

# Development of Dummy-Based Rotational Brain Injury Criterion

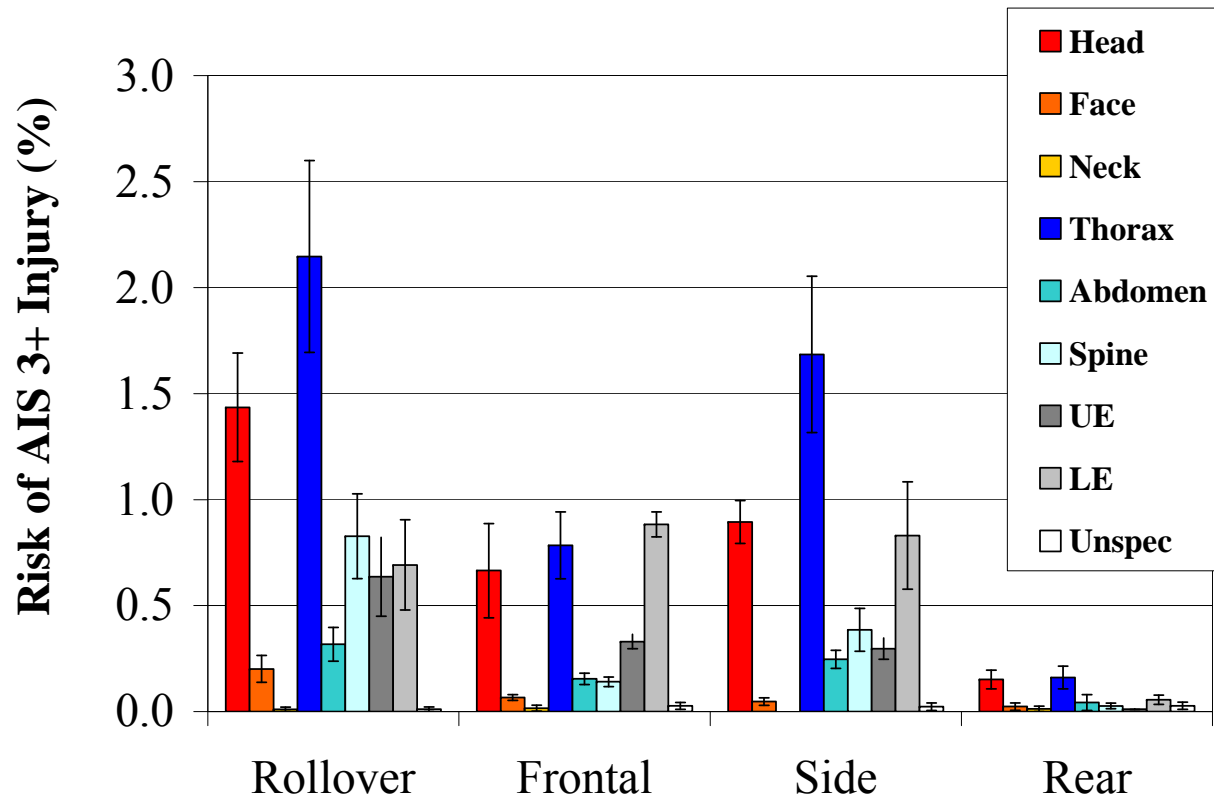
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# Brain Injury Research

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- Data Driven Research
  - CIREN, NASS
- The SIMon Process
- Dummy-Based Procedure

