GTR 7 Informal Working Group
February 5/6, 2014
Brussels, Belgium

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Update on Potential BioRID Injury Criteria

PMHS Injury Analysis
IV-NIC vs. Kinematic Criteria

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	IV-NICrot
	R^2 - value
NDCrot	0.75
NDCx	0.48
~~NDCz~~	~~0.14~~
NIC	0.45

Potential BioRID Injury Criteria
NDCrot

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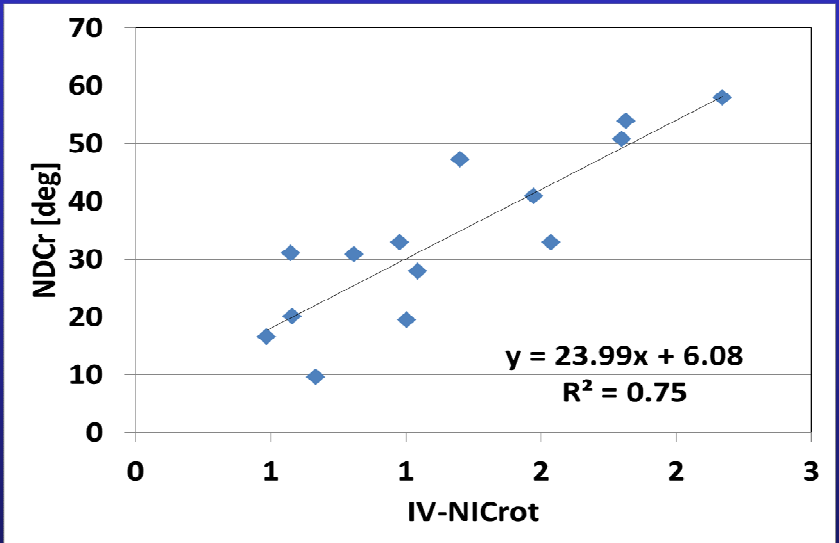
PMHS Regression model



50 % chance of AIS 1+ injuries for PMHS

NDCrot = 32.5 deg (flexion)

50 % chance of AIS 1+ injuries for BioRIDII

NDCrot : 12.2 deg (flexion)

PMHS

BioRIDII

Scaling

$$\frac{\text{Average}(\text{Max}(\text{BioRIDII } NDCr))}{\text{Average}(\text{Max}(\text{PMHS } NDCr))}$$

Head Restraint Forces
Production Seats

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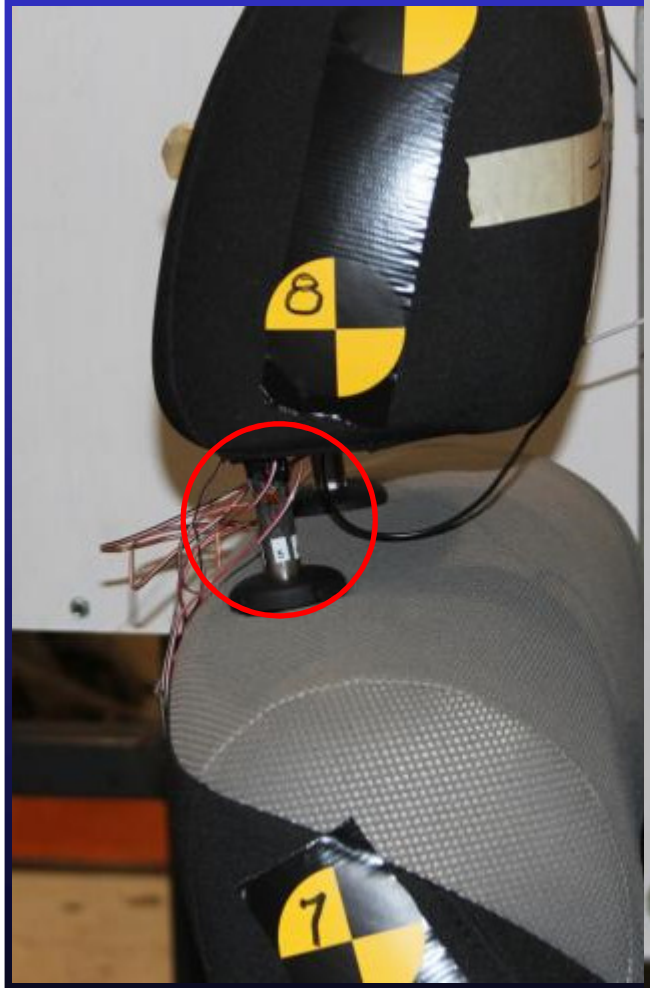

