

Occupant Injury Patterns in Side Pole Crashes

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Narrow-Object Side Impacts



- ◆ Single vehicle crash
- ◆ Potential for severe trauma
- ◆ Greater / concentrated levels of intrusion
- ◆ Ways to reduce injury?
- ◆ What can side airbags do?

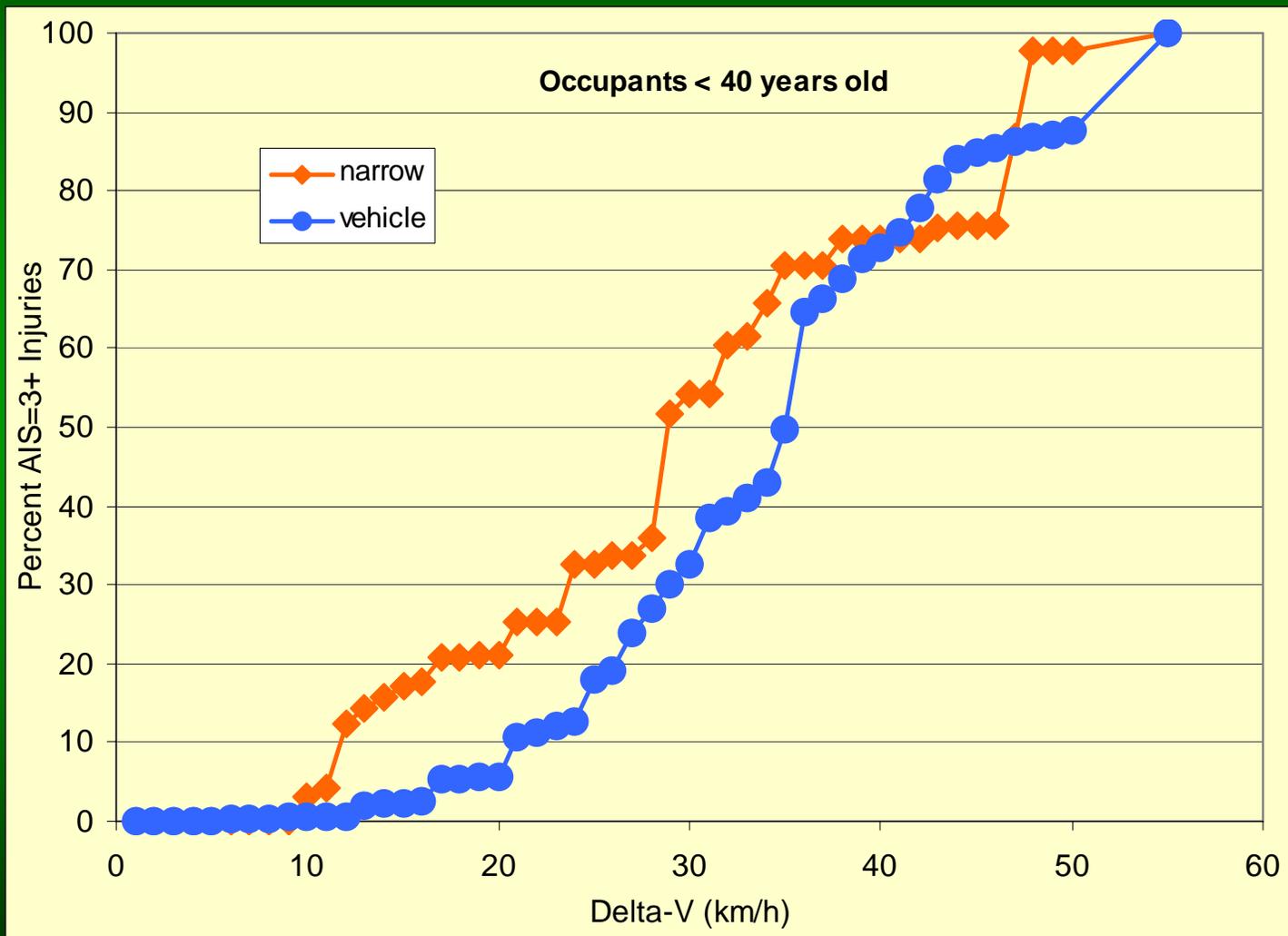
Narrow-Object Side Impacts

CIREN Analysis

- ◆ Query CIREN database
- ◆ Near side 8-10 or 2-4 pole/tree crashes
- ◆ Apply Biomechanics Tab coding
- ◆ Characterize Injury Patterns