# Data Driven Research: NASS



Adults 15-59, MY+> 2000, NASS-CDS 1999-2006

# CIREN Case Example of Brain Injury

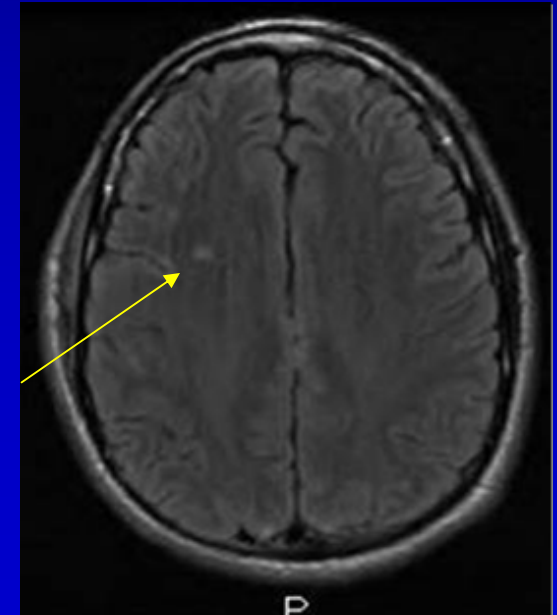
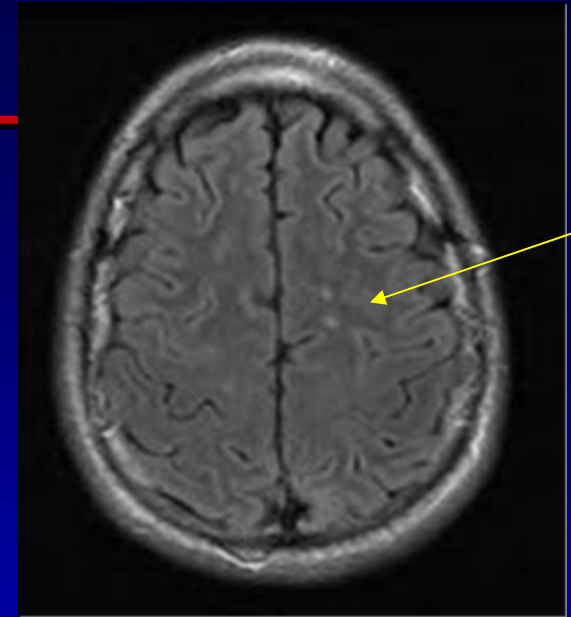
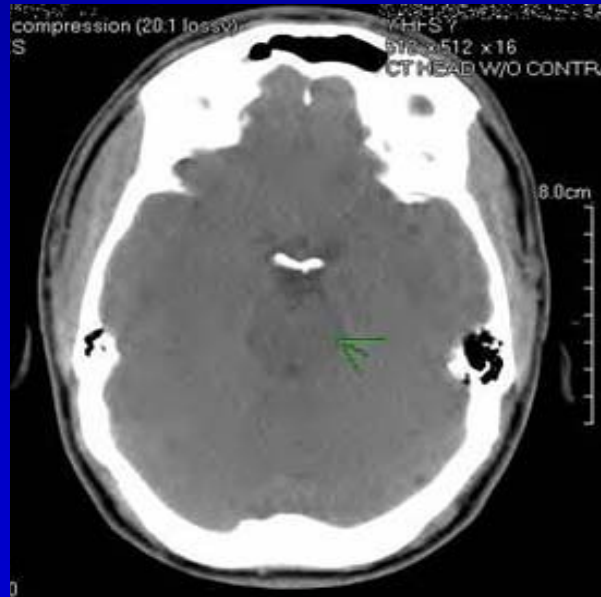
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- Case vehicle DV = 20 mph (32 kmph)
- Max crush = 39 cm.
- Max intrusion = 7.9 in. ( 20 cm.) at right roof rail
- PDOF = 20 degrees
- Adult Male Right Front Passenger



# Clinical Evidence

- Brain injury expands from initial contact
  - Diffuse hemorrhage and axonal injury
    - Intracerebral
    - Corpus callosum
    - Brainstem



