An Analysis Of Injury Type And Distribution Of Belted, Non-ejected Occupants Involved In Rollover Crashes

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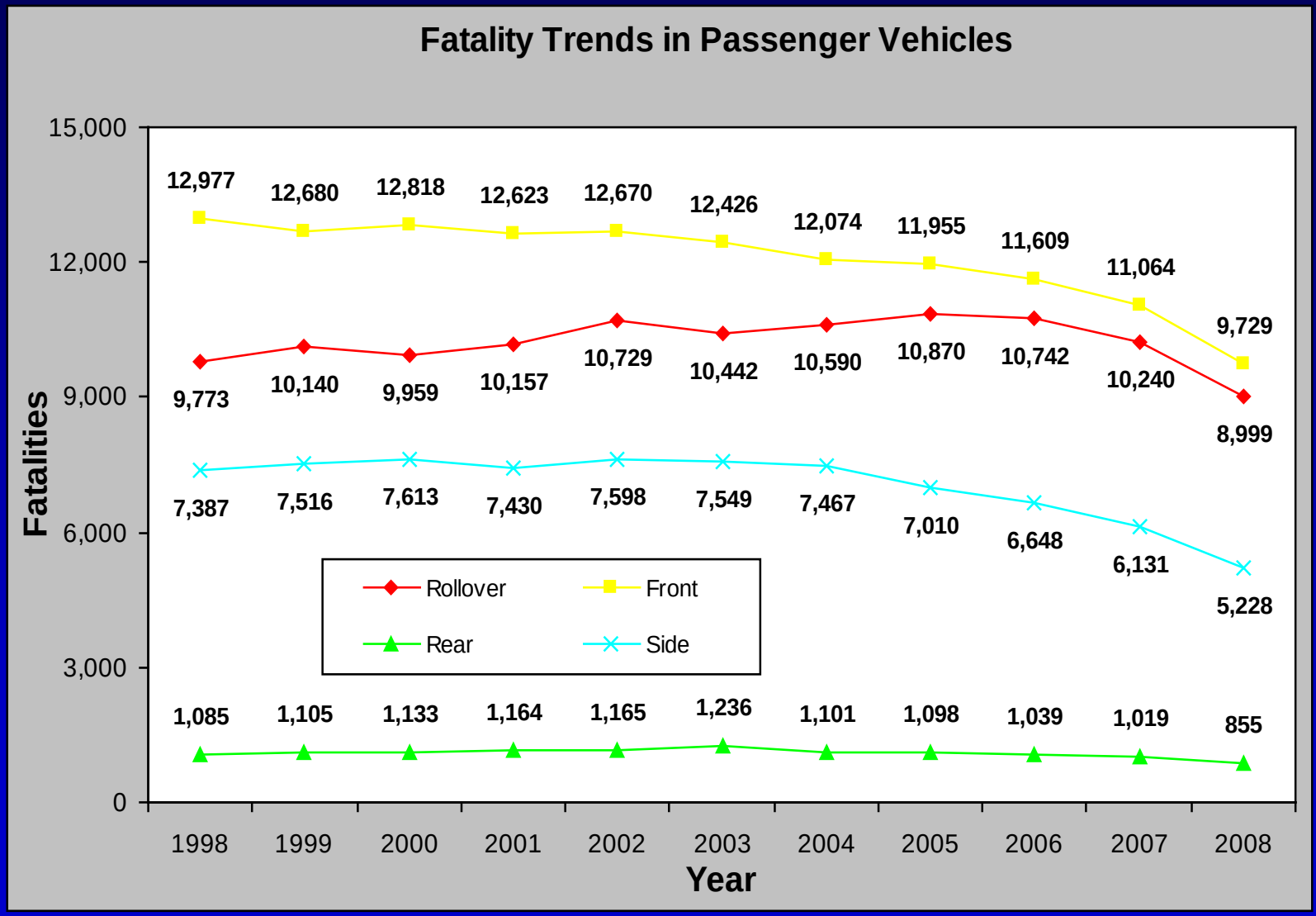
Issue



