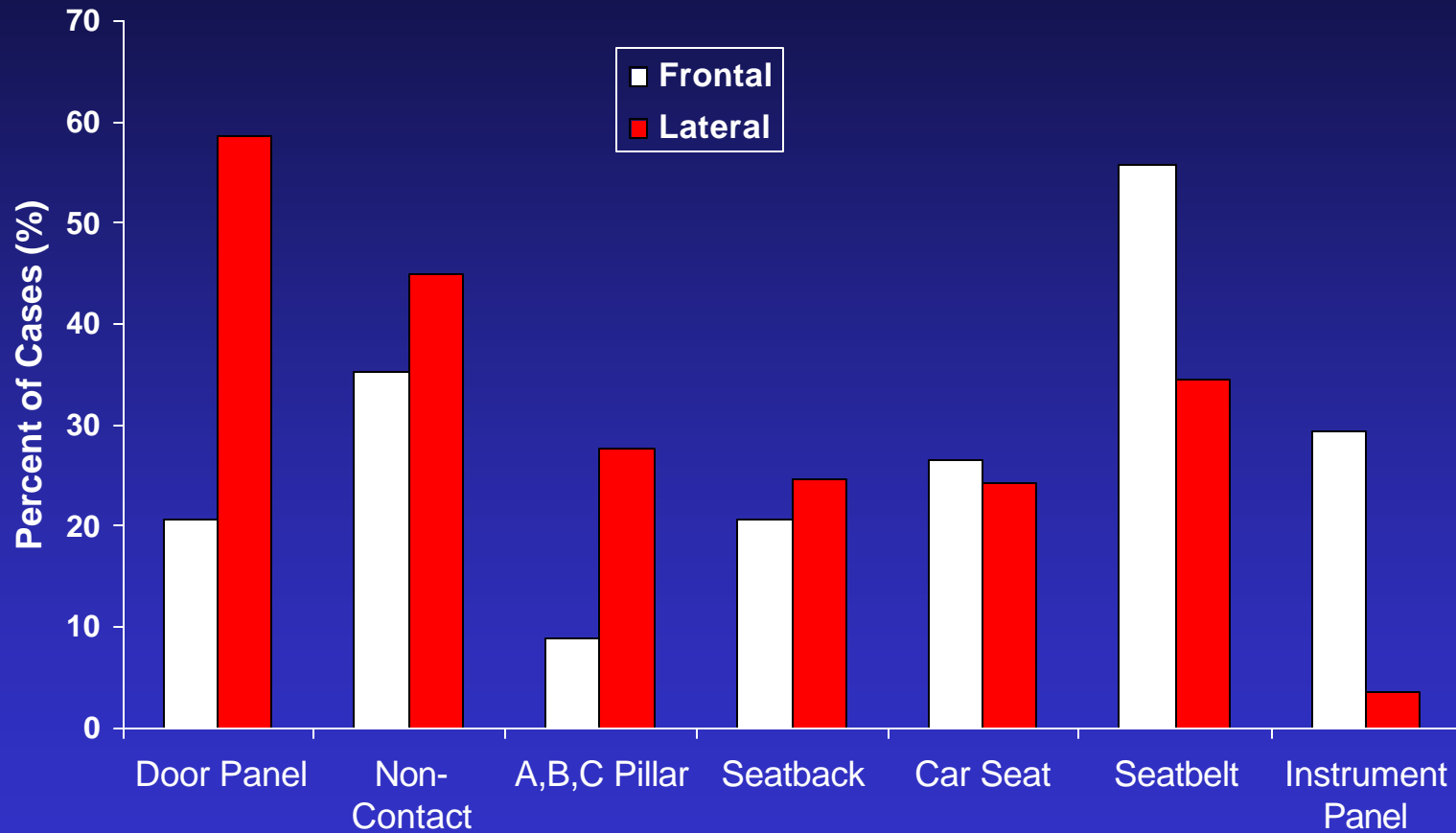
	Odds Ratio	95% CI	P-value
AIS2+	2.5	1.1, 5.5	.020
AIS3+	2.3	1.3, 4.0	.006
AIS4+	2.8	1.4, 5.2	.002
AIS5+	2.7	1.1, 6.2	.020
AIS2+ Head	2.5	1.4, 4.4	.003
AIS3+ Head	2.8	1.5, 5.3	.001
AIS4+ Head	3.4	1.6, 7.0	.001
AIS2+ Chest	4.0	2.0, 8.0	.000
AIS3+ Chest	4.8	2.3, 9.9	.000
AIS4+ Chest	4.3	1.5, 12.6	.008
AIS2+ Cervical	3.7	1.2, 11.3	.018
GCS <9	4.9	2.2, 10.6	.000
ISS > 15	3.1	1.7, 5.8	.000

