Update on UMTRI Work to Compare PMHS and WorldSID Midsize Male Lateral Impact Responses

WorldSID Informal Group Meeting
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Motivation

1. WorldSID abdomen response is based on tests where cadavers were dropped on armrest-shaped impactors.
2. More data are needed on the side impact response of the abdomen from whole PMHS sled tests because previous studies either did not
    - separately measure abdominal force and deflection or
    - scale impactor size with subject size.
3. Little side impact sub-injury response data
4. Little low-severity impact response data and no low-severity abdomen impact response data

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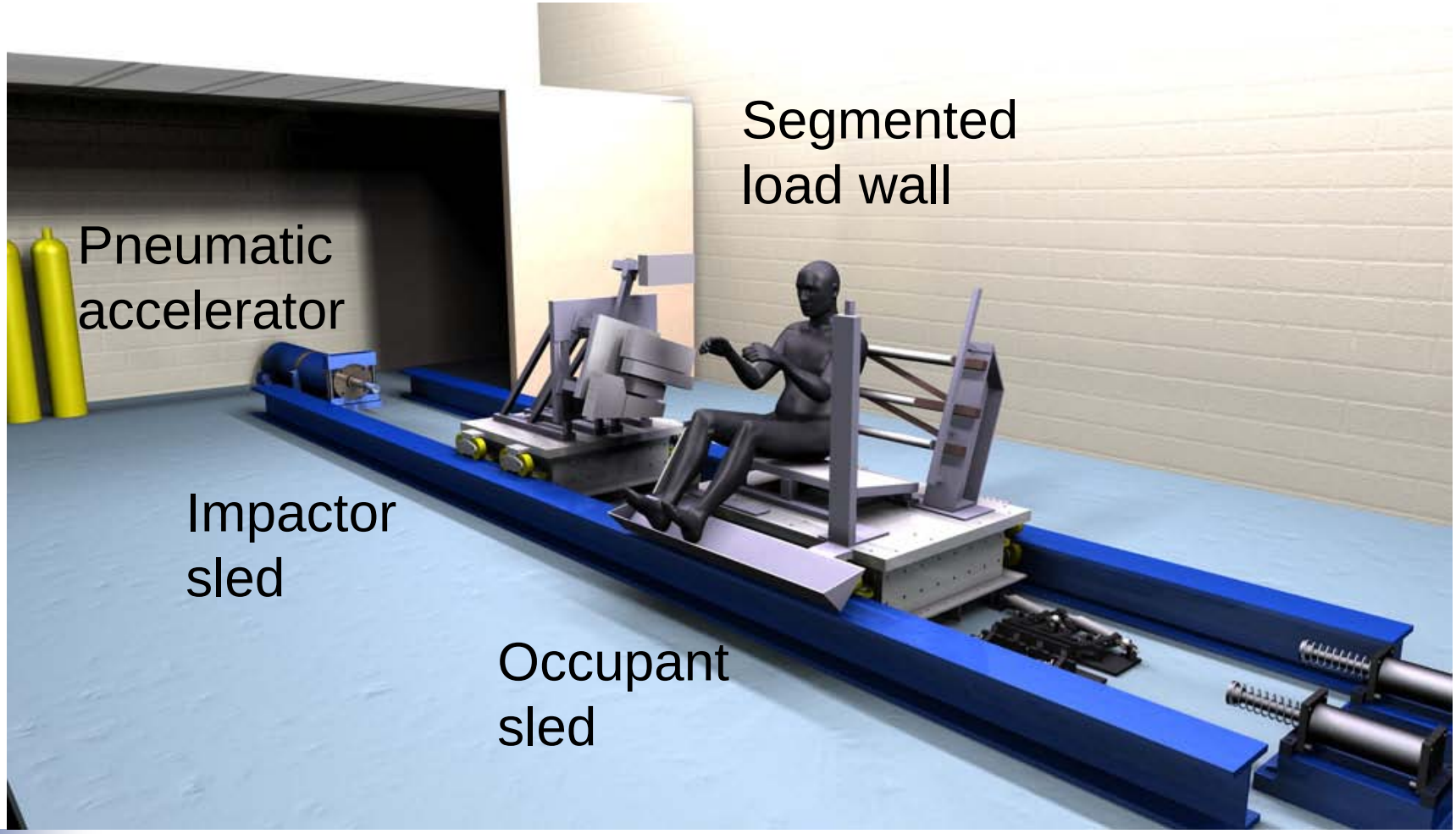
Cadaver Test Methods

- Impacted seven male cadaver twice using a padded impact wall with a 50-mm abdomen offset.
  - First impact at 3 m/s
  - A second impact at 8 m/s to contralateral side of the body was performed for four of the seven cadavers.
  - Velocities were selected based on a review SNCAP door velocity histories
- All tests were conducted using the UMTRI dual-sled side impact sled facility.

