

NHTSA's Research Program for Adult Rear Occupants in Frontal Crashes

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NHTSA

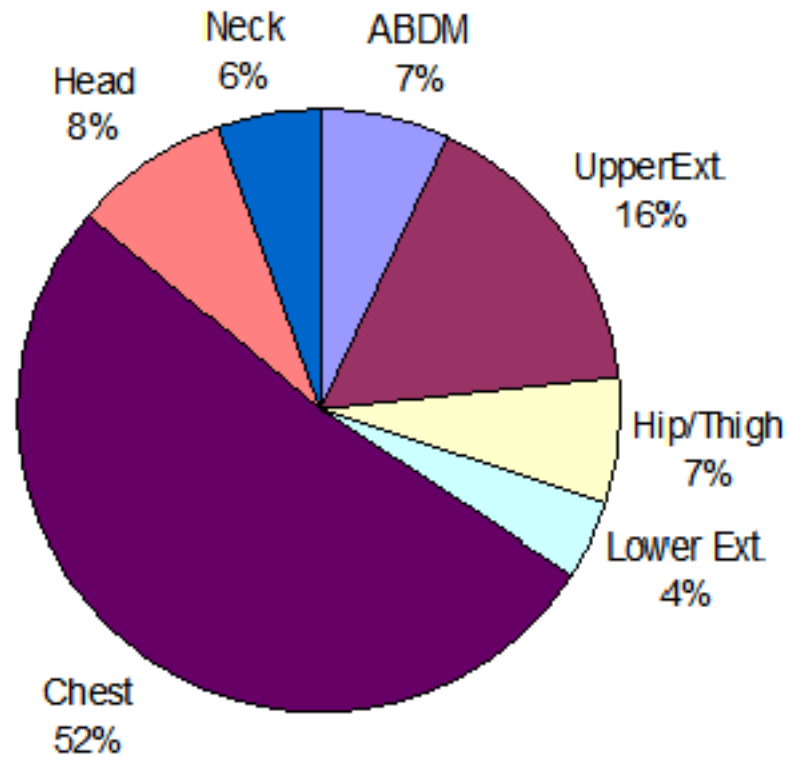
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Background

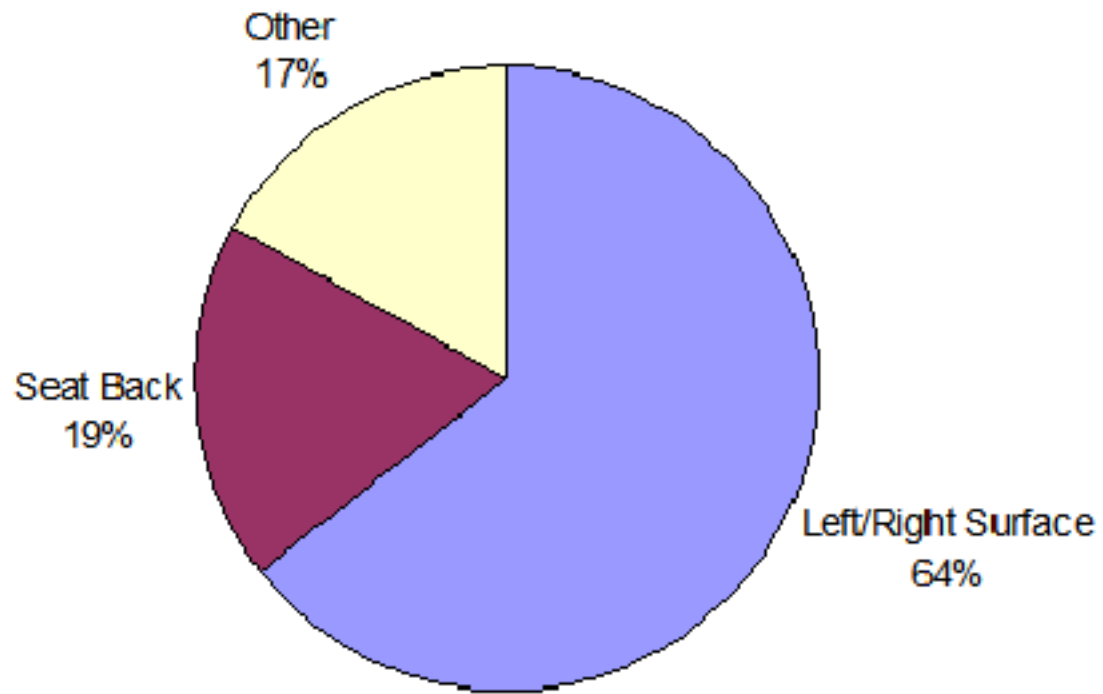
- Rear seat and rear restraints required to meet FMVSS 207, 209, and 210.
 - Static requirements.
- Front outboard seats required to meet the above standards and FMVSS 208.
 - FMVSS 208 adds dynamic requirement.
- Investigating performance of rear restraint systems dynamically.