NASS Data

Narrow-object versus Car-to-car

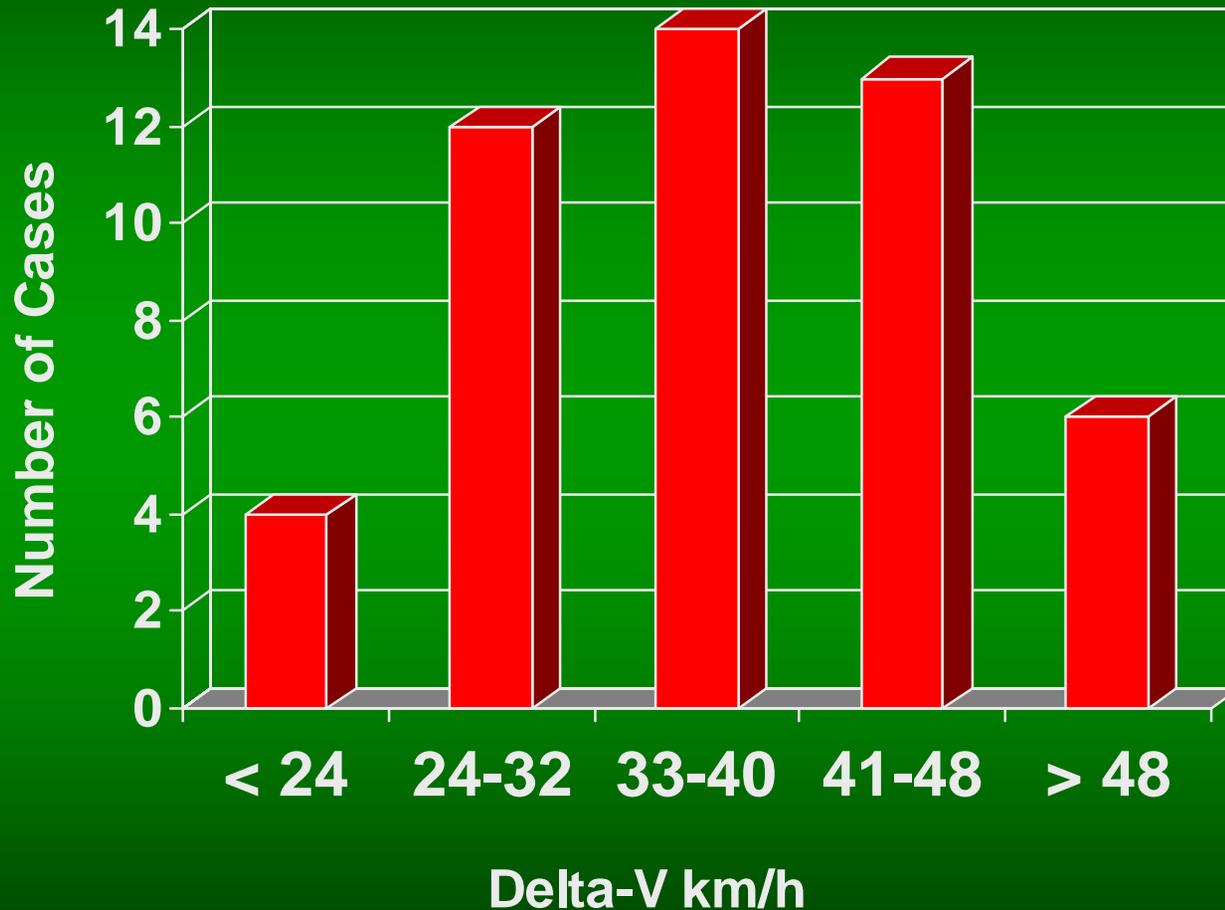


Narrow Object Side Impacts

CIREN Case Analysis

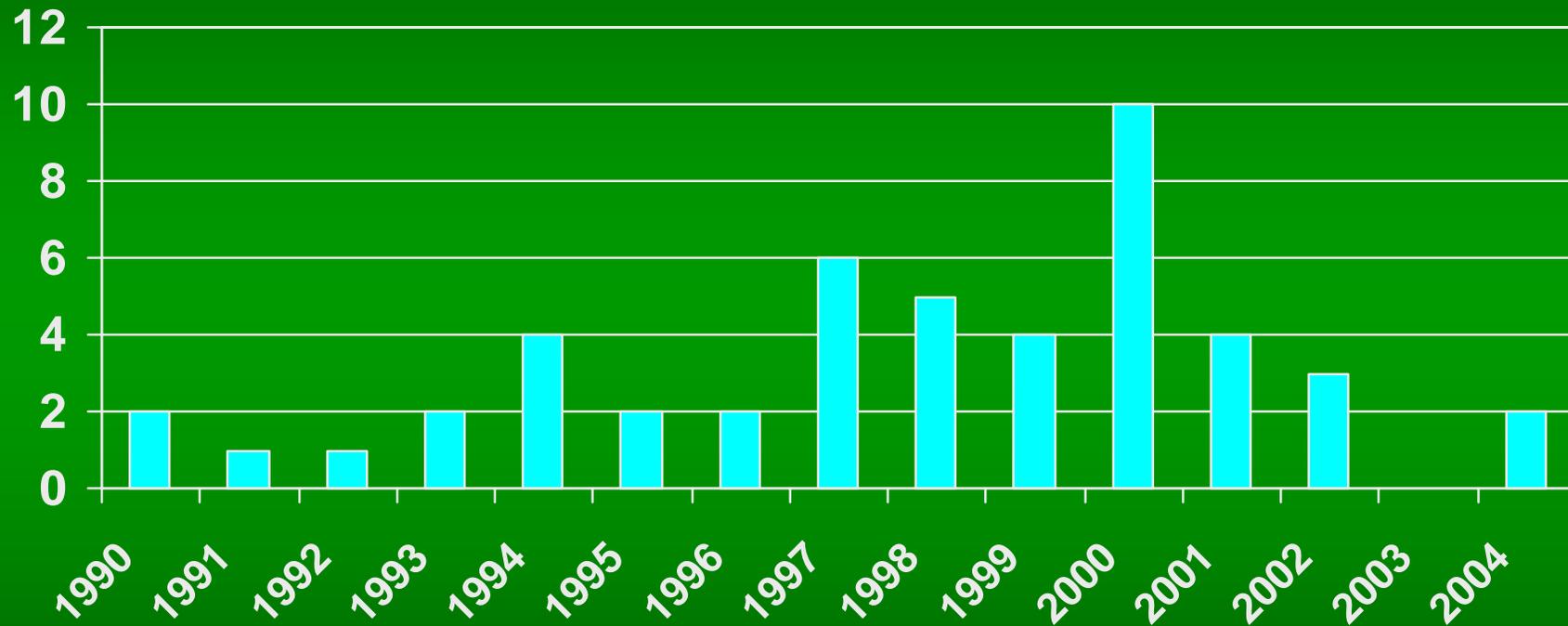
- ◆ 49 analyzed
- ◆ Of the 49:
 - 25 males, 24 females
 - 15 age 10-18 YO; 34 age 19-63 YO
 - 35 drivers; 14 passengers
 - Belt use: 38 yes, 11 no
- ◆ CIREN inclusion
 - Late-model vehicles 1990 – 2004
 - AIS=3+ or multiple AIS=2 injuries