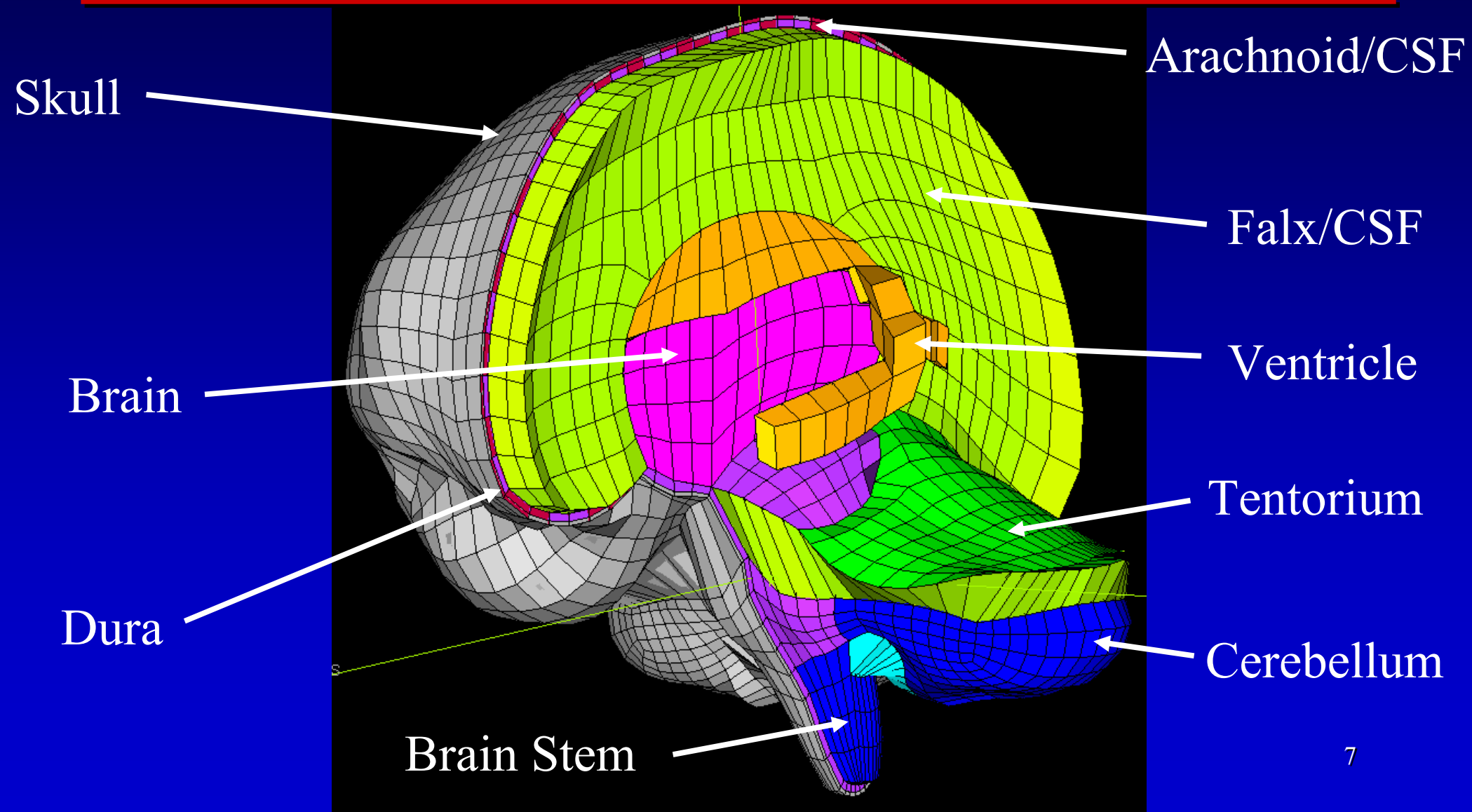
# The SIMon Process

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- NHTSA has been working on a brain injury prediction tool for several years called SIMon
  - Published at 2003 and 2008 Stapp Car Crash Conferences
- SIMon stands for **S**imulated **I**njury **M**onitor
- It takes as an input head kinematic measurements from a test dummy or a simulation (linear and angular accelerations or velocities) and calculates/outputs potential for most common brain injuries
- It utilizes finite element modeling technology to carry out the calculations