Side Impact Syndrome



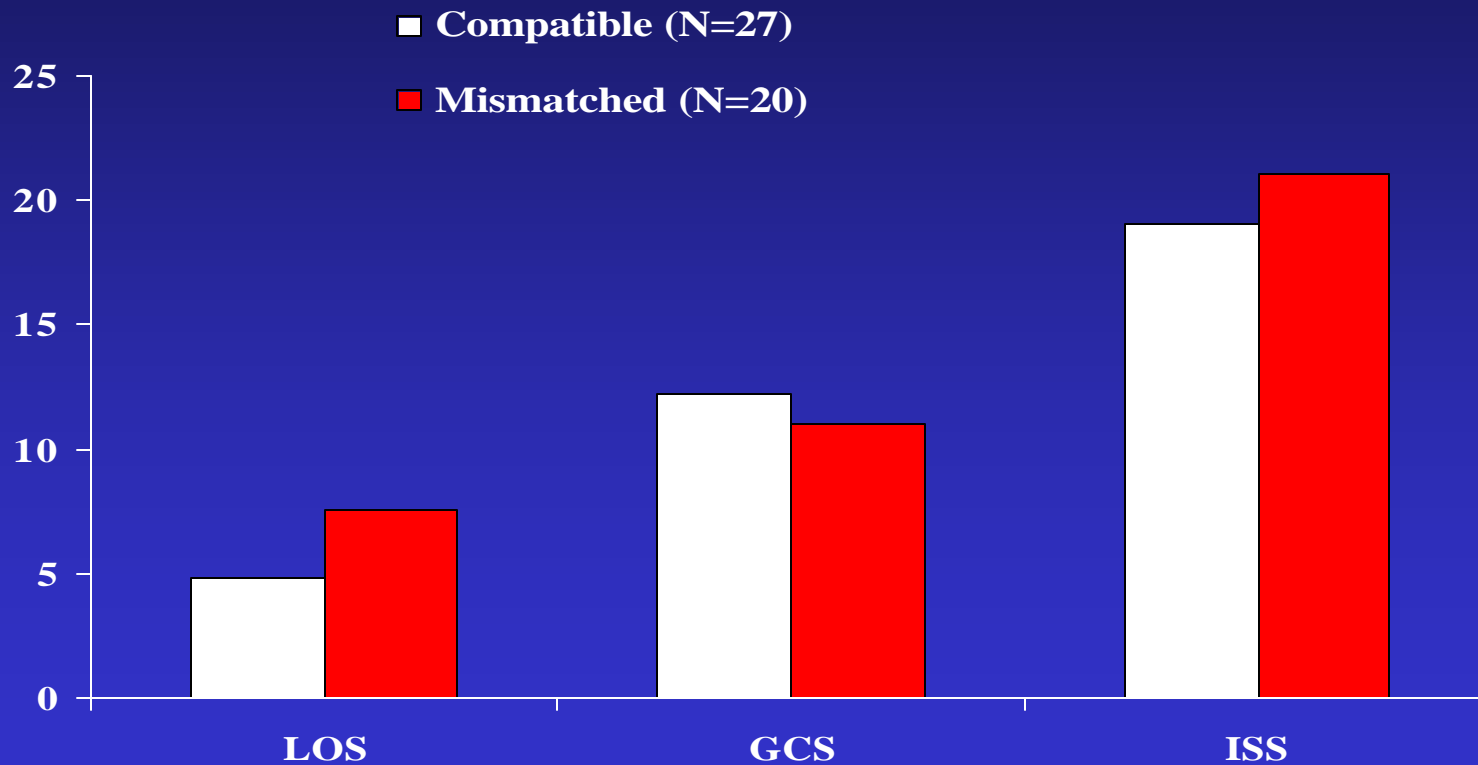
All Frontal Impacts Vs. All Lateral Impacts