Narrow-Object CIREN Cases



Narrow-Object CIREN Cases

Number of Cases by Vehicle Model Year



Narrow Object Side Impacts

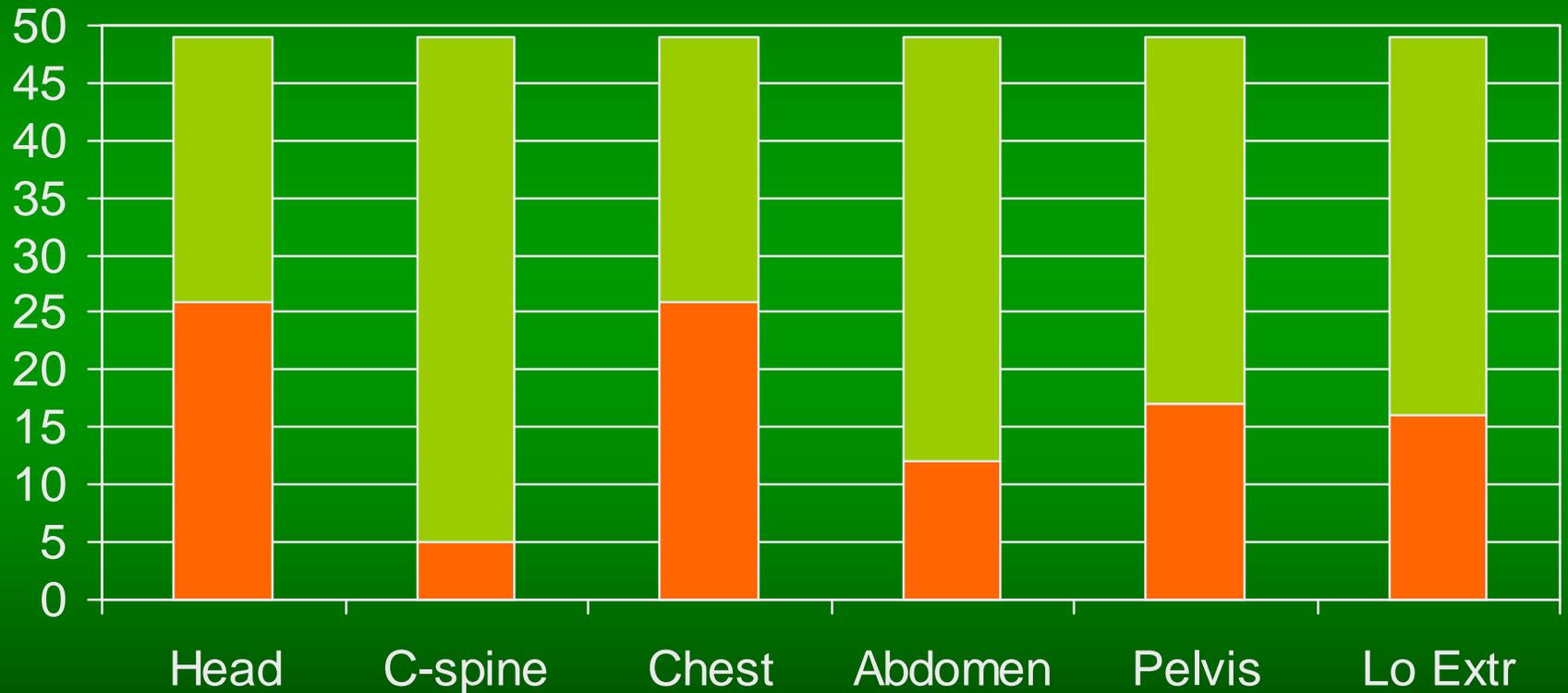
CIREN Case Analysis

- ◆ 26 of 49 with Thorax Injury
- ◆ 26 of 49 with Head Injury
- ◆ 17 of 49 with Pelvic Injury
- ◆ 16 of 49 with Lower Extremity Injury
- ◆ 12 of 49 with Abdomen Injury
- ◆ 5 of 49 with Cervical Spine Injury
- ◆ 4 of 49 with Upper Extremity Injury



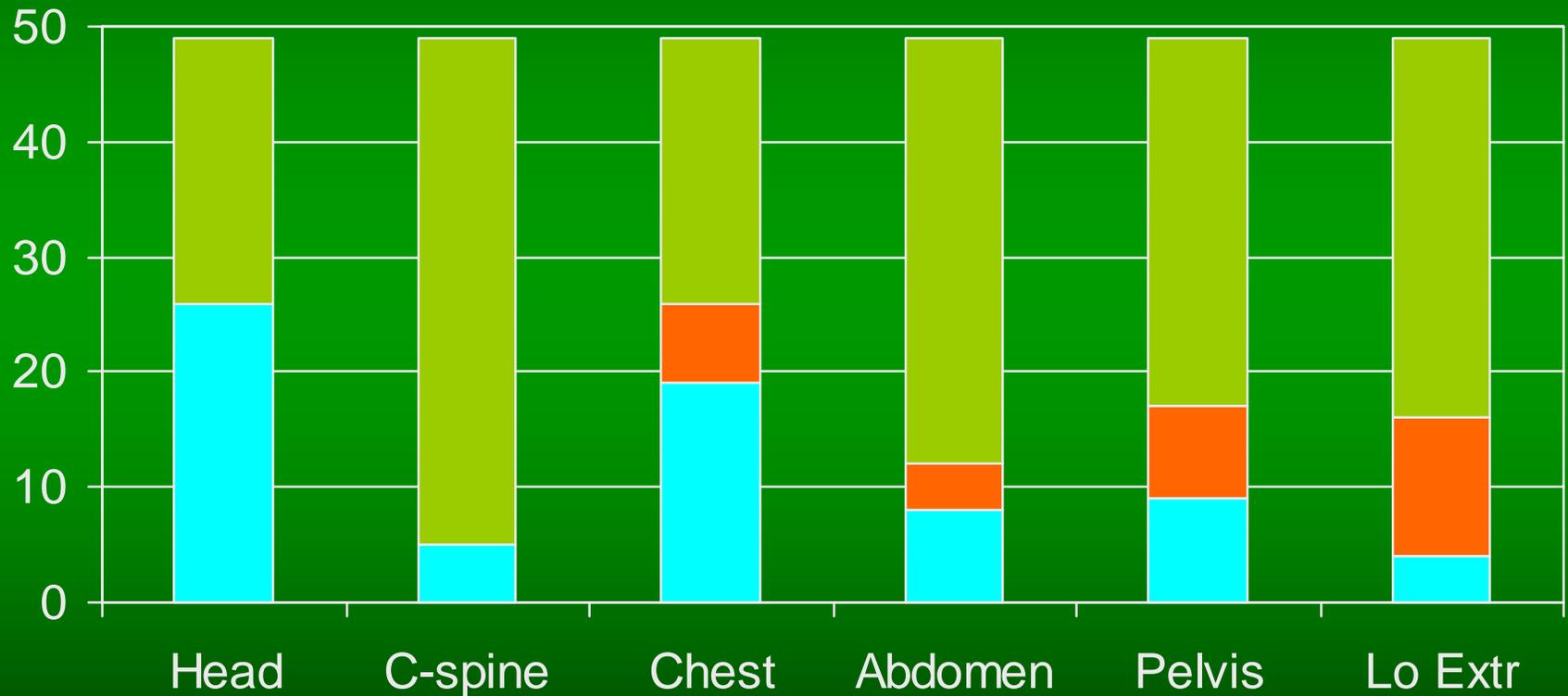
Narrow Object Side Impacts CIREN Case Analysis

Number of Occupants with Trauma to Body Region



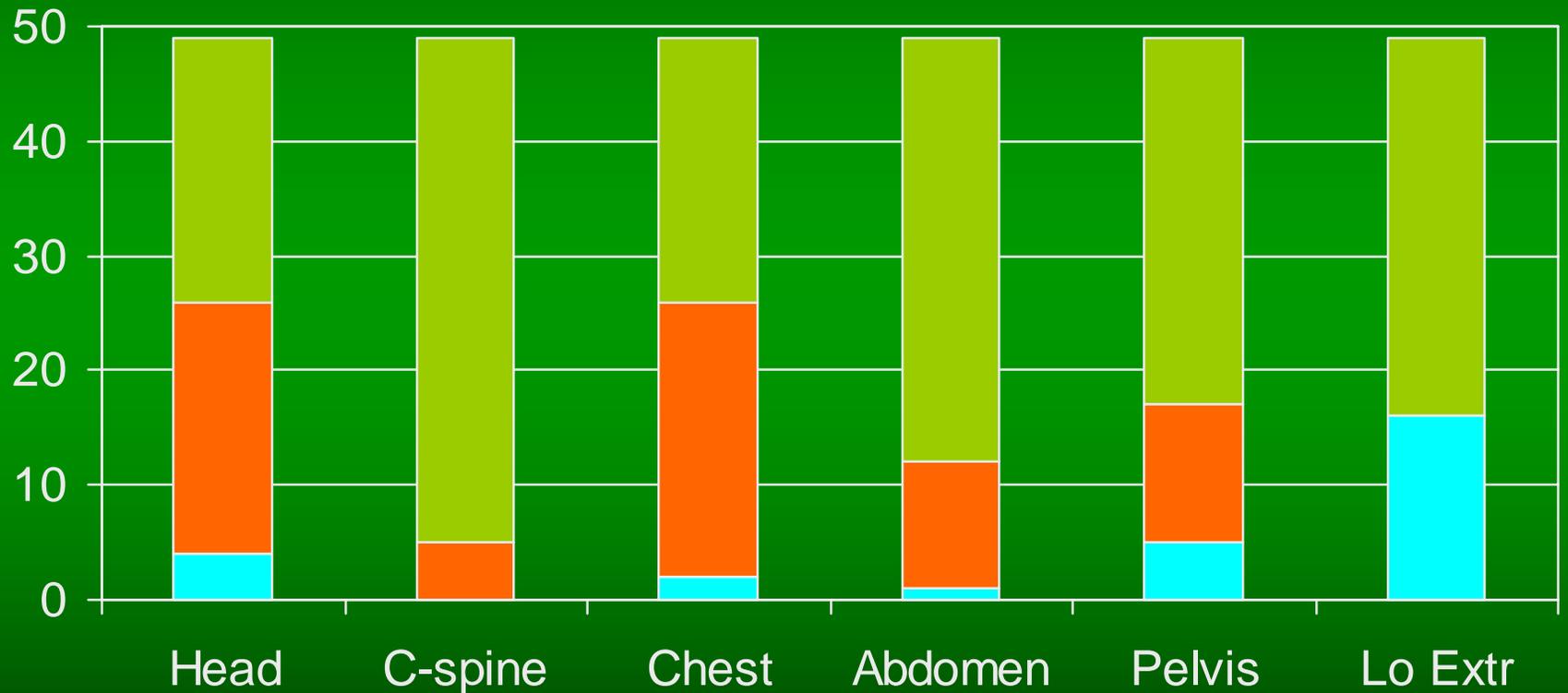
Narrow Object Side Impacts CIREN Case Analysis