Test Methods—UMTRI Side Impact Facility



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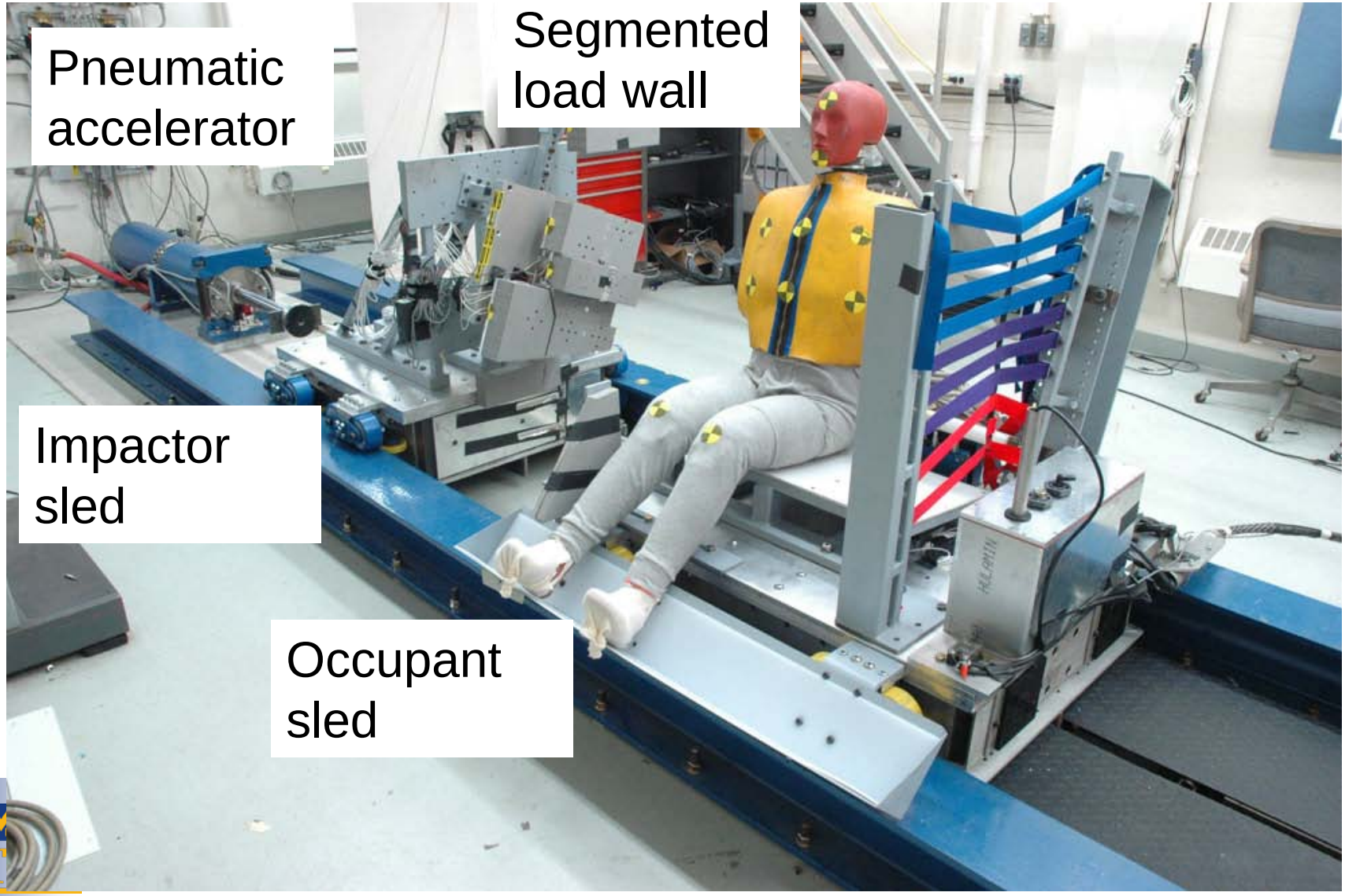
Test Methods—UMTRI Side Impact Facility



Test Methods, cont.