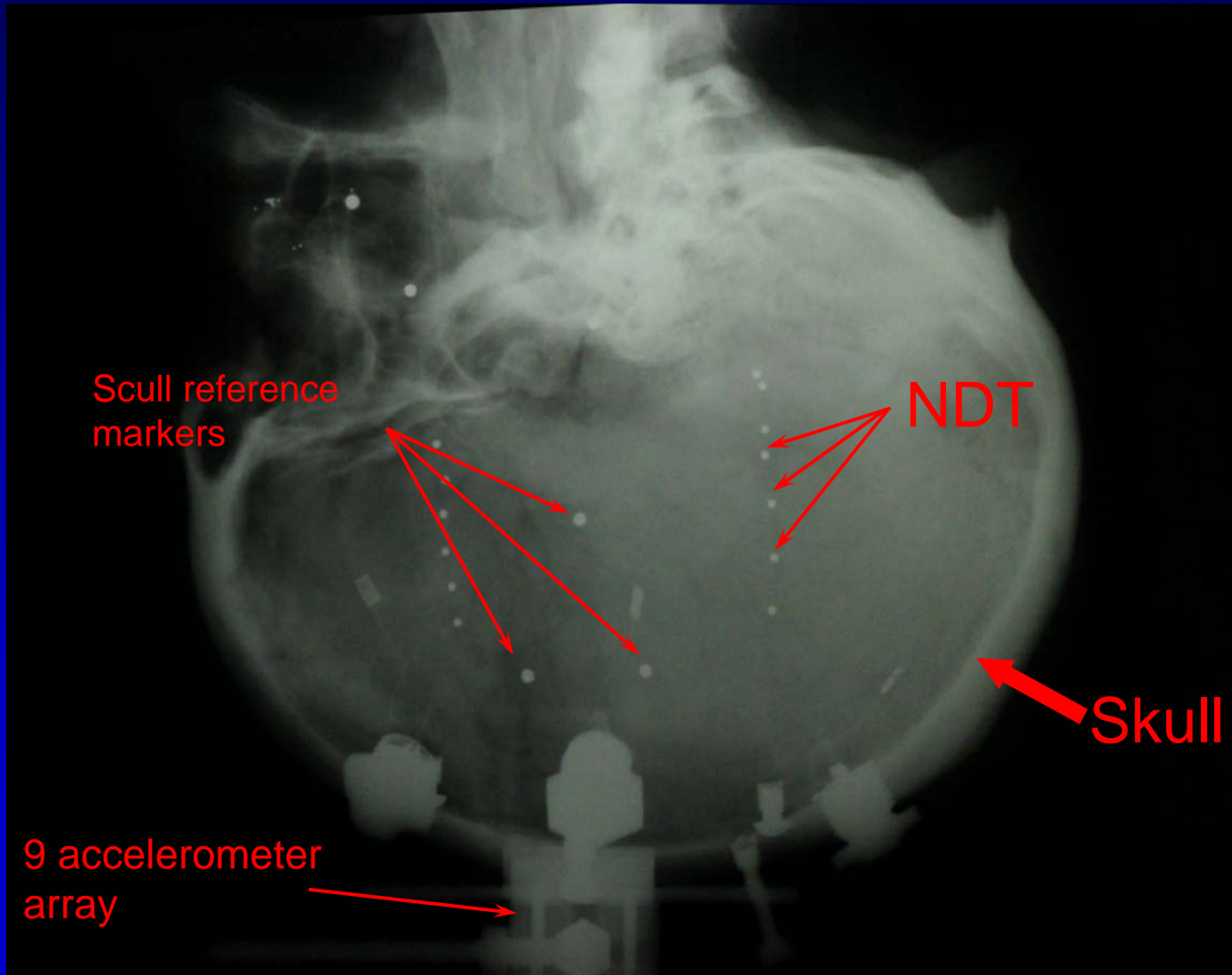


# SIMon FE Head Model



# New SIMon FE Head Model (coarse version): NDT data (Hardy et. al, 2002)

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# New SIMon FE Head Model (coarse version): NDT validation