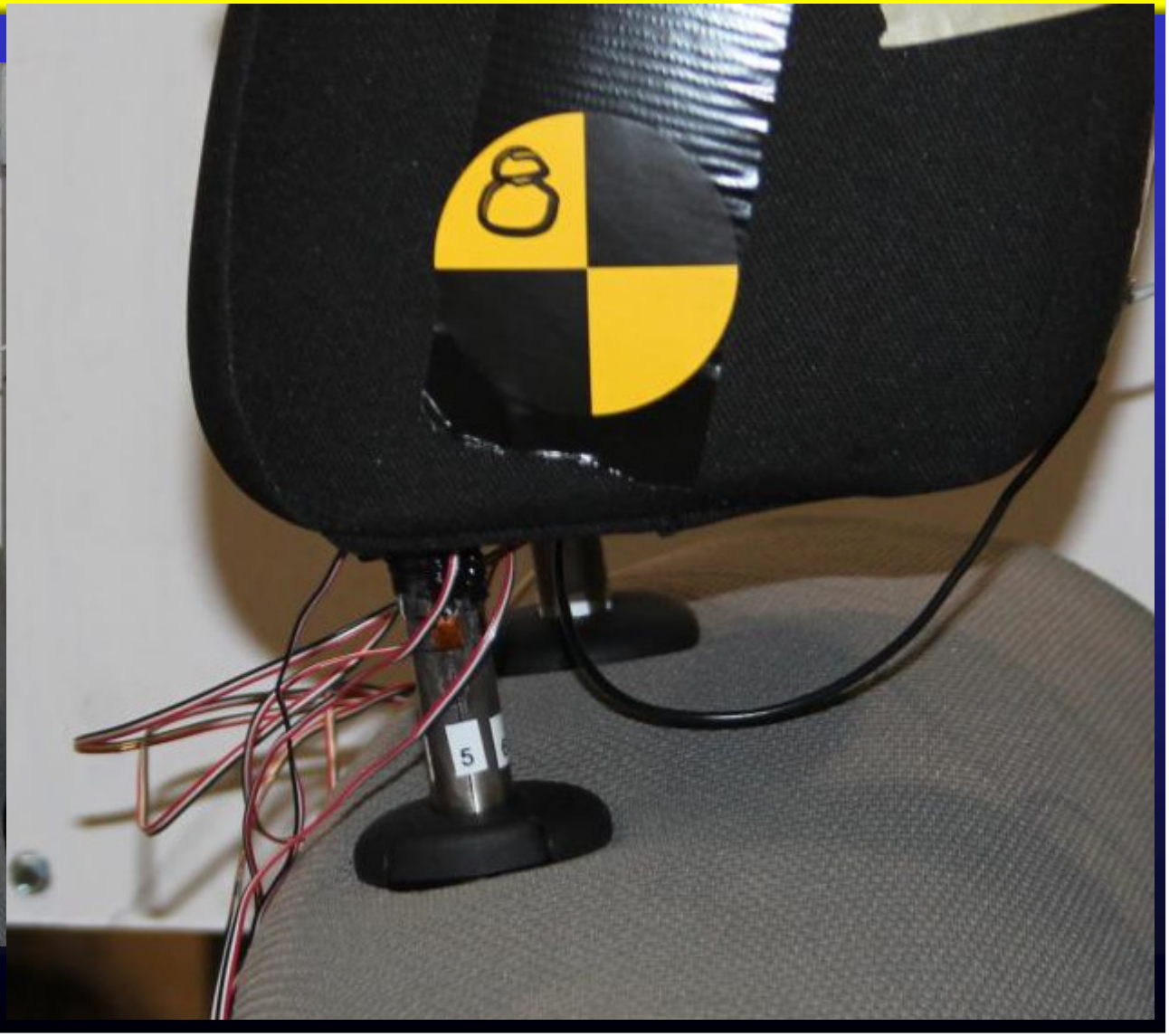

Head Restraint Forces
Production Seats

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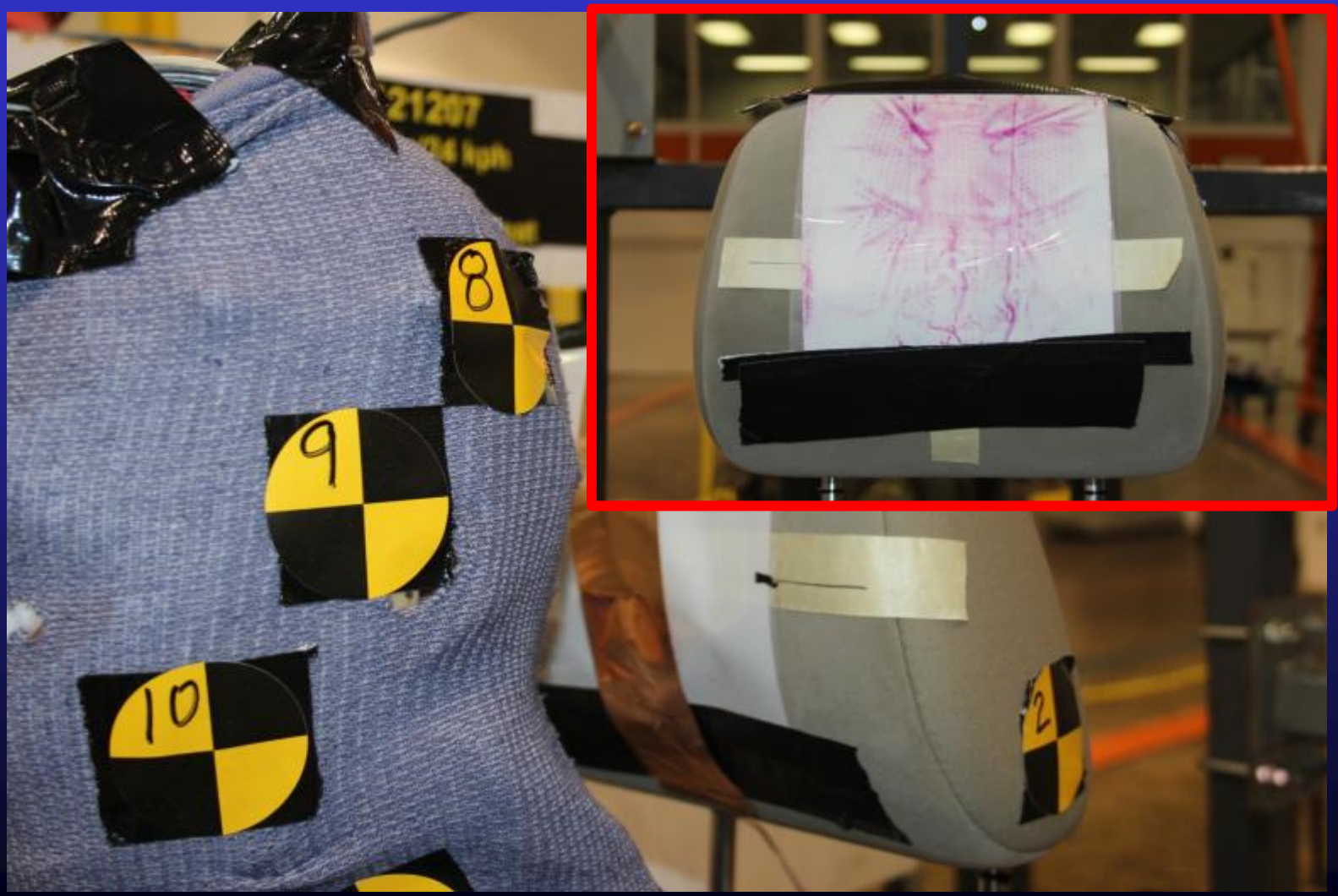

Head Restraint Forces
Production Seats

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- **Inherent issues with HR Contact Force Estimation**
  - Force of head contact is perpendicular to HR (x-direction)
    - No axial loading on the HR
    - Predicted HR force is very sensitive to HR contact height
    - Assumptions inherent to inverse dynamics analysis

Head Restraint Forces
Production Seats

- **Analysis of BioRID HR contact force versus Fx skull cap load**

Head Restraint Forces
Production Seats

- **Analysis of BioRID HR contact force versus Fx skull cap load**
  - Match for only 2 out of 7 tests
    - Large Fz skull cap (as much as 50% of Fx)
  - Algorithm to compensate strain gages for axial HR loads
    - 5 out of 7 tests matched

Head Restraint Forces
Production Seats

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- **Analysis of BioRID HR contact force versus Fx skull cap load**
  - Match for only 2 out of 7 tests
    - Large Fz skull cap (as much as 50% of Fx)
  - Algorithm to compensate strain gages for axial HR loads
    - 5 out of 7 tests matched
- **PMHS → no way to estimate axial contribution**
  - Assume same Fz/Fx ratio as BioRID for given test condition
  - Apply compensation algorithm
  - Recalculate upper/lower neck loads
  - Still no good correlations