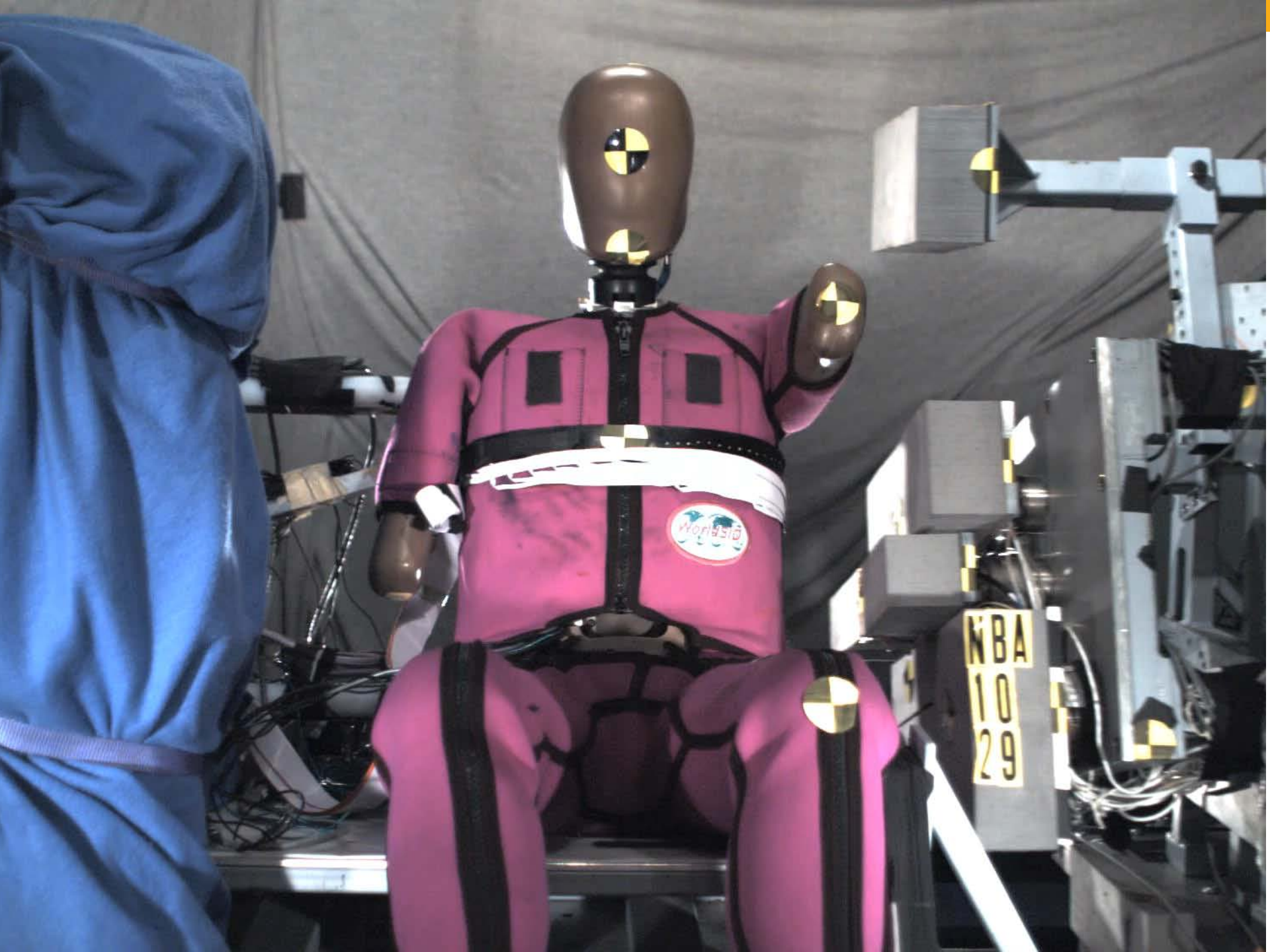
- Padding force-deflection characteristics set so that mean ATD responses from SNCAP tests were reproduced when impactor and occupant sled masses and velocities were tuned to reproduce door and vehicle velocity histories from SNCAP tests
- Recorded forces applied to anatomic regions including: thorax, abdomen, iliac crest, greater trochanter, and mid femur. Scaled heights of impactor plates with subject size to ensure that each segment of the impact wall loads the same body region across tests.
- Recorded thorax and abdomen deflection using 59-channel chest bands
- Recorded rib accelerations and FX timing based on strain gage data

Cadaver Corridor Development

- Normalized using equal-stress equal velocity scaling based on total body mass.
- Calculated ±1SD responses using Maltese method.