Source: FARS 1998-2008

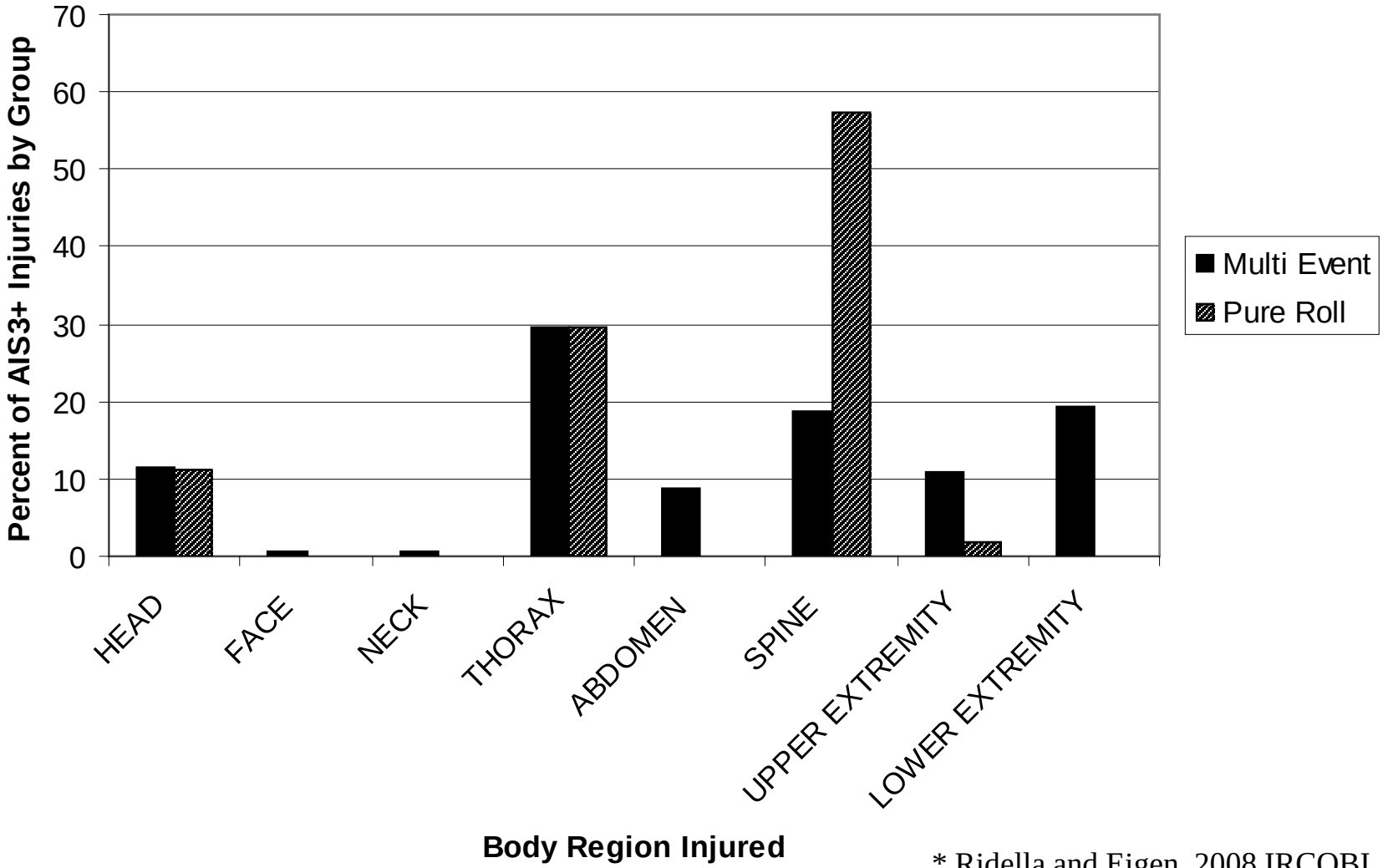
Issue

- About 25% of rollover fatalities are to belted, non-ejected occupants.
- Little published data on nature of specific injuries to these rollover-involved occupants on a national scale.
- This study to determine distributions of specific injury types in rollover crashes of belted, non-ejected occupants from recent years of the NASS-CDS database.