MAIS 2+ for each Body Region



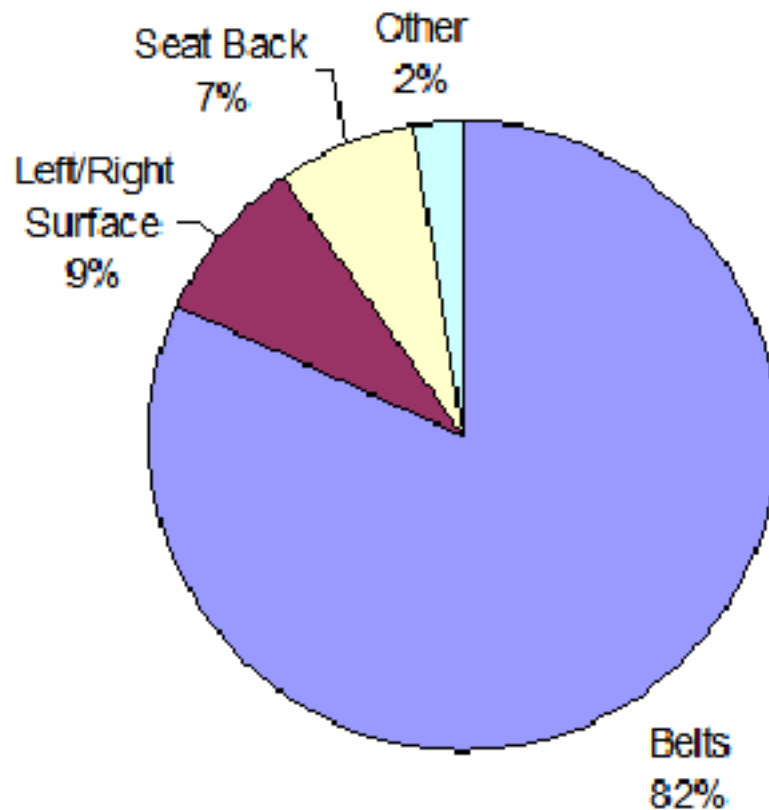
NASS/CDS 1993-2004, Occupants age ≥ 13 yo