WorldSID test matrix

- 3 m/s and 8 m/s impact velocities using 50-mm abdomen offset
- 4 repeats at each velocity test condition
- Measure abdomen and chest deflection with chestbands and IR-TRACCs
- Recalibrated at halfway point in test matrix and after all tests were completed.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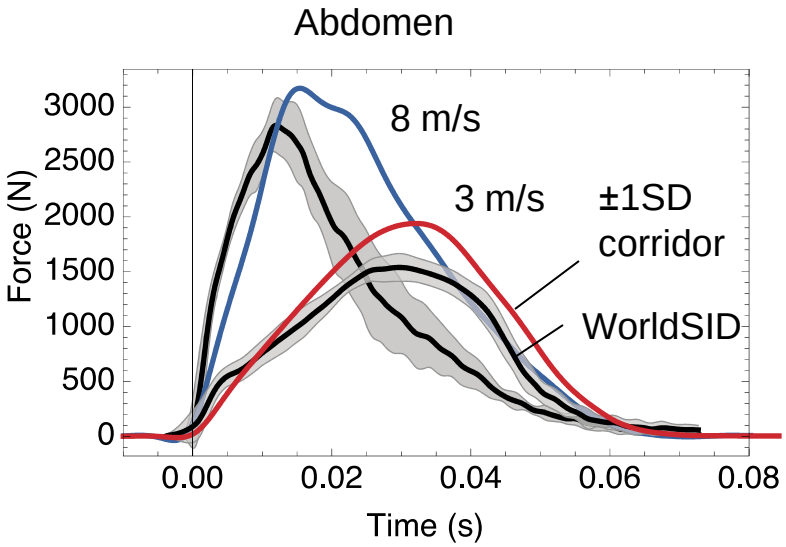
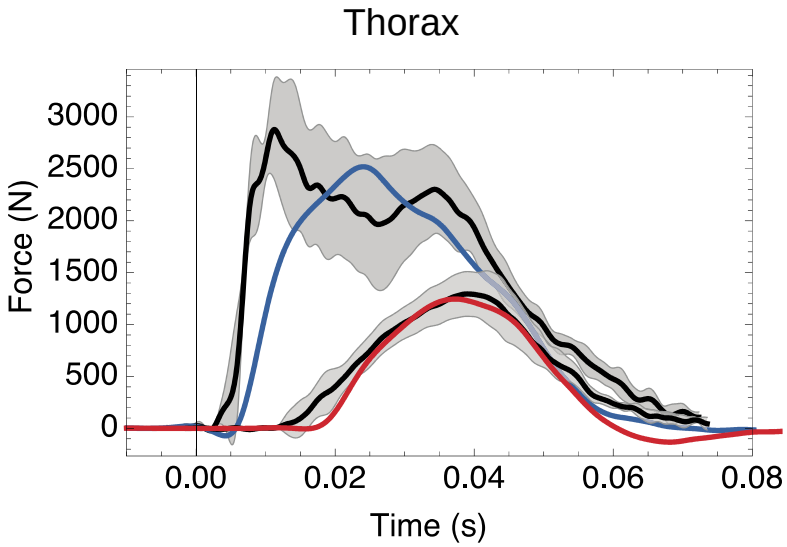
Comparison of WorldSID Force Responses to Force Corridors from 3 m/s and 8 m/s Impacts





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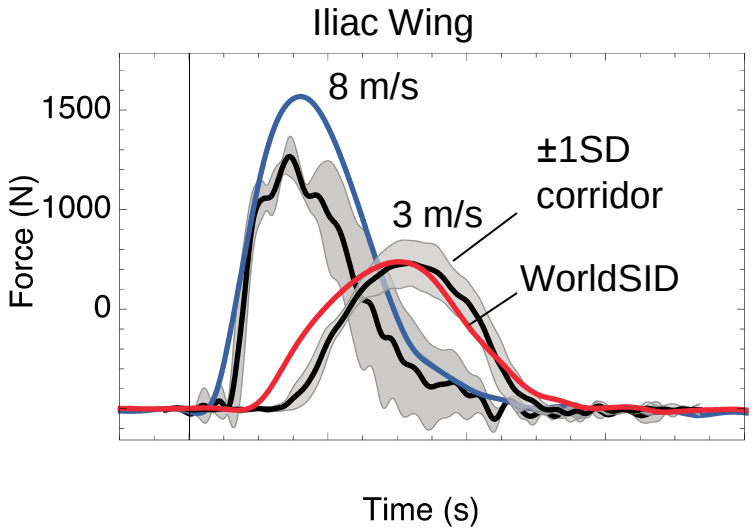
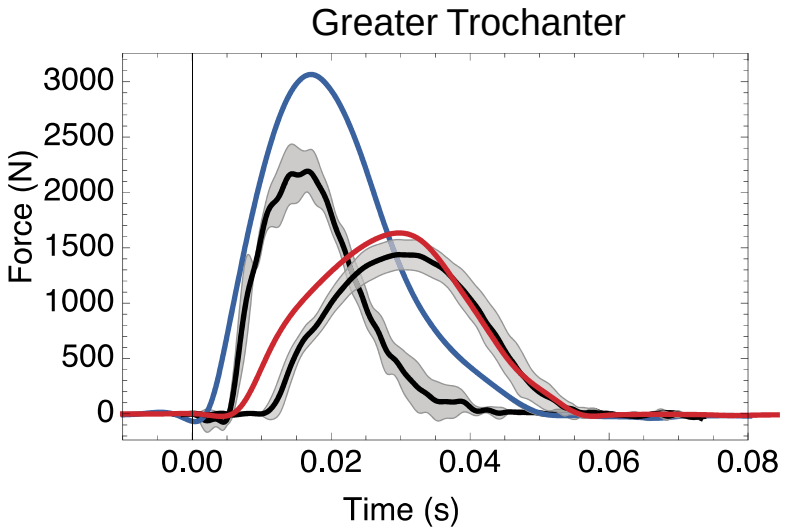
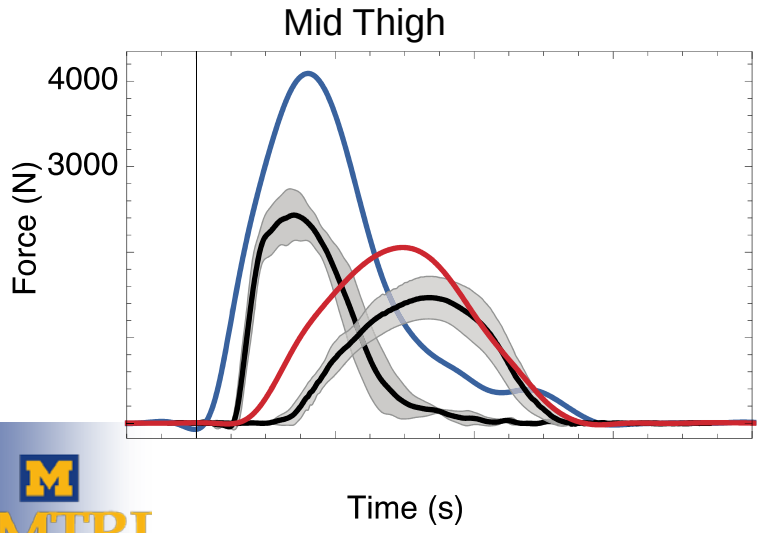
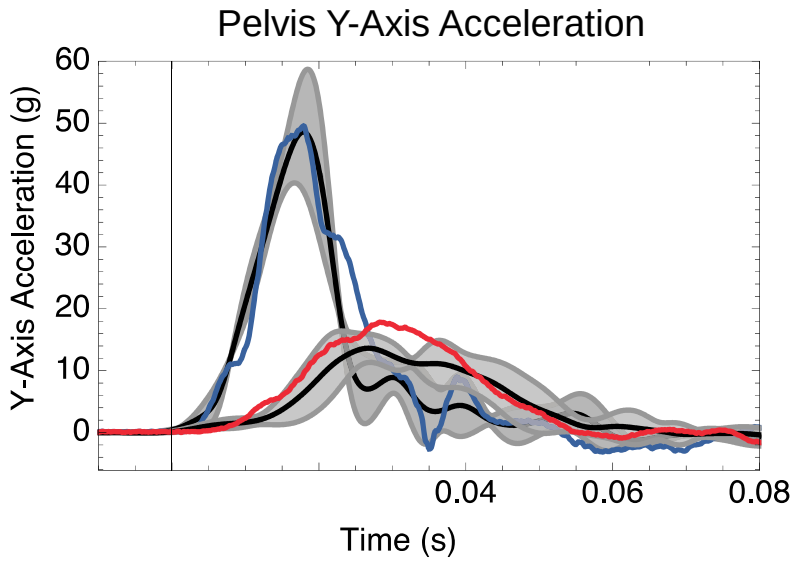
Comparison of WorldSID Responses to Corridors from 3 m/s and 8 m/s Impacts