Dynamic Rollover Assessment

- NHTSA is exploring dynamic rollover test procedure.
- Need to assess vehicle, crash, and occupant parameters sensitive to occupant injury frequency and severity.
- Data will help to understand mechanisms associated with most severe injuries and help to develop test procedure including dummy assessment and injury criteria.

AIS 3+ Injury Distribution by Body Region/Rollover Crash Type from CIREN*

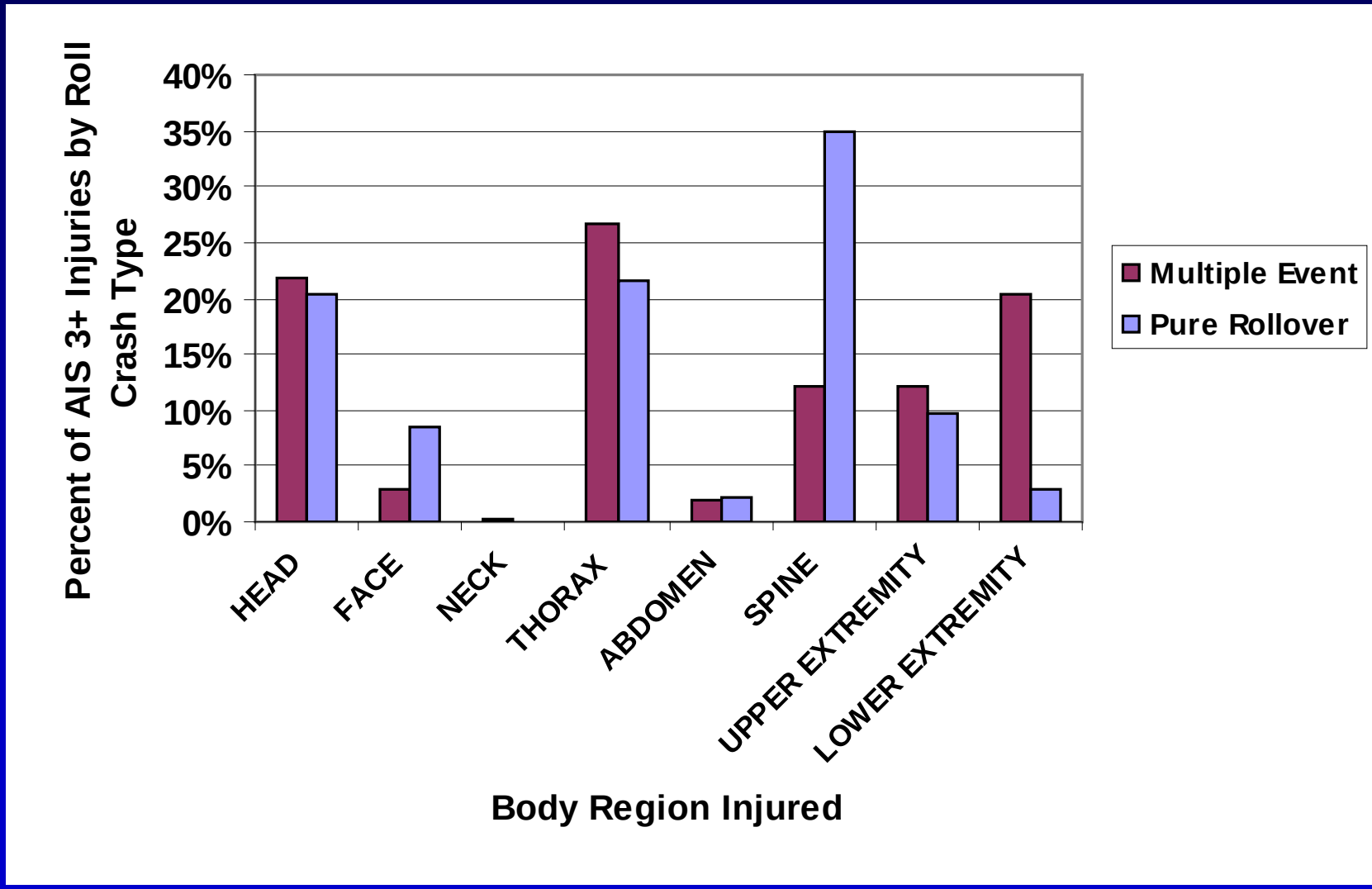


* Ridella and Eigen, 2008 IRCOBI

Method

- Data Source
  - NASS-CDS 2003-2007 Rollover Crashes (weighted data analysis)
- Selection parameters (similar to Ridella and Eigen, 2008)
  - Occupant: Adult, front-row, outboard, belted, non-ejected
  - Vehicle: Passenger vehicles, <= 2 roof inversions (eight ¼ turns or less)
- Analysis
  - AIS3+ injury distribution by body region for pure and multi-event rollovers
  - Determine top 10 injuries (by AIS90 code) for both rollover modes
  - Determine top 5 body region injury codes for pure rollover crashes
  - Determine demographic information