PMHS Injury Analysis
IV-NIC vs. Upper/Lower Neck Loads

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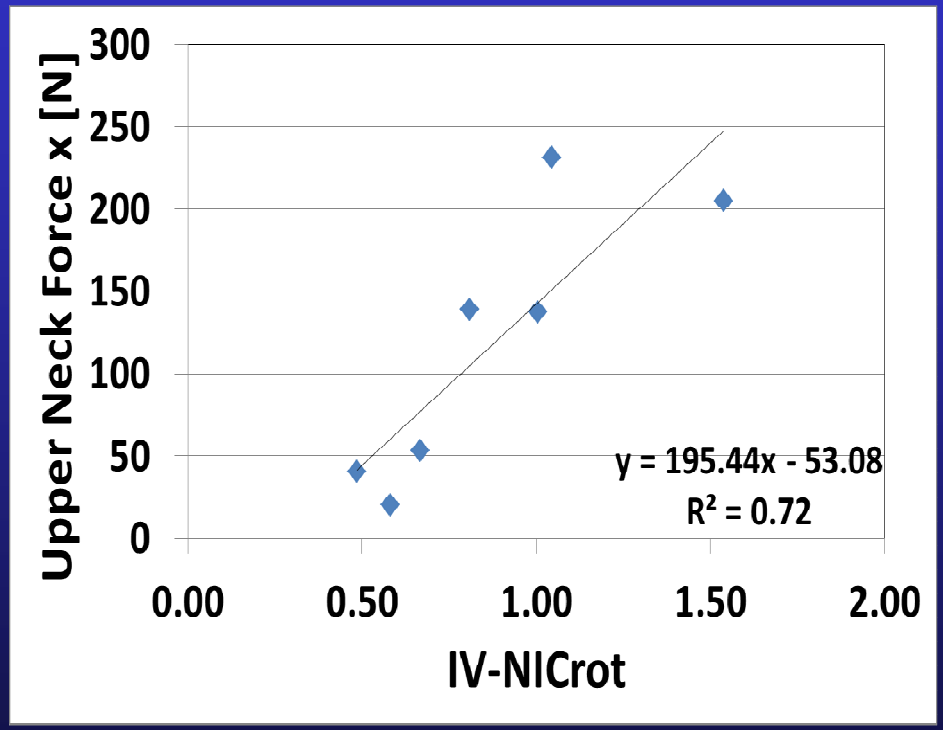
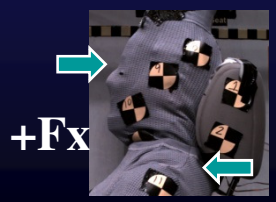
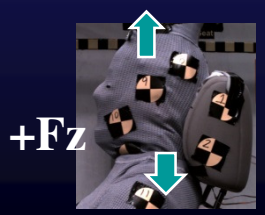
			IV-NICrot	
			R - value	P - value
Upper Neck	Fx	+	0.72	0.02
		-	0.01	0.85
	Fz	+	0.09	0.51
		-	0.14	0.41
	My	+	0.04	0.65
		-	0.22	0.29
Lower Neck	Fx	+	0.35	0.16
		-	0.01	0.87
	Fz	+	0.00	0.99
		-	0.00	0.93
	My	+	0.00	0.92
		-	0.10	0.48







BioRID Sled Test Plan

- **Certify and upgrade BioRID dummies**
  - Incorporate design changes that improved reproducibility
  - Ensure these dummies represent the future regulatory tool

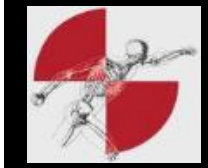
- **1) Re-run 5 injury criteria sled tests (using both BioRIDs)**
  - Conduct all 5 tests in one week
  - Refine injury criteria numbers
    - Improve direct correlations and intervertebral kinematics?
  - Two dummies to check reproducibility
  - Seats: Chevy Cruze and Toyota Camry (same as PMHS tests)

BioRID Sled Test Plan

- **Conduct paired BioRID/Hybrid III sled tests**
  - 2) Extension tests → NDCrot criterion developed in production seats is flexion only
    - Use modified Chevy Cruze seat to create large backsets
    - All three pulses
    - 12 deg Hybrid III extension = ?? deg BioRID

BioRID Sled Test Plan

- **Conduct paired BioRID/Hybrid III sled tests**
  - 3) Small-scale fleet assessment
    - Compare 202a criteria with HyIII to proposed BioRID criteria
    - All three pulses
    - Variety of seats (including active or re-active HR)
      - Chevy Cruze
      - Toyota Camry
      - Toyota Matrix
      - Ford F150
      - Honda Odyssey re-active HR seat (mechanically-induced)



Questions??

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