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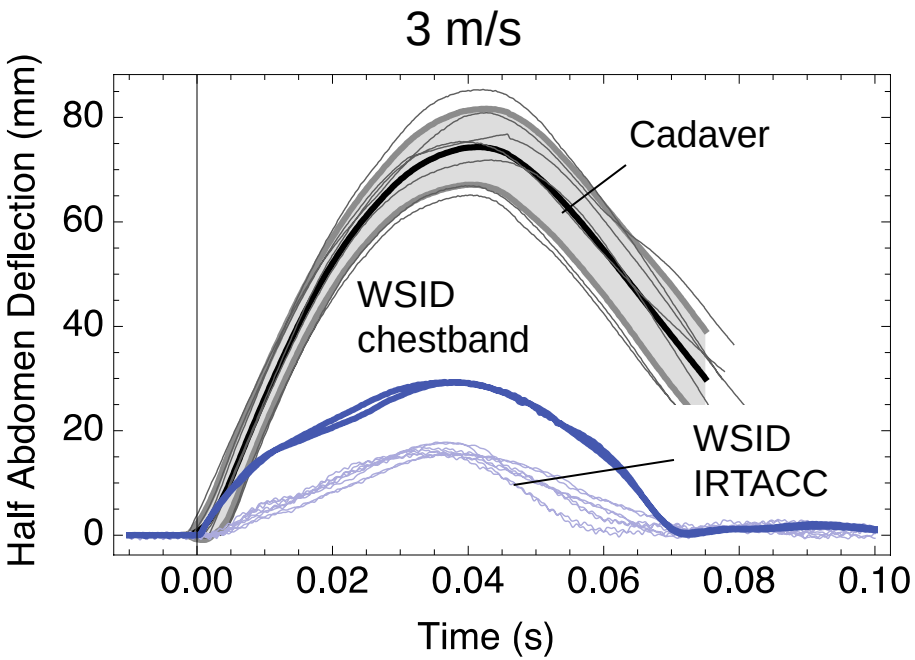
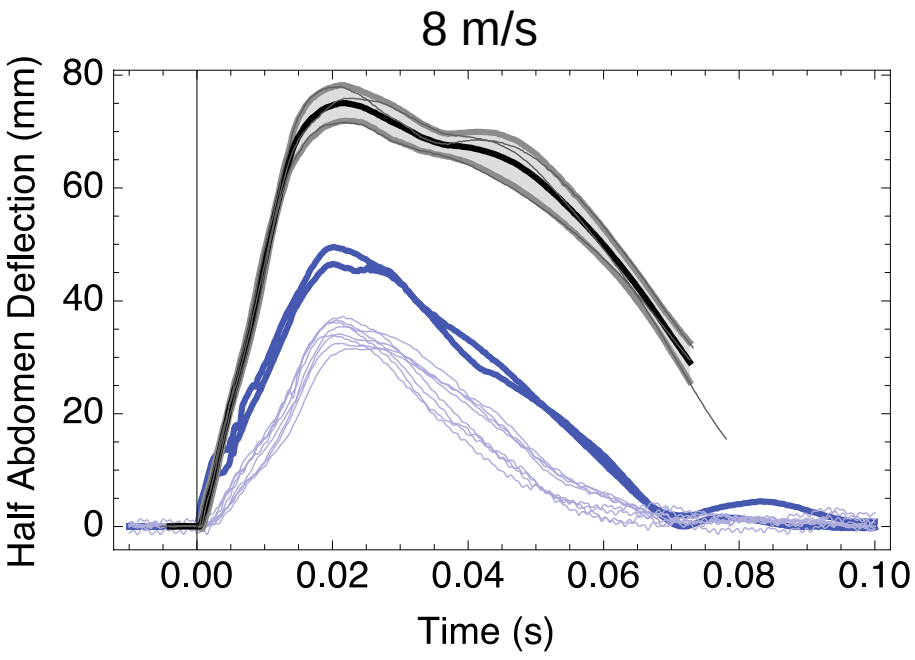
Cadaver Abdomen Deflection vs. WorldSID External and Internal Abdomen Deflection Histories