Injury Source that Produced AIS2+ Head Injuries



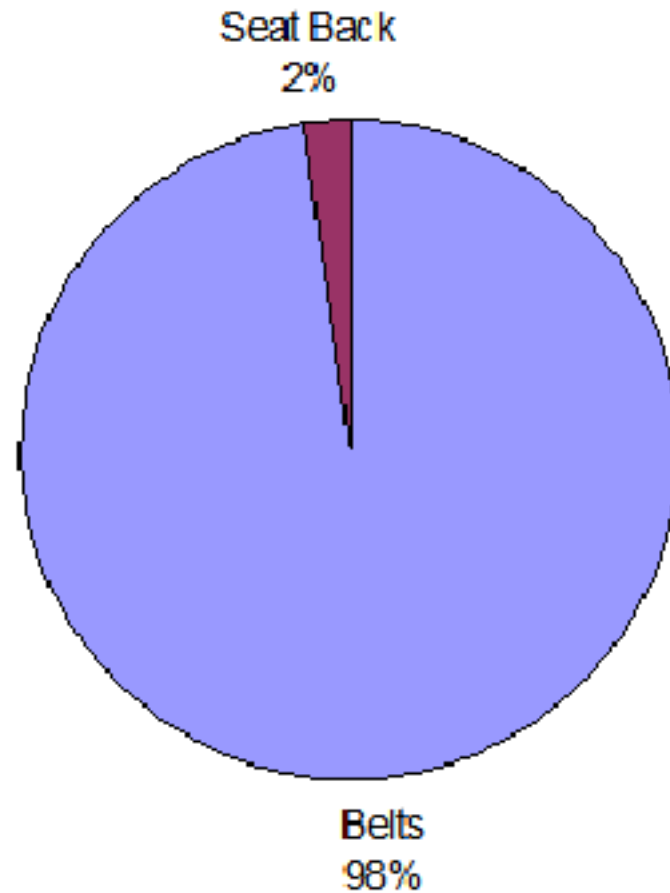
NASS/CDS 1993-2004, Occupants age ≥ 13 yo

Injury Source that Produced AIS2+ Chest Injuries



NASS/CDS 1993-2004, Occupants age ≥ 13 yo

Injury Source that Produced AIS2+ Abdominal Injuries



NASS/CDS 1993-2004, Occupants age ≥ 13 yo

Properly Belted Rear Occupant with AIS 3+ Injuries in Frontal Crashes (CIREN)

Vehicle	PDOF	DV	Max Crush (mm)	Age	MAIS	Injury	Injury Source
Case 1	0	50	970	14 F	5	Rib Fx	Belt
Case 2	0	50	970	14 F	4	Liver Lac.	Belt
Case 3	350	35	150	71 M	4	Cervical Spine Cord Cont.	Non Contact @ (Belt)
Case 4	350	35	150	70 F	5	Liver Lac.	Belt
Case 5	10	33	UN	53 F	3	Jejunum-ileum Lac.	Belt
Case 6	0	58	920	10 M	3	Humerus Fx	Seat Back
Case 7	0	58	920	13 M	3	Lung Cont.	Belt
Case 8	340	24	800	12 F	4	Liver Lac.	Belt
Case 9	10	35	UN	27 M	3	Abdomen Arteries	Belt