Injury Contact Points for Seriously Injured Children

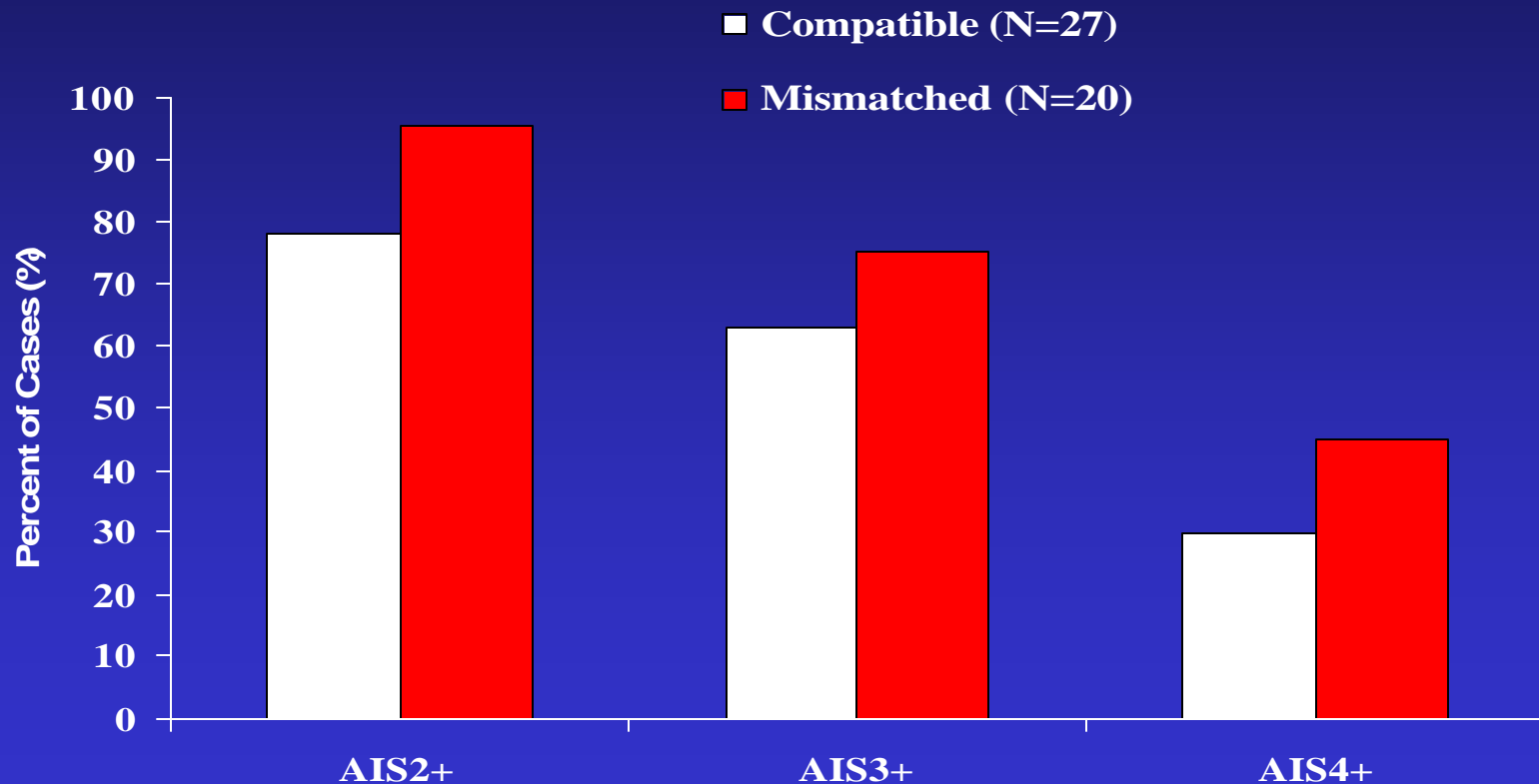


All frontal cases with ISS>15 compared to all lateral cases with ISS>15.