- Difference between WorldSID internal and external deflections is approximately the thickness of the chest jacket.

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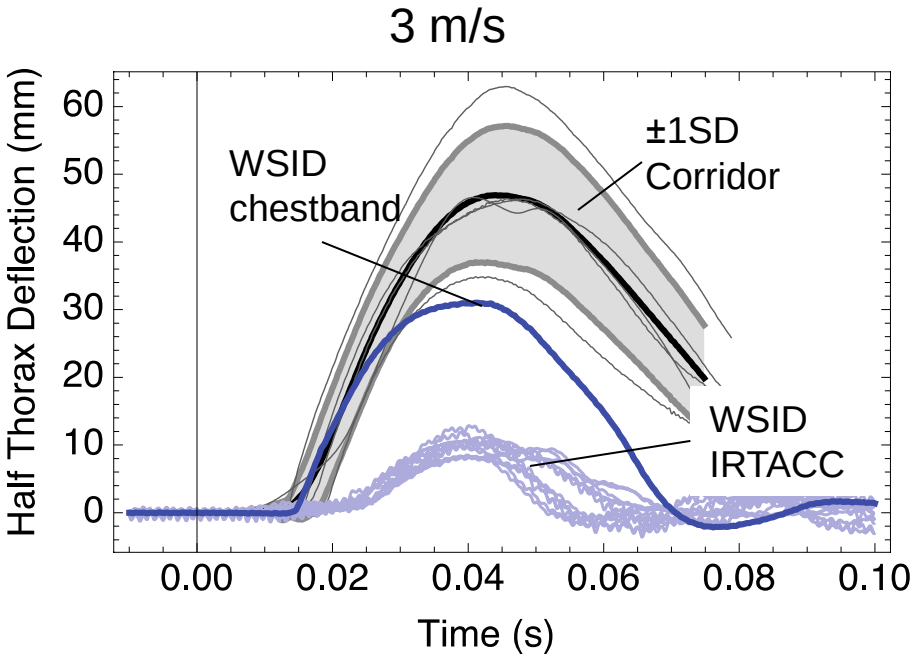
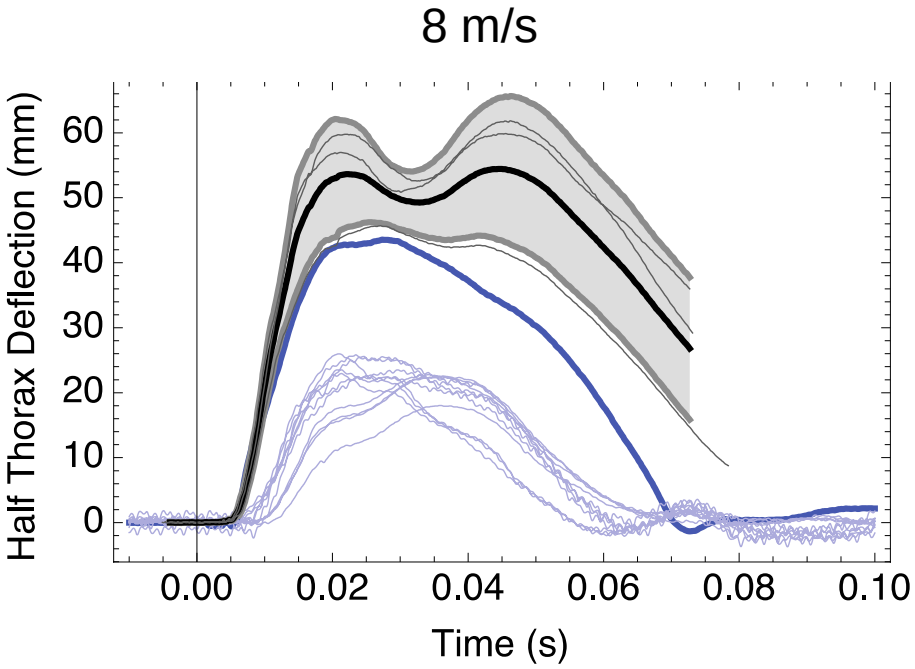
Cadaver Thorax Deflection vs. WorldSID External and Internal Thorax Deflection Histories, 8 m/s