AIS 3+ Injury Distribution by Body Region and by Rollover Crash Type

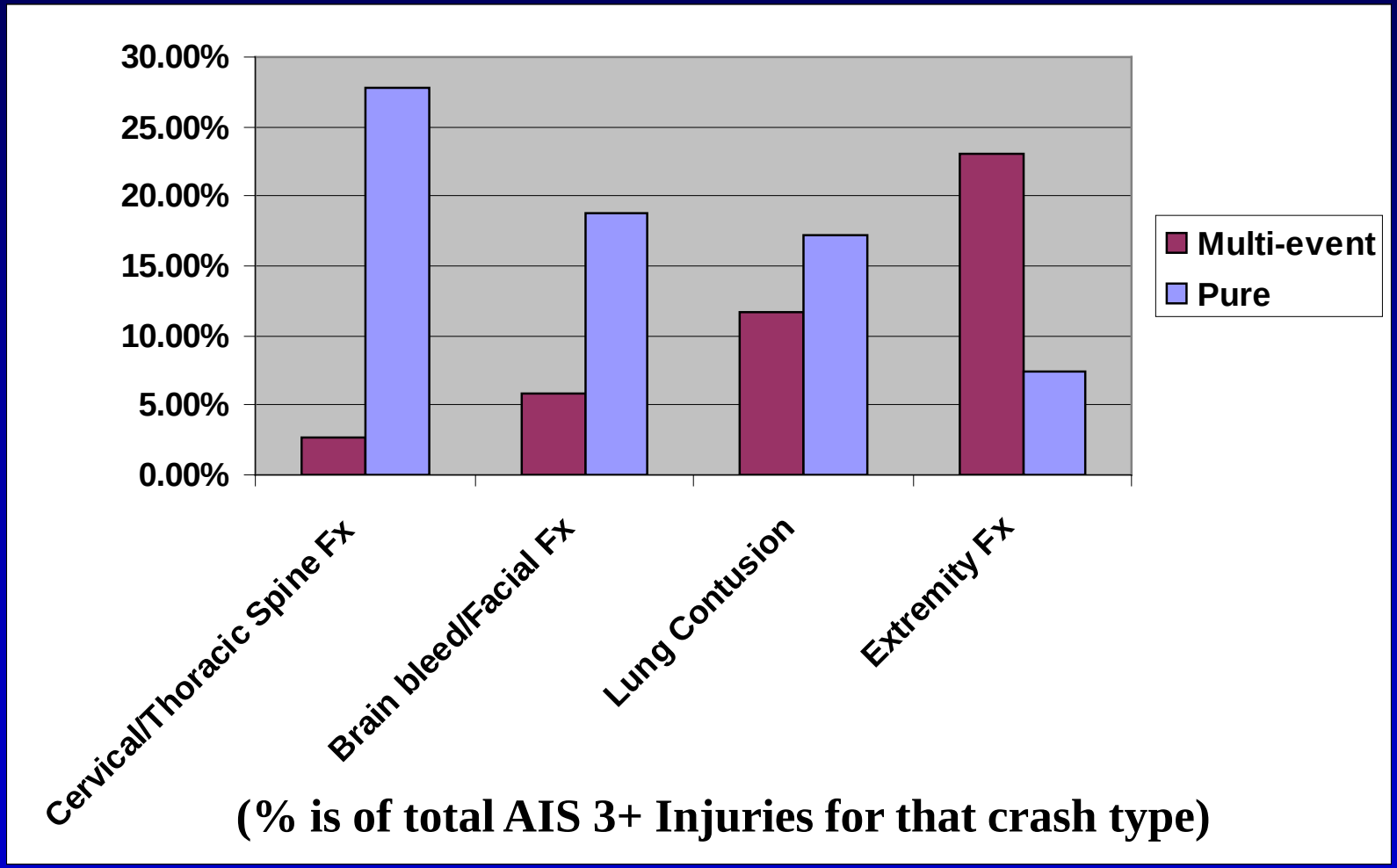


Top Ten AIS 3+ Injuries by Rollover Crash Type

Pure Rollover			Multi-Event Rollover		
Injury	N	%	Injury	N	%
Cervical Spine fracture facet	1,128	12.0%	Lung contusion unilateral with or without HTX/PTX	2,518	8.2%
Lung contusion bilateral with or without HTX/PTX	954	10.1%	Pelvis fracture open/displaced/comminuted	1,916	6.2%
Orbit fracture open/displaced/comminuted	768	8.1%	Humerus fracture open/displaced/comminuted	1,512	4.9%
Cerebrum subarachnoid hemorrhage	710	7.5%	Tibia fracture shaft open/displaced/comminuted	1,434	4.6%
Radius fracture open/displaced/comminuted	693	7.4%	Radius fracture open/displaced/comminuted	1,279	4.2%
Lung contusion unilateral with or without HTX/PTX	675	7.2%	Lung contusion bilateral with or without HTX/PTX	1,084	3.5%
Cervical Spine fracture lamina	616	6.5%	Femur fracture shaft	956	3.1%
Cervical Spine fracture pedicle	458	4.8%	Cerebrum contusion single small	913	3.0%
Thoracic Spine fracture lamina	418	4.4%	Orbit fracture open/displaced/comminuted	908	3.0%
Cerebrum hematoma/hemorrhage subdural small	289	3.1%	Cervical Spine fracture facet	803	2.6%

(% is of total AIS 3+ Injuries for that crash type)

Distribution of Top Ten AIS 3+ Injuries by Injury and Rollover Crash Type



Top 5 AIS 3+ Injuries for Head, Spine and Thorax for Pure Rollover Crash Type

Head			Spine			Thorax		
Injury	N	%	Injury	N	%	Injury	N	%
Cerebrum subarachnoid hemorrhage	710	37.1%	Cervical Spine fracture facet	1,128	34.2%	Lung contusion bilateral with or without HTX/PTX	954	46.9%