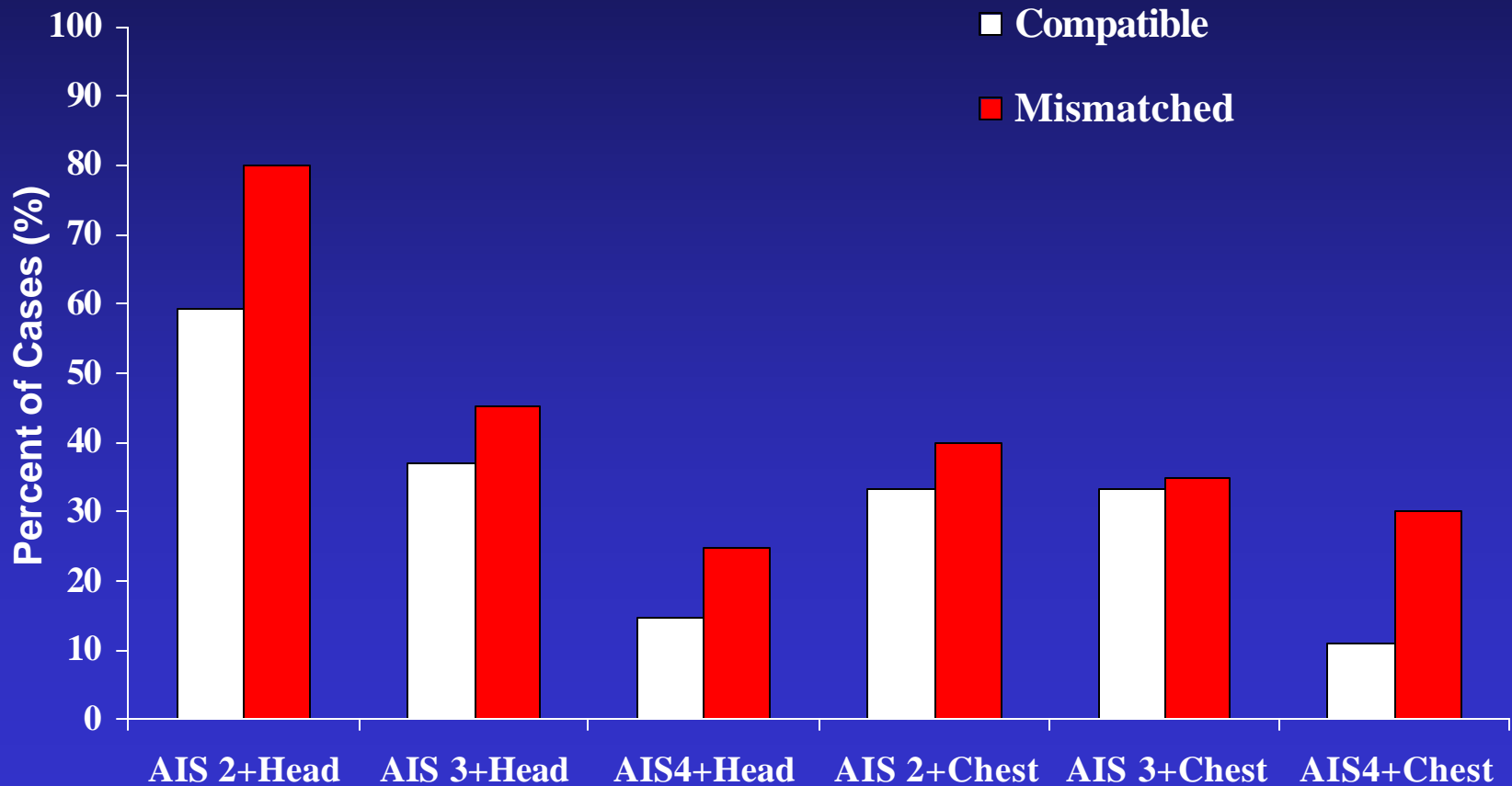
Injury Severity in Mismatched Near Side Impacts



Injury Severity in Mismatched Near Side Impacts



Injury Severity in Mismatched Near Side Impacts



Conclusions

- Side Impact Syndrome - Head, Neck, Chest
- Mismatched Side Crashes  ISS (Trend)

Potential Injury Reduction Methods

- Improved Child Safety Seat Designs
 - More Head Padding
 - Increased Depth of Head Wings
- Improved Child Seat Installation Technology
 - LATCH: Rigid versus Flexible
 - Some Sled Test Show that Rigid LATCH anchorage systems prevent occupant contact with door panel

Potential Injury Reduction Methods

- Increase Booster Seat Use
- Head Wings
- Improve Side Impact Protection Technology
- Develop Crash Test Dummy for Side Impact Tests
- Crash Testing of Mismatched Vehicles