Differences between WorldSID and cadaver external deflections are partially from differences in pelvis to-spine coupling that result in the WorldSID tilting towards the impactor and thus reducing deflection of the ribs that are underneath the chestband location.

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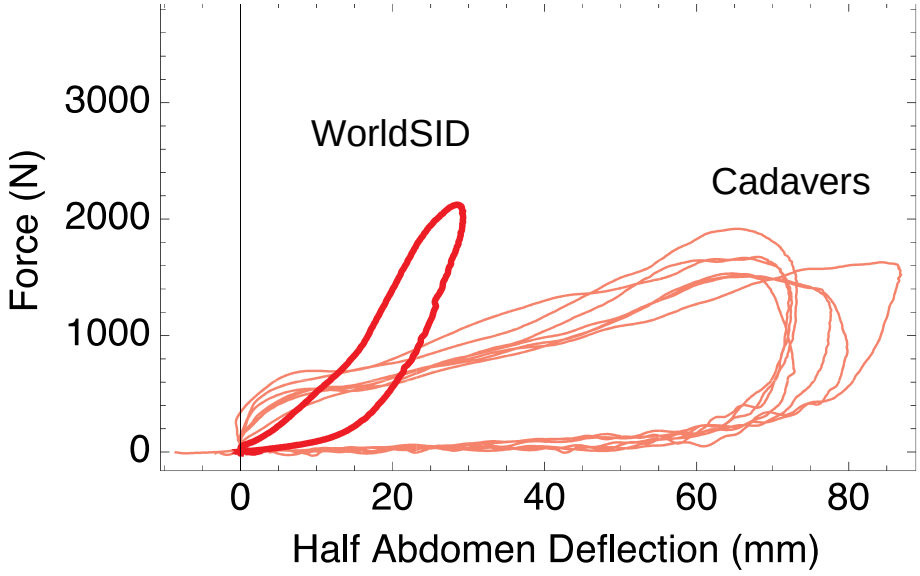
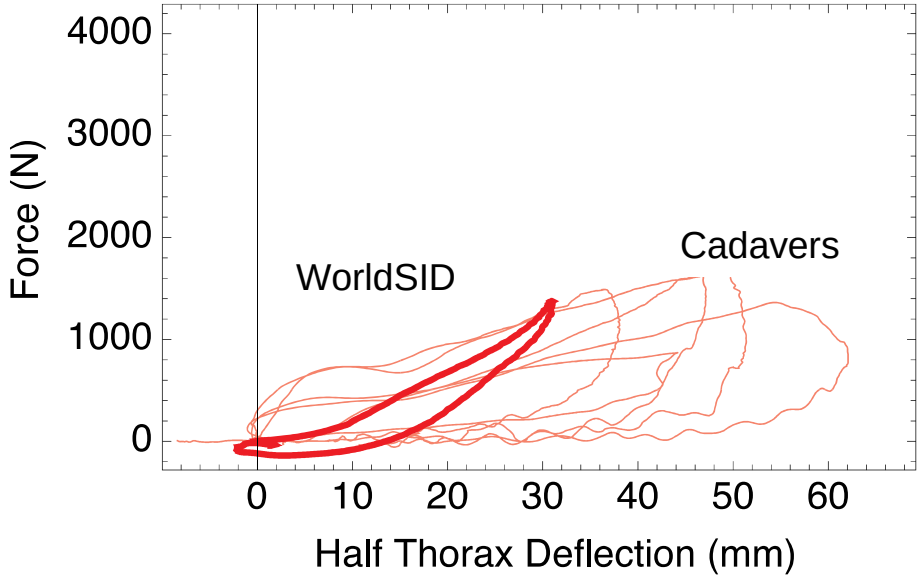
Cadaver vs. WorldSID Abdomen and Thorax Force-Deflection Responses