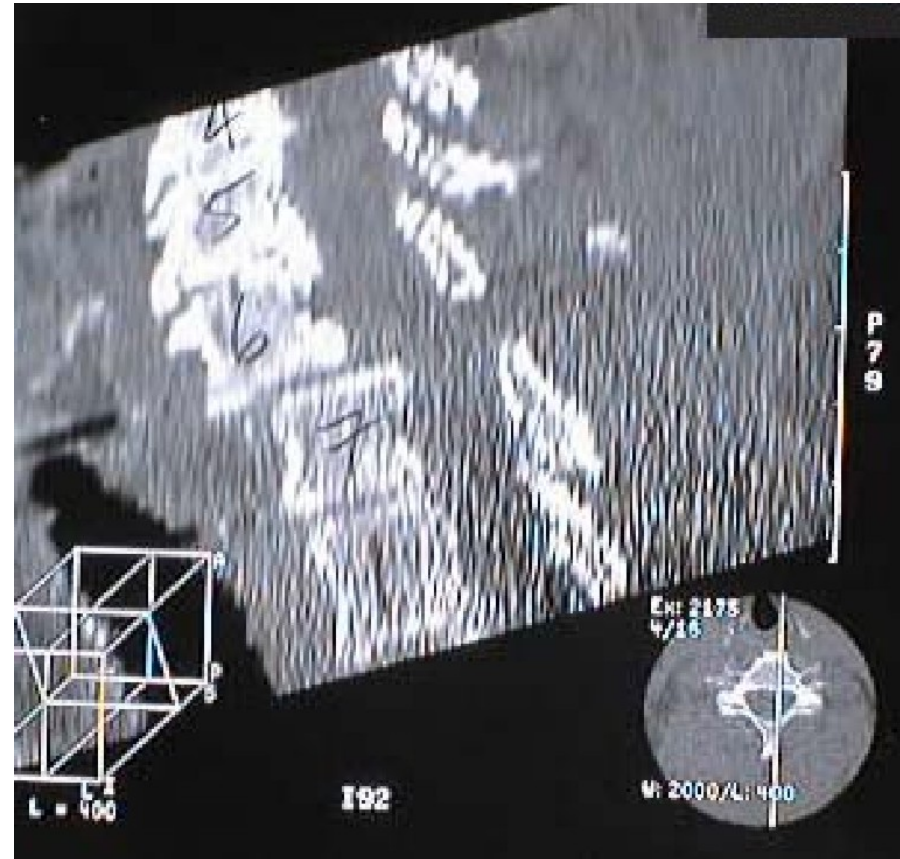
Case 3



Major Injuries to 71yo Male