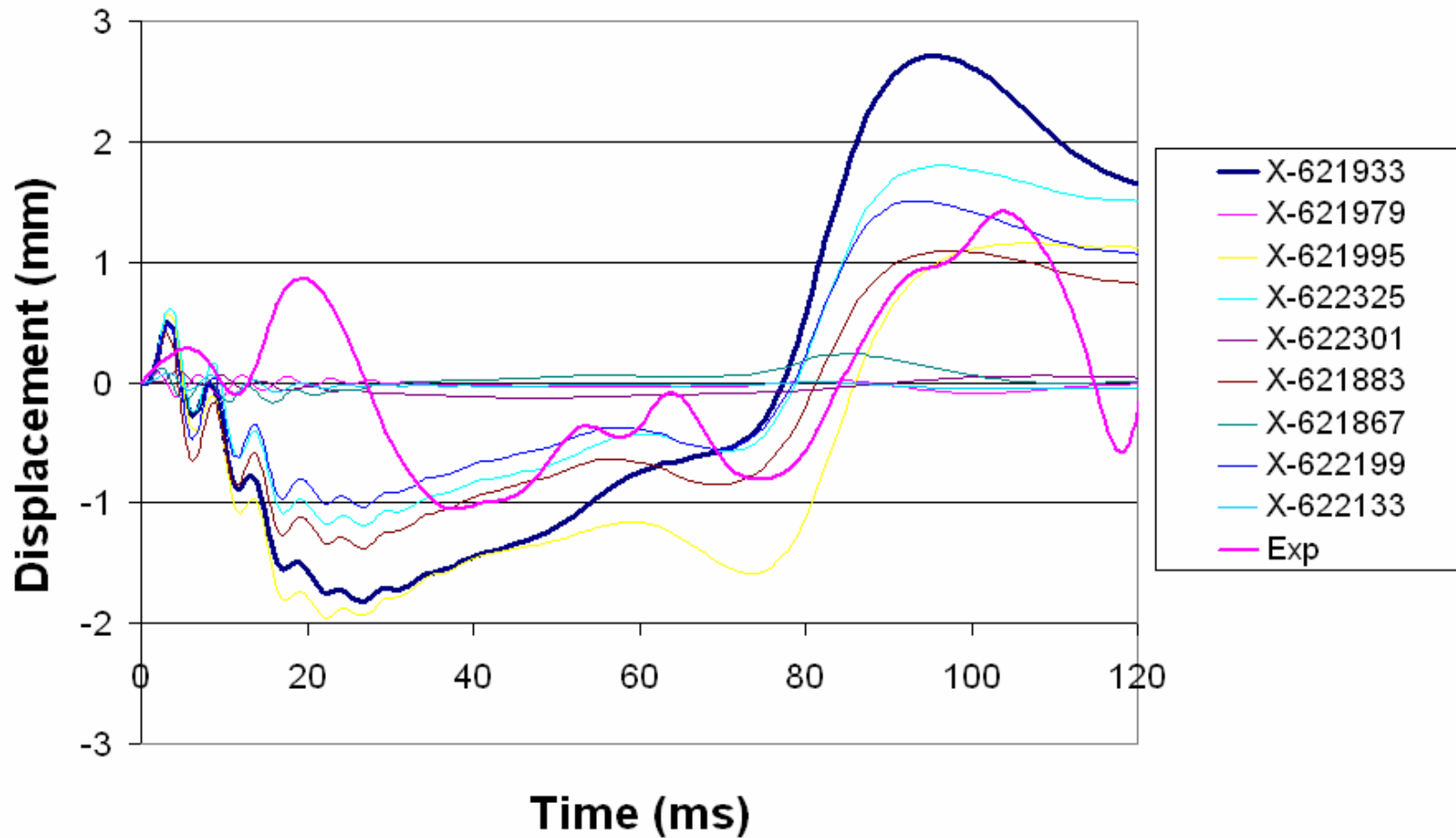


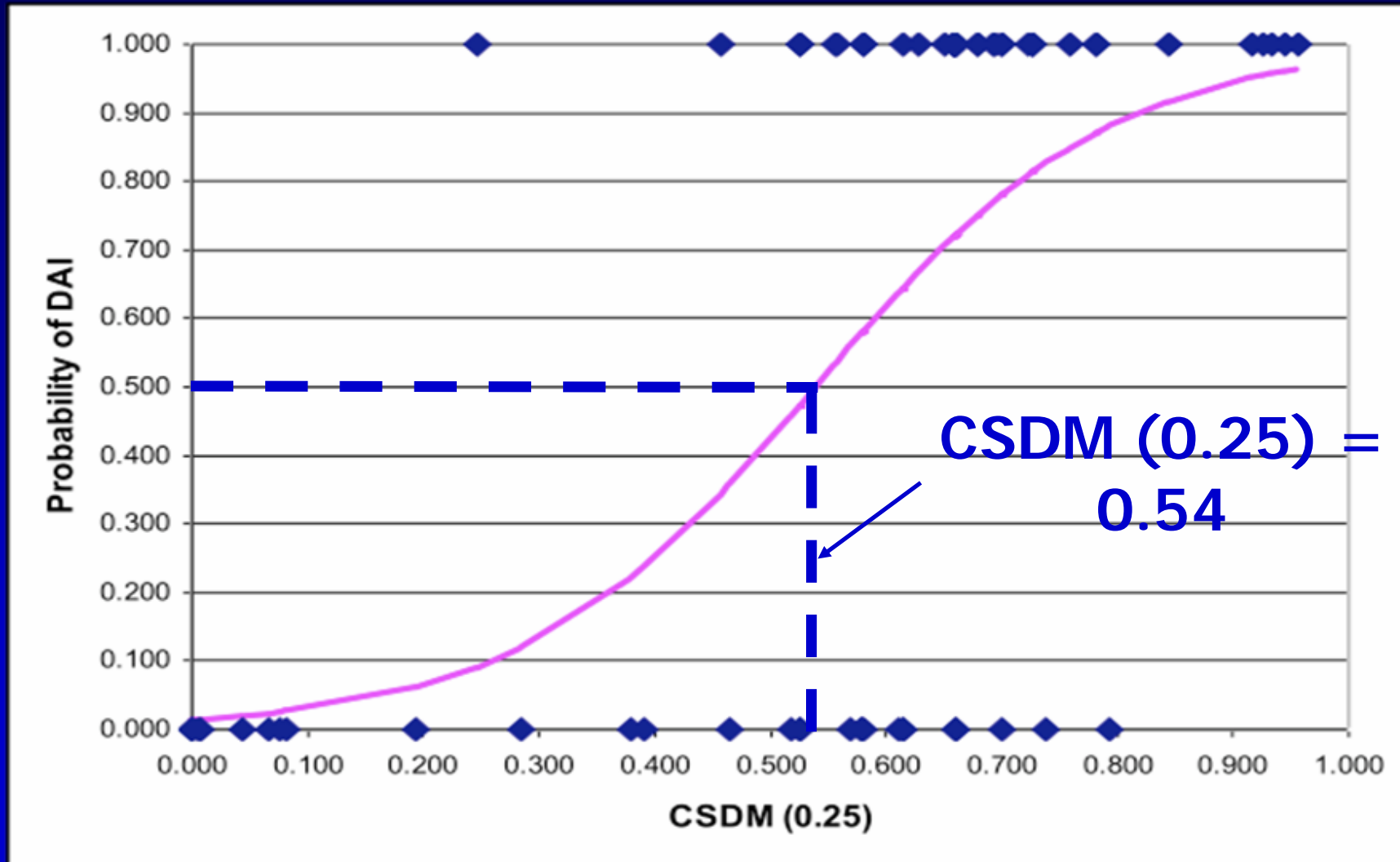
Figure B3. 383-T1-A6x

# Most Common TBI in MVC - Biomechanical Equivalents

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- ❖ Cumulative Strain Damage Measure (CDSM) for DAI
- ❖ Dilatational Damage measure (DDM) for Focal injuries/Contusions
- ❖ Relative Motion Damage Measure for ASDH
- ❖ Maximum Principal Stress and Strain, Product of strain and strain rate, etc.