3 m/s Abdomen



3 m/s Thorax



All deflections are based on chestband data

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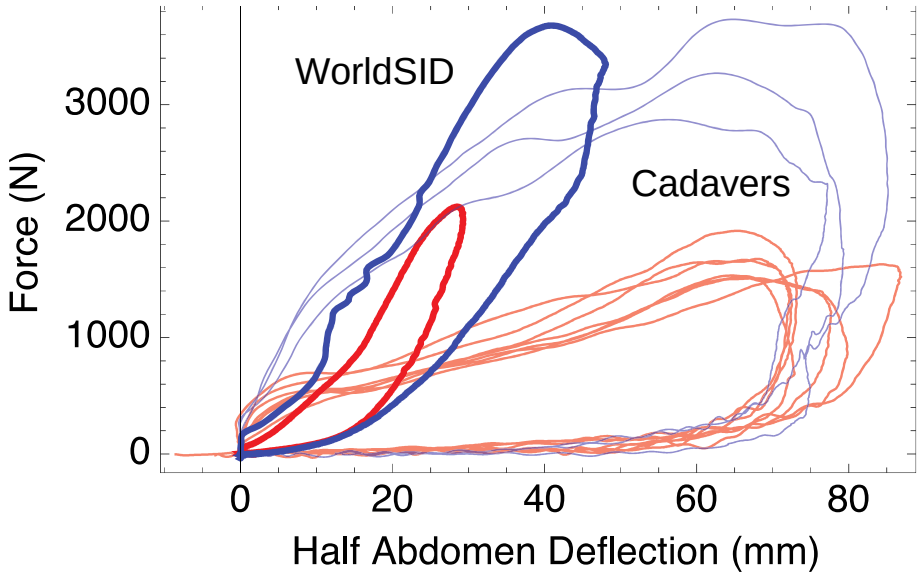
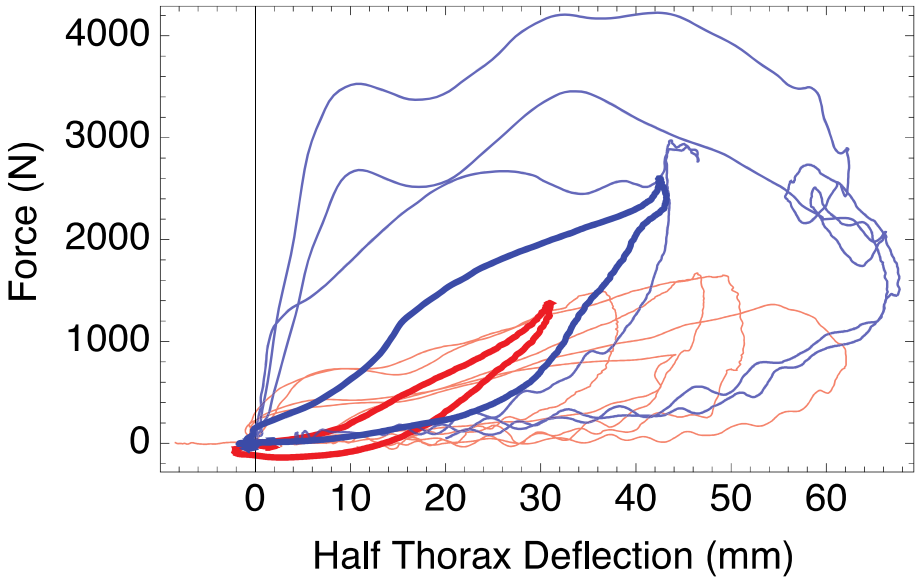
Cadaver vs. WorldSID Abdomen and Thorax Force-Deflection Responses

3 and 8 m/s Abdomen



3 and 8 m/s Thorax



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Summary

- WorldSID abdomen does not deform as much as the cadaver abdomen under similar loading conditions
- WorldSID pelvis forces were higher than the cadaver response corridors at 8 m/s, but WorldSID pelvis Y-axis was within the response corridors, suggesting that the WorldSID pelvis may need to be less stiff and have less tightly coupled mass.
- WorldSID mid thigh flesh forces were above cadaver response corridors for both the 8 m/s and 3 m/s test conditions. Suggests thigh flesh may be too stiff.

Summary, cont.

- Differences in thorax responses between WSID and cadavers may be due to difference in torso kinematics.
- All data in this talk are available in the NHTSA biomechanics database and are contained in Rupp et al. (2011), ESV paper 11-0080.

Next Steps

- Ongoing program to collect response data from females and preferentially frail occupants.
- Using MCW-style impactor that is reconfigurable with subject size and shape so that contact will all body regions occurs at the same time.
- Plan to compare WorldSID small female to response corridors developed from these tests when WSID is available.
- Also plan to test WSID small female relative using abdomen offset test conditions

Thanks for your attention.

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