Number of Occupants with Associated Head Trauma

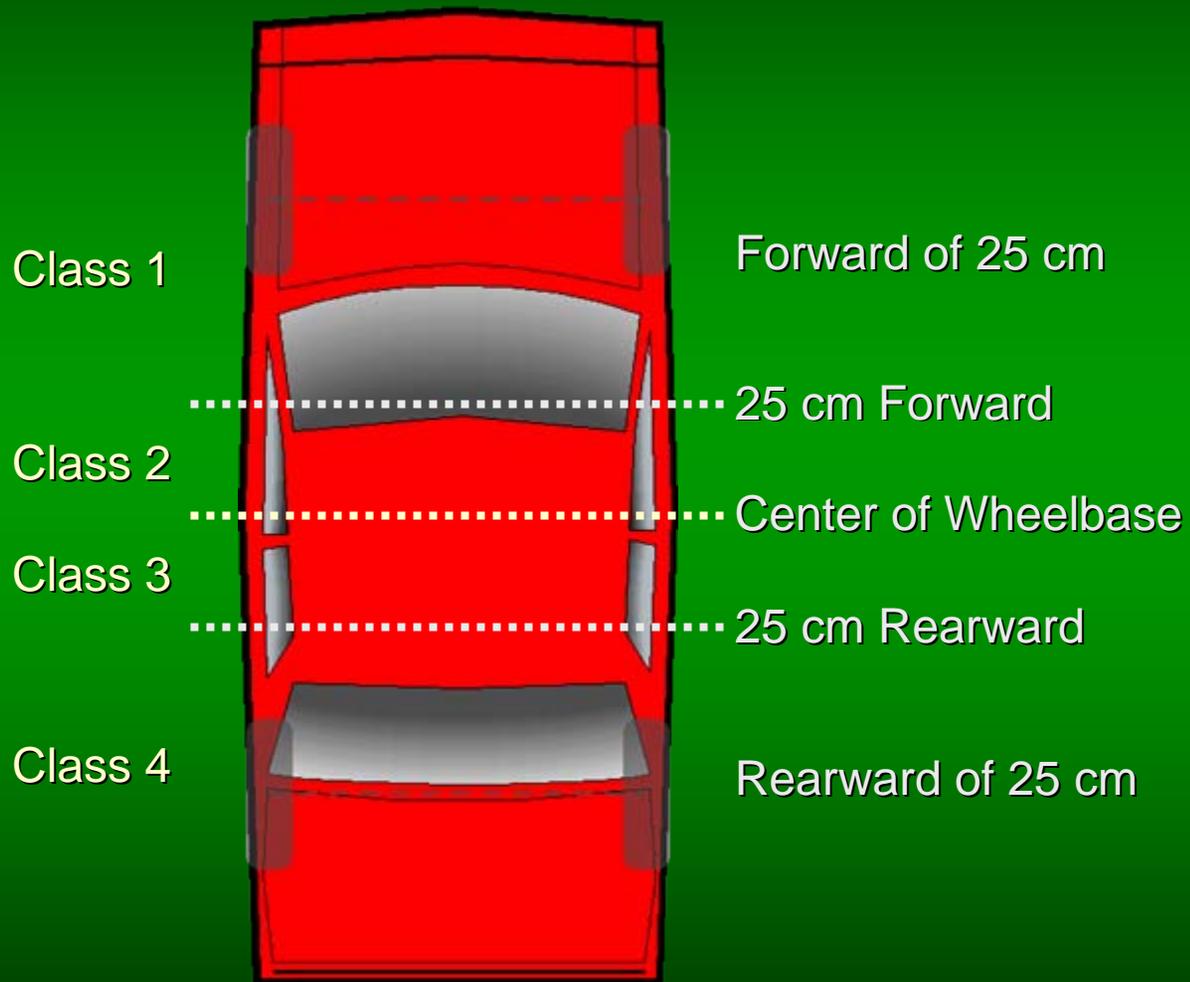


Narrow Object Side Impacts CIREN Case Analysis

Number of Occupants with Associated **Lo Extremity Trauma**

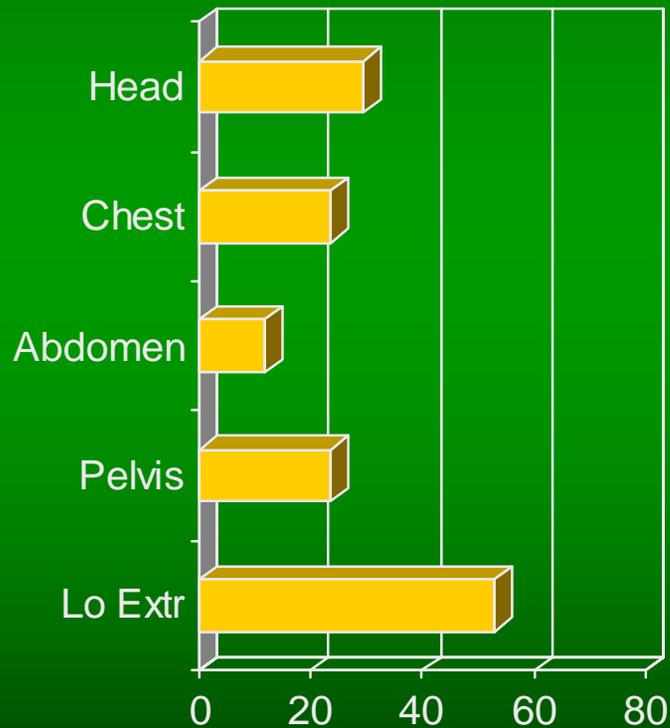


Narrow Object Side Impact Location

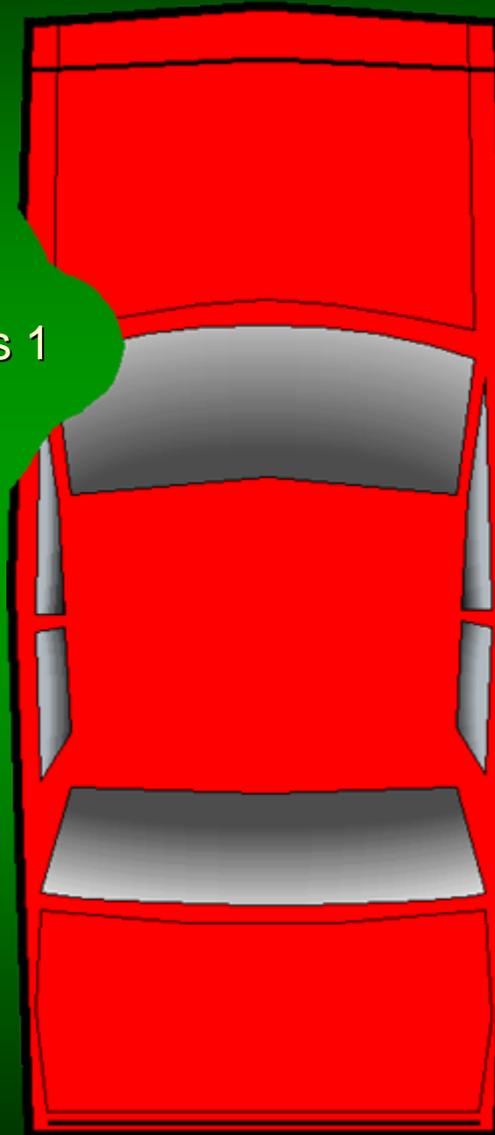


Narrow Object Side Impact Location

17 Total Class 1 Cases
Percent of occupants with injury

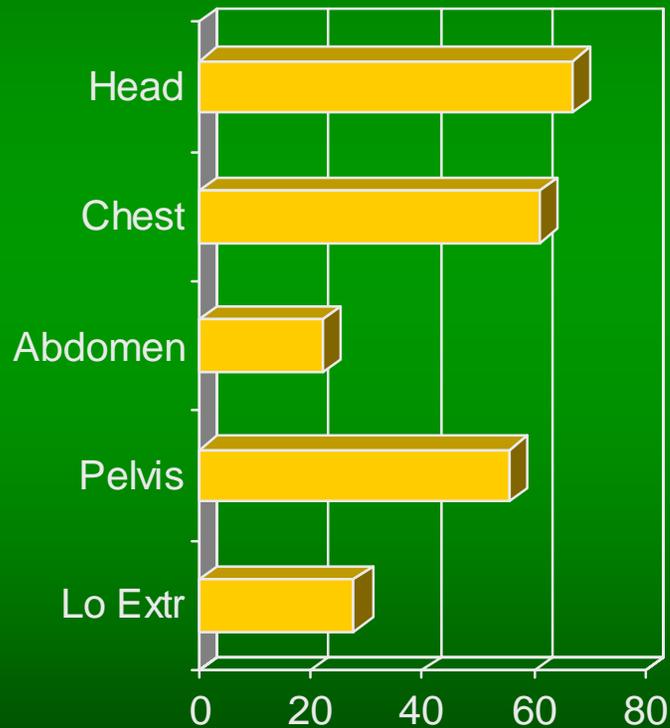


Class 1

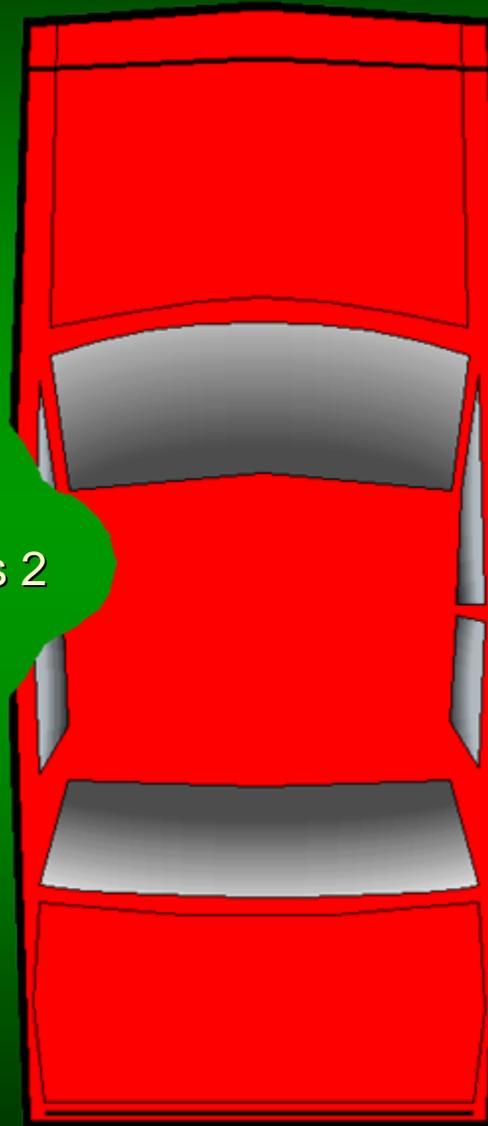


Narrow Object Side Impact Location

18 Total Class 1 Cases
Percent of occupants with injury

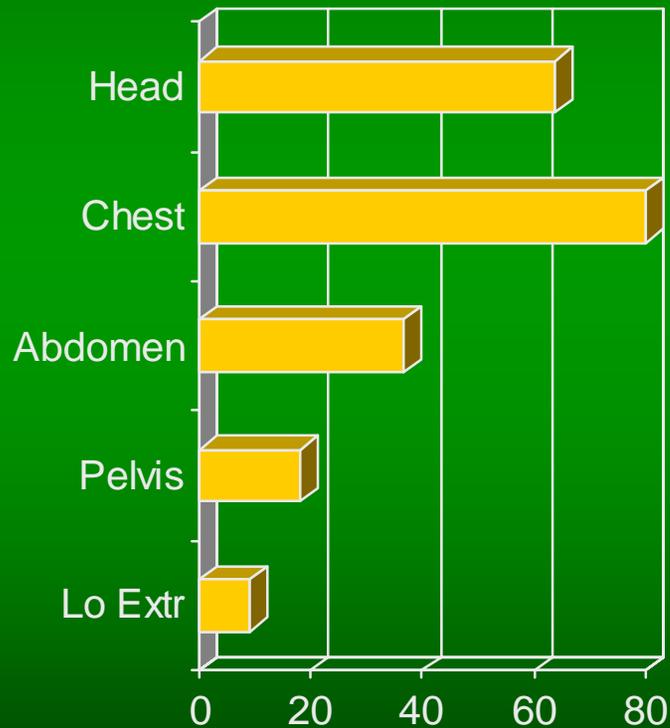


Class 2

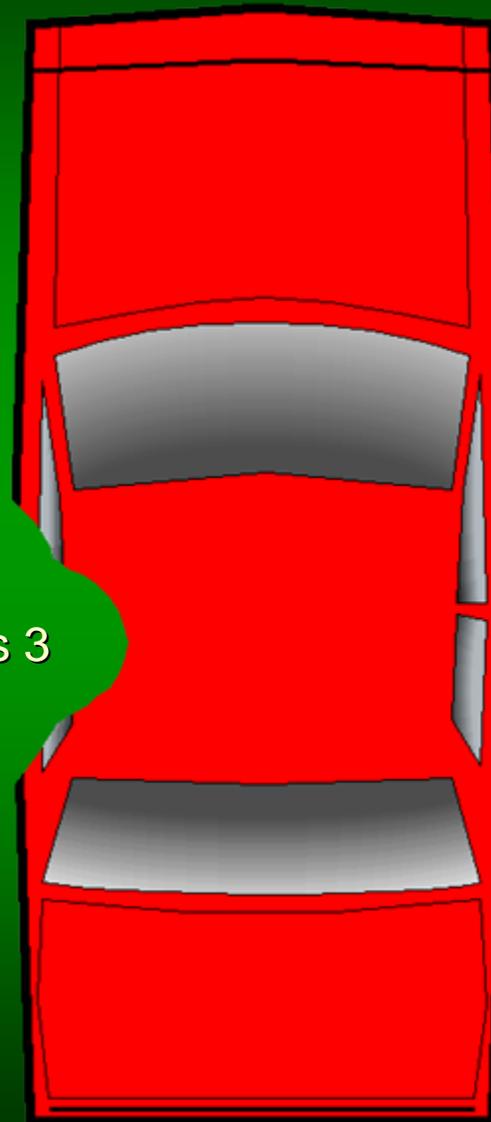


Narrow Object Side Impact Location

11 Total Class 1 Cases
Percent of occupants with injury



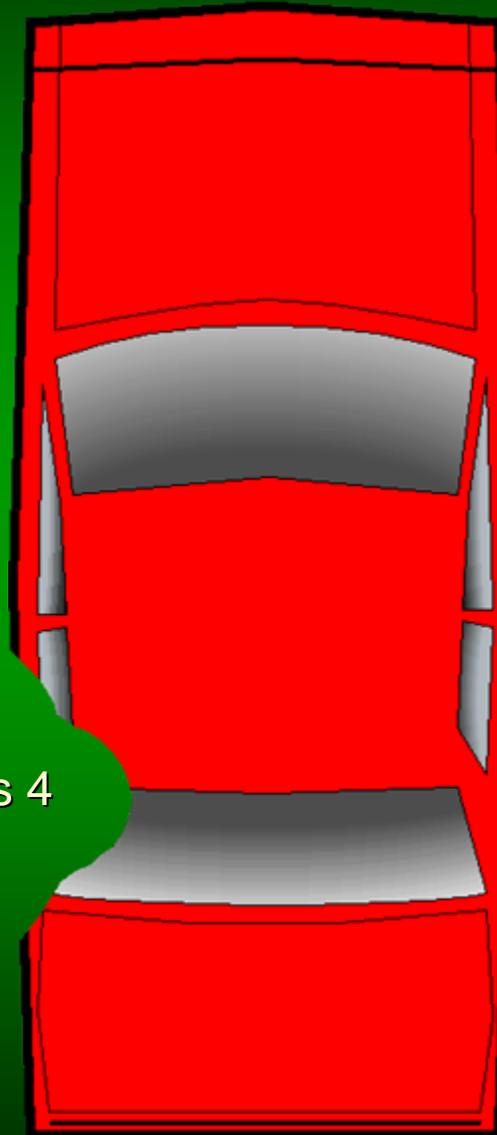
Class 3



Narrow Object Side Impact Location