# Correlation to Injuries from Animal Studies (CSDM)



# Side Impact Tests Evaluation - HIC

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HIC15 = 668

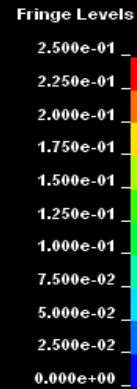
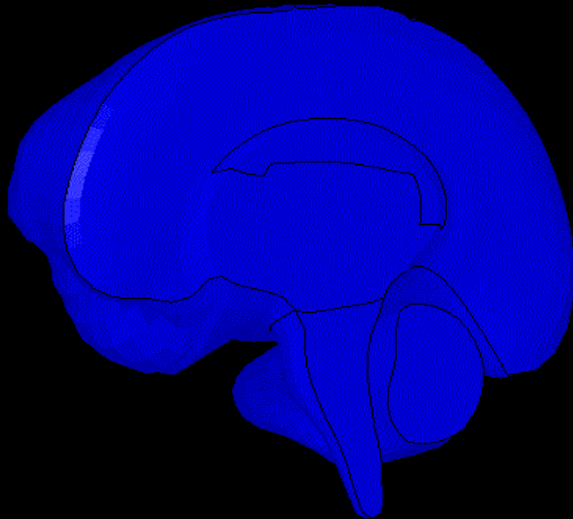


HIC15 = 225

# Side Impact Tests Evaluation - CSDM

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BRAIN-TG1  
Time = 0  
Contours of Effective Plastic Strain  
max ipt. value  
min=0, at elem# 7336  
max=0, at elem# 7336



BRAIN-TG1  
Time = 0  
Contours of Effective Plastic Strain  
max ipt. value  
min=0, at elem# 7336  
max=0, at elem# 7336

