Evaluation of the WorldSID impact response and injury prediction capabilities
Assessment of pelvic injuries

Damien Subit, Richard Kent, Steve Ridella

University of Virginia

Center for Applied Biomechanics

Existing injury risk curves

WorldSID revision 1

Shoulder:

deflection, lateral force

Thorax:

deflection (Thorax and abdomen ribs), VC (Thorax and abdomen ribs)

Abdomen:

lower spine acceleration 3 ms, VC, abdomen rib deflection

Pelvis:

pubic force, pelvic acceleration 3 ms

Petitjean et al, Stapp 2009

Pelvis Injury Risk Curve (IRC) based on pubic force only

Only the pubic force was measured in version 1. Experimental data with WorldSID equipped with SI loadcell not available for all the matching WorldSID/PMHS tests.

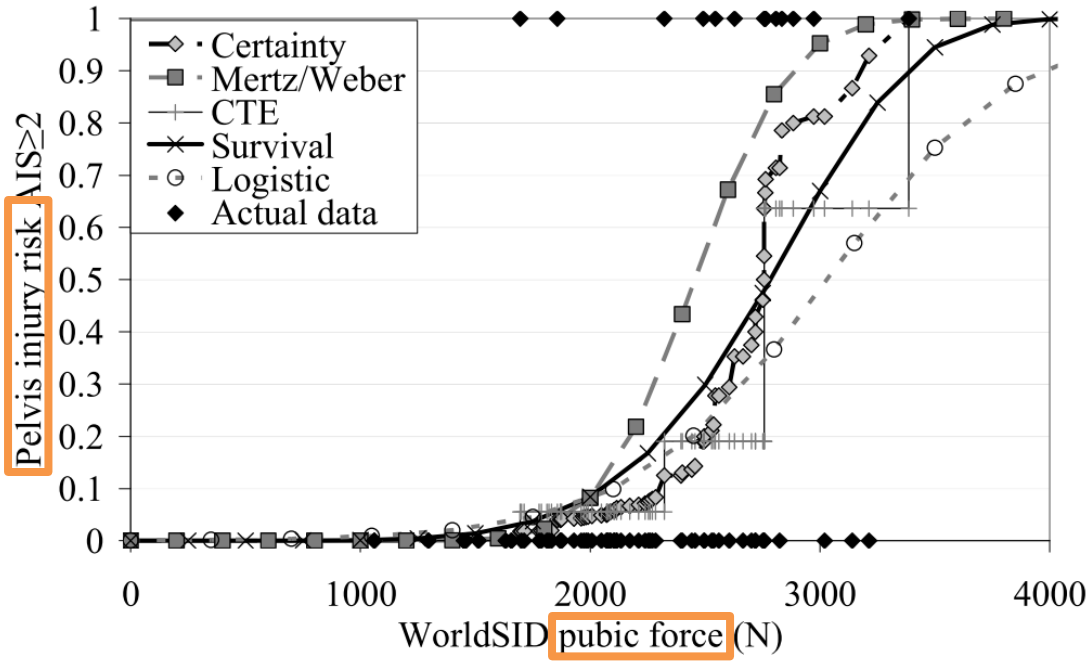
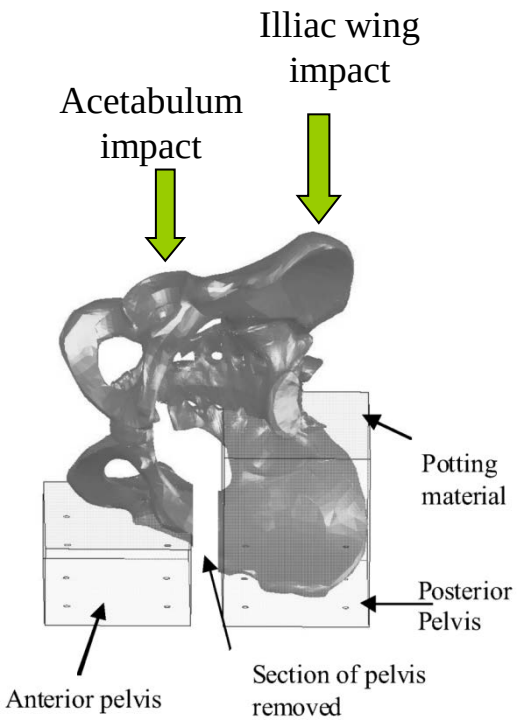