Less than 5 cases

Class 4



Head Trauma in Narrow Object Side Impacts

CIREN Case Analysis

- ◆ 26 of 49 cases had Head injury
 - 10 had skull fractures; 8 were skull base
 - 17 had hemorrhage; subdural, subarachnoid...
 - 4 had LOC; 3 had DAI
 - 4 had isolated head injuries
 - 19 had associated chest trauma
 - 8 had associated abdomen trauma
 - 5 had associated C-spine trauma
 - 9 had associated pelvis trauma
 - 4 had associated low extremity trauma

Head Trauma in Narrow Object Side Impacts CIREN Case Analysis

Percent of Head-Injured Occupants with Associated Trauma



Head Trauma in Narrow Object Side Impacts Involved Physical Component using Bio-Tab

- ◆ Object intrusion location Class 2, 3
- ◆ 13 / 26 contacted object (pole, tree)
- ◆ 9 / 26 A-, B-pillar, or roof side rail
- ◆ 3 / 26 contacted door

Head Trauma in Narrow Object Side Impacts

Effect of Stature

- ◆ 3 with door contact
 - 11 year old male, 152 cm
 - 17 year old female, 160 cm
 - 18 year old male, 157 cm
- ◆ Small stature occupants

Head Trauma in Narrow Object Side Impacts

Involved Physical Component

Effect of Stature

- ◆ 9 with A-, B-Pillar, Roof Rail contact
 - 3 Roof side rail contact
 - ◆ Occupants 183, 185, 188 cm height
 - 4 B-pillar contact
 - ◆ Occupants 163, 168, 168, 183 cm height
 - ◆ Class 1, 2, 3, 4
 - ◆ PDOF; kinematics; seat position
 - 1 A-pillar contact
 - ◆ Occupant 196 cm; Class 1 impact
 - 1 Roof contact with intrusion

Head Trauma in Narrow Object Side Impacts Involved Physical Component Effect of Stature

- ◆ 13 with Pole / Tree contact
 - 3 in Class 1
 - ◆ Occupants 163, 168, 188 cm height
 - 7 in Class 2
 - ◆ Occupants 152 to 178 cm height
 - 3 in Class 3
 - ◆ Occupants 163, 165, 183 cm height