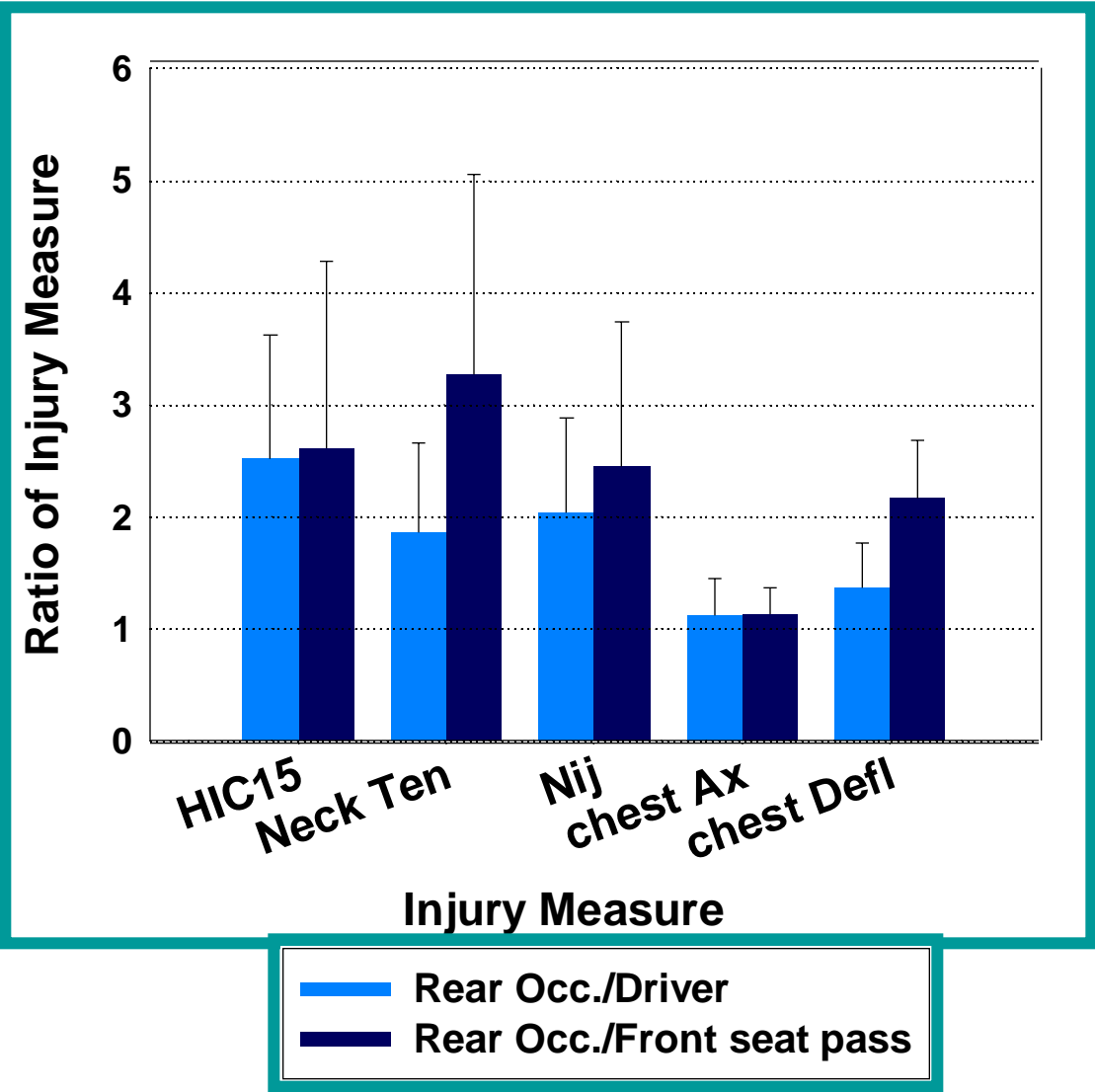
Cervical Spine Cord contusion
incomplete cord syndrome but
NFS