Cerebrum hematoma/ hemorrhage subdural small	289	15.1%	Cervical Spine fracture lamina	616	18.7%	Lung contusion unilateral with or without HTX/PTX	675	33.2%
Cerebrum hematoma/ hemorrhage intra-cerebral bilateral	202	10.6%	Cervical Spine fracture pedicle	458	13.9%	Rib cage fracture open/ displaced/ comminuted with HTX/PTX	173	8.5%
Cerebrum hematoma/ hemorrhage epidural or extradural NFS	127	6.6%	Thoracic Spine fracture lamina	418	12.7%	Lung NFS	105	5.2%
Base (basilar) skull fracture without CSF leak	105	5.5%	Thoracic Spine fracture vertebral body major compression	232	7.0%	Rib cage fracture >3 ribs on one side and <4 ribs on either side	67	3.3%

(% is of total AIS 3+ Injuries for that body region)

Selected Occupant and Vehicle Statistics for Top 5 Injuries by Body Region

	Head	Spine	Thorax
% Two roof inversions	62.3	38.8	58.7
% Max Intrusion > 30cm	54.6	46.2	45.2
Median Age (yrs)	30	43	30
% Obese (BMI > 30)	21.4	41.3	0.0
Near/Far Occupant ratio	3.4	1.2	0.3

Continuing Work

- Determine Specific Injuries for All Body Regions
  - Focus on head, cervical spine and thorax
  - More NASS and CIREN analysis in progress
    - Injury causation and injury mechanism analysis
- Determine Injury Clustering Scenarios
- Multi-variate regression analysis to find significant factors involved

Summary/Conclusions

- National estimates for rollover injury types using recent crashes
- Data helps to determine priorities for:
  - Test procedure development
  - Crash dummy response requirements and injury criteria
  - Countermeasure development to mitigate injuries