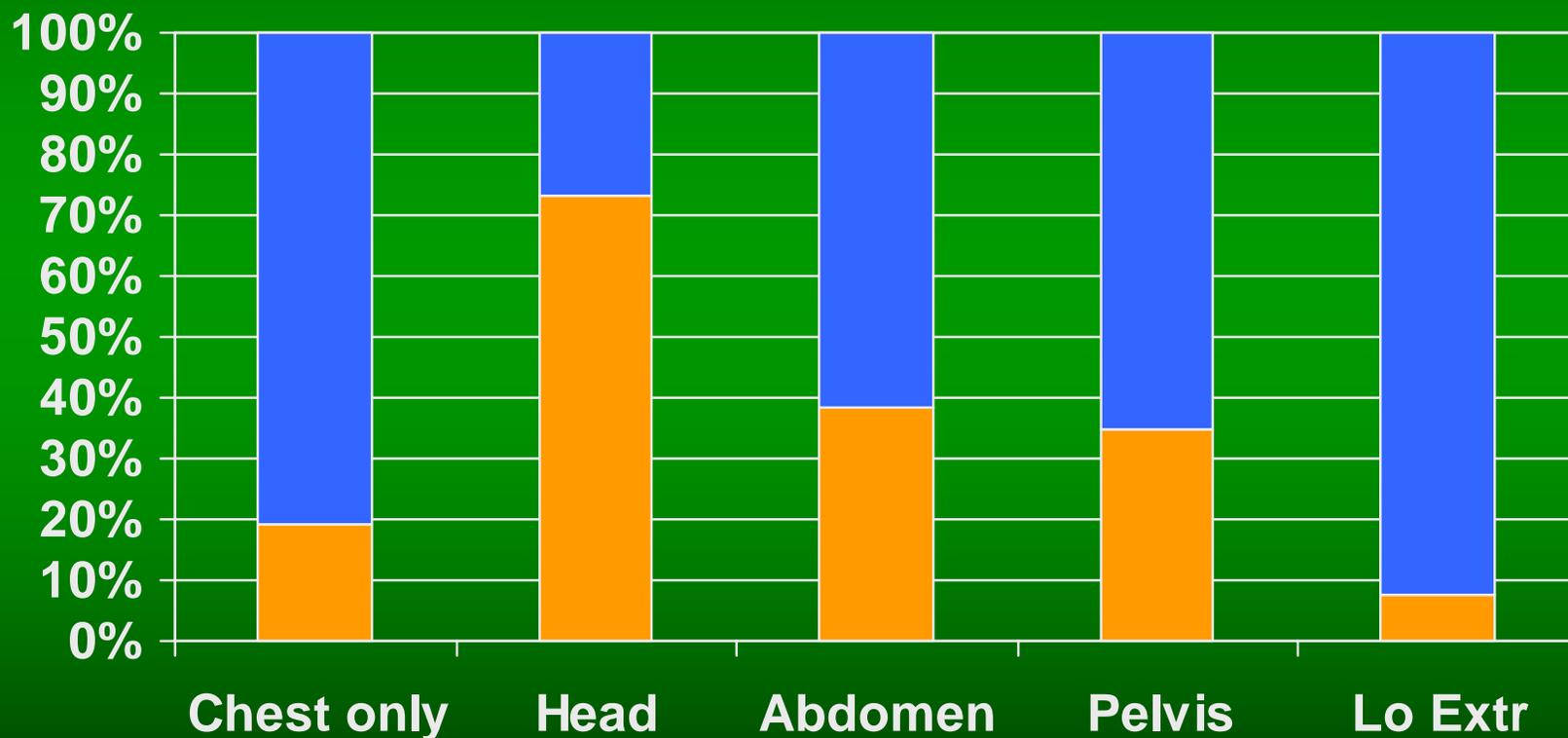
Chest Trauma in Narrow Object Side Impacts

CIREN Case Analysis

- ◆ 26 of 49 cases had Thorax injury
 - 17 had lung contusion
 - 19 had rib fractures
 - 4 had isolated thorax injuries
 - 19 had associated head trauma
 - 10 had associated abdomen trauma
 - 5 had associated C-spine trauma
 - 9 had associated pelvis trauma
 - 2 had associated low extremity trauma

Chest Trauma in Narrow Object Side Impacts CIREN Case Analysis

Percent of Chest-Injured Occupants with Associated Trauma



Chest Trauma in Narrow Object Side Impacts Involved Physical Component

- ◆ 25 / 26 contact with intruding door
- ◆ Object intrusion location Class 2, 3
- ◆ Oblique door load antero-lateral ?

Chest Trauma in Narrow Object Side Impacts

CIREN Case Analysis

Torqued Seat Class-2



Multiple Rib Fractures
Unilateral (left)
With hemo-pneumothorax
Spleen laceration

Chest Trauma in Narrow Object Side Impacts

CIREN Case Analysis

Torqued Seat Class-2



Unilateral (left) rib fracture
Unilateral (left) lung contusion
With hemo-pneumothorax

Chest Trauma in Narrow Object Side Impacts

CIREN Case Analysis

Torqued Seat Class-3



Unilateral (left)
Multiple rib fractures
Spleen laceration

Chest Trauma in Narrow Object Side Impacts

CIREN Case Analysis

Torqued Seat Class-2



Unilateral (right) Rib Fractures
Right flail chest
With hemo-pneumothorax
Lung contusions
Liver laceration
Aortic injury

Chest Trauma in Narrow Object Side Impacts

CIREN Case Analysis SUMMARY

- ◆ Chest injuries associated with other injuries
 - Head predominantly
 - Abdomen
 - Less with pelvis
 - Not with low extremity
- ◆ Unilateral rib fractures
 - Torqued seatback in 11 / 15 cases
 - Oblique load to chest from door
- ◆ Object intrusion class 2 and 3

Narrow Object Side Impacts

CIREN Analysis: Side Airbags

- ◆ 2002, 45 km/h, 9-o'clock, class 1
 - Combo thorax-head bag
 - Lung contusions; pelvis fractures
- ◆ 2004, 24 km/h, 9-o'clock, class 3
 - Combo thorax-head bag
 - Spleen laceration AIS=3
- ◆ 2000, 34 km/h, 11-o'clock, class 1
 - Combo thorax-head bag
 - Bilateral femur fractures AIS=3

CIREN Case Example

- ◆ Right front passenger
- ◆ 22-year-old male
- ◆ 191 cm (6' 3"), 102 kg (225 lb)
- ◆ Belted, right curtain and torso side air bags deployed
- ◆ MAIS = 5 Head, Chest Injuries
- ◆ ISS = 42