Cervical Spine dislocation facet bilateral

Average Ratio of Injury Measures

Restrained III 5F dummy in front and rear seats in frontal NCAP test



Rear Seat 5th 35 mph Tests Results

Vehicle Class	Chest G	Chest Disp (mm)	CTI	HIC 15	Nij ver. 10	Neck Ten	Neck Comp
.	60	52	1.00	700	1.00	2620	2520
MED	42	33	0.86	534	0.89	2378	95
UV	42	42	0.96	541	1.32	2221	1192
UV	51	49	1.12	659	0.92	2520	212
COMP	53	38	1.03	924	1.23	3085	78
COMP	53	43	1.10	1160	1.21	3253	750
MV	53	37	1.02	1053	1.17	3354	293
MED	49	47	1.09	781	0.94	2775	490

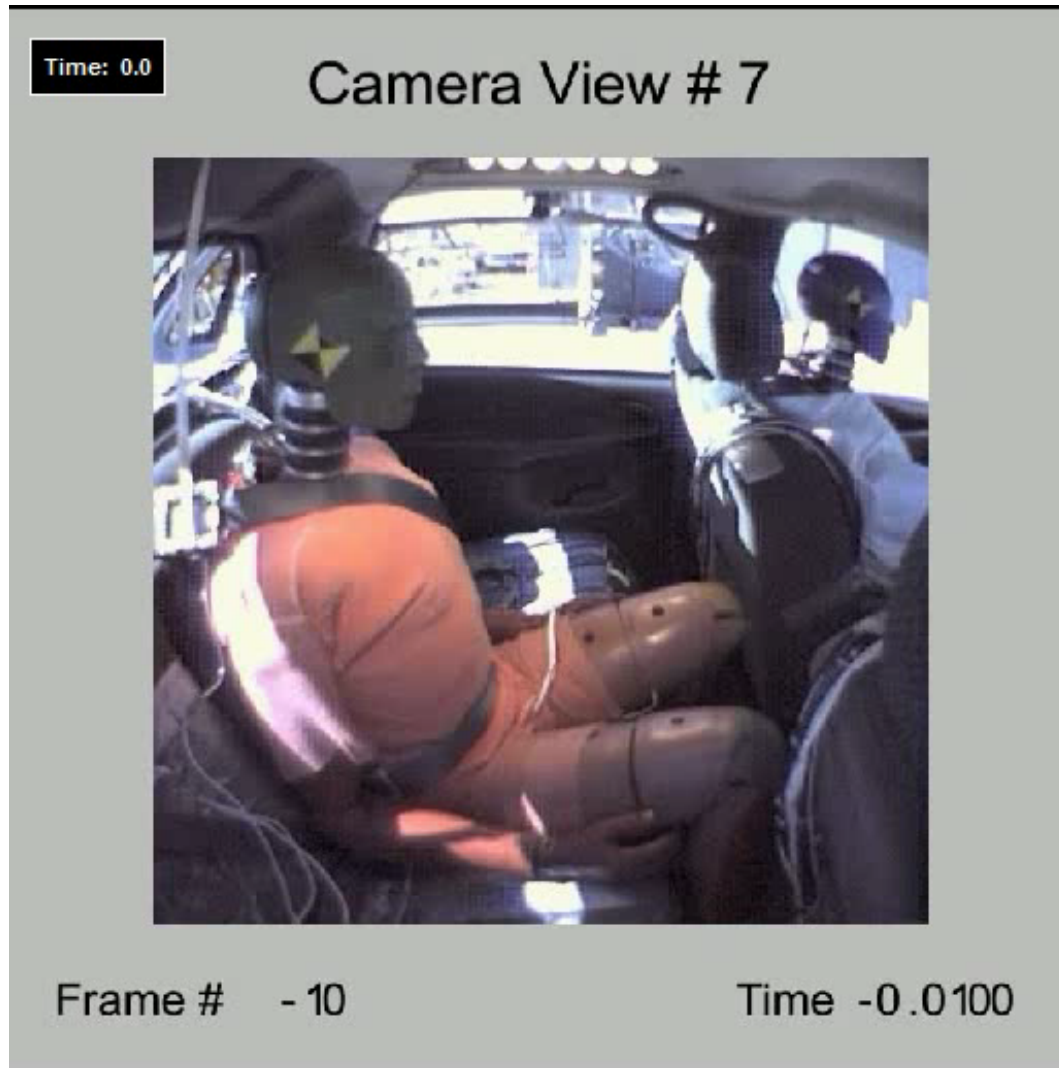
Rear Seat 50th 35 mph Tests Results

	Chest G	Chest Disp (mm)	CTI	HIC 15	Nij ver. 10	Neck Ten	Neck Comp
	60	63	1.00	700	1.00	4170	4000
COMP	50	36	0.89	751	0.78	3280	955
COMP	52	46	1.02	834	0.74	3037	3063
UV	45	34	0.83	1096	0.59	3549	675
MED	49	ND	ND	631	0.87	2859	1516
UV	39	ND	ND	461	0.82	5514	96
MV	45	34	0.82	554	ND	2644	754
MV	45	ND	ND	989	0.97	3406	990
MED	45	ND	ND	630	0.67	2834	81
UV	45	36	0.85	1738	0.79	4249	482
UV	48	72	1.23	2054	0.87	4777	273
UV	52	40	0.96	1358	ND	ND	ND
UV	47	40	0.91	2071	0.64	3526	879

Sled Tests Dummy/Seat Kinematics (integrated Seat)



50th 35 mph Full Frontal Dummy Kinematics



HIC15 = 461

Chest G = 39

Chest Displacement = ND

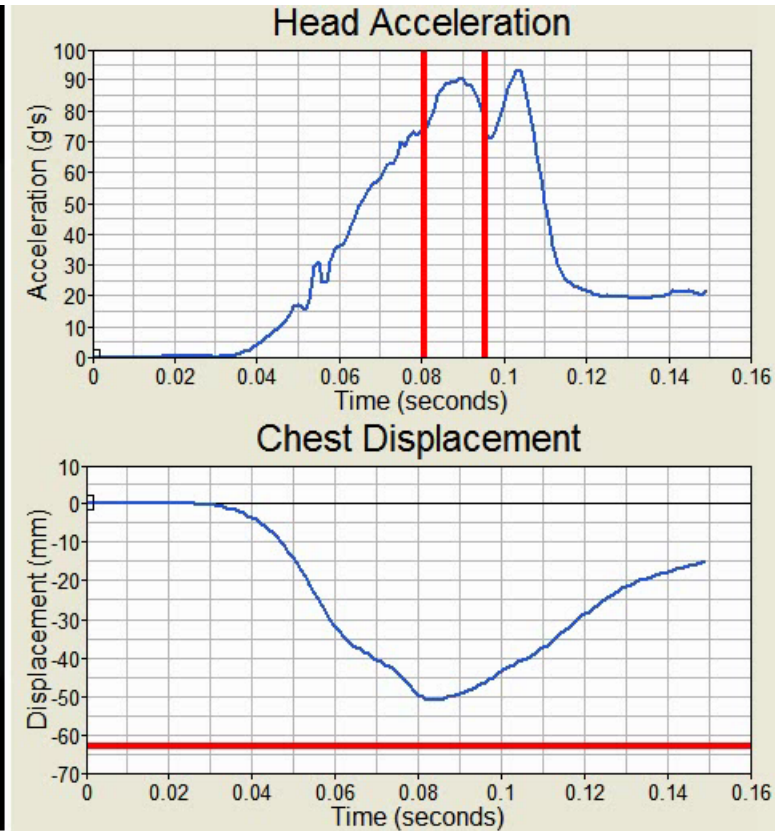
CTI = ND

Nij = .82

Neck Tension = **5514**

Neck Compression = 96

50th Sled Test



HIC 15 = 996

Chest G = 56

Chest Displacement = 51

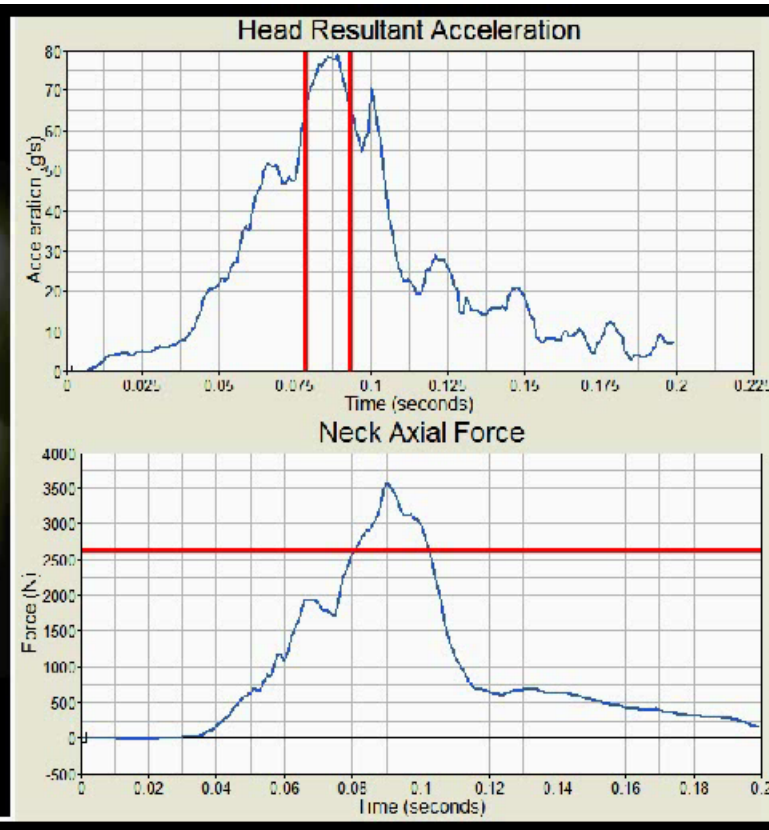
CTI = 1.12

$N_{ij} = .987$

Neck Tension = 3426

Neck Compression = 23

5th Sled Test



HIC 15 = 701

Chest G = 63

Chest Displacement = 46

CTI = 1.24

$N_{ij} = 1.17$

Neck Tension = 3567

Neck Compression = 164

Conclusions

- NASS/CDS shows 52% of the injuries to rear occupants, 13 yo or older, were chest injuries
 - 82% of the chest injuries were due to the belt
- CIREN cases showed most of the MAIS was due to the belt.
- 5th dummy injury values in the rear were typically higher than the front in testing.
- Most HII 5th tests exceeded CTI, HIC 15 and Nij.
- Most HII 50th tests exceeded HIC 15.

Future Work

- Investigate the feasibility of using advanced restraint systems in the rear seat for frontal crashes.