2001 Volkswagen

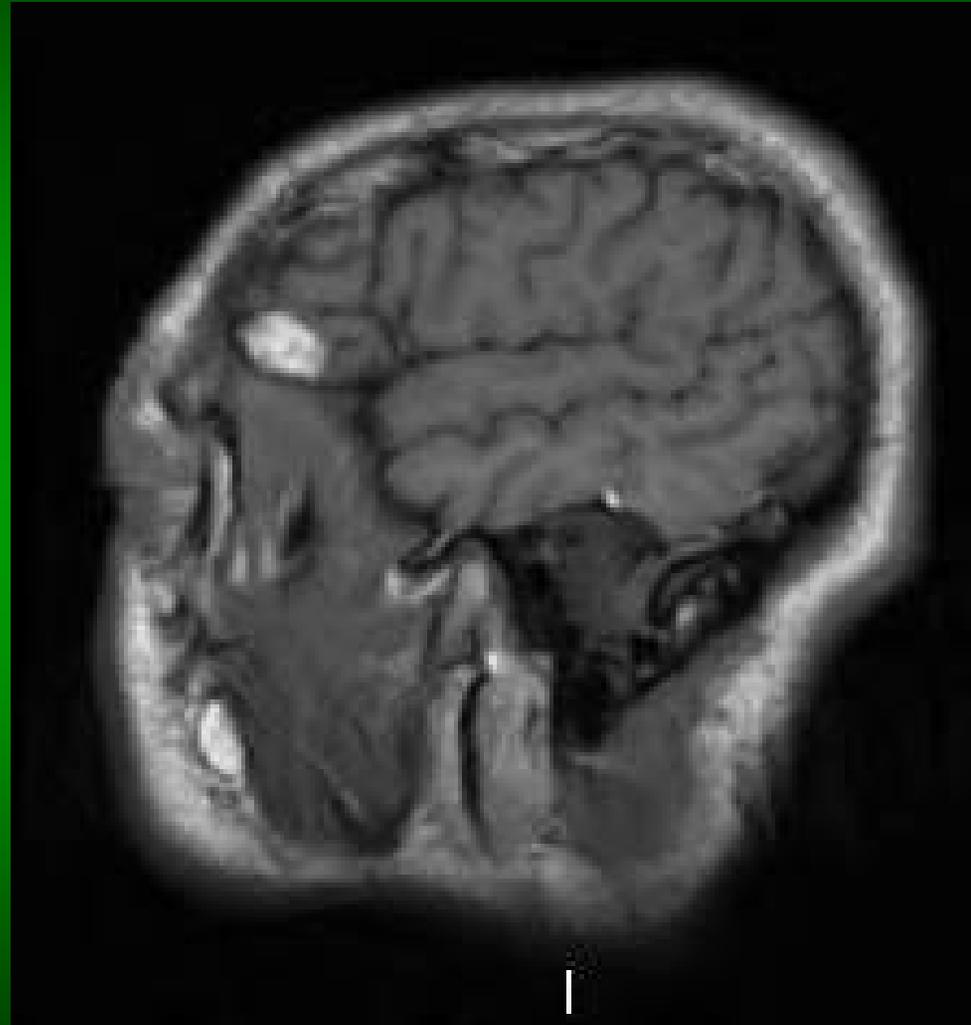
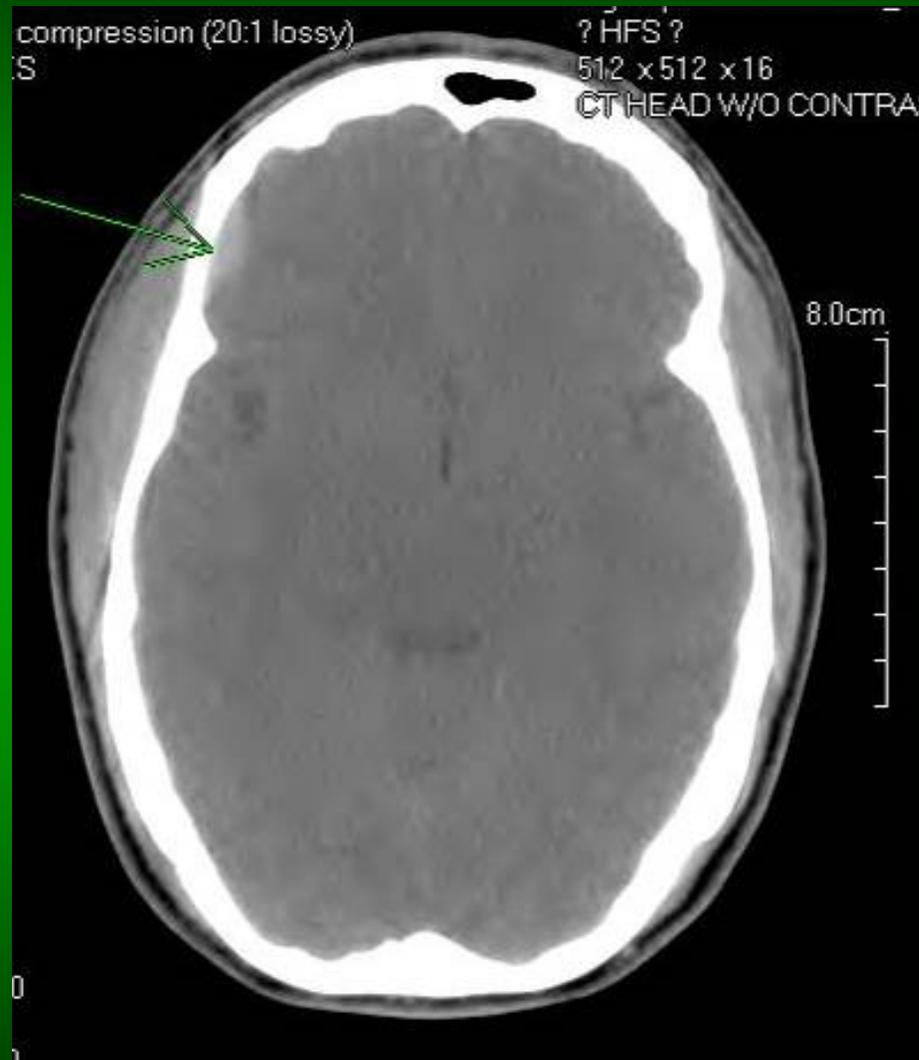


20 mph BES

2001 Volkswagen



Case Occupant

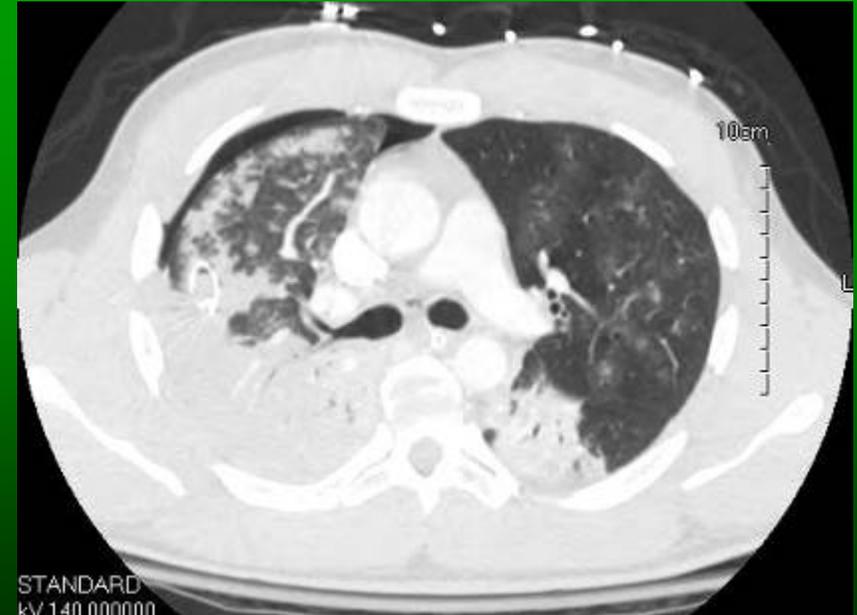


2001 Volkswagen



Note: Case Occupant Seat Torqued

Case Occupant



Case Occupant



Narrow Object Side Impacts Summary of 49 CIREN Cases

- ◆ Location of impact influences injury patterns
- ◆ Head injuries influenced by stature
- ◆ Chest injuries influenced by oblique door loading
- ◆ Torqued seat may be indicator
- ◆ Limited data on side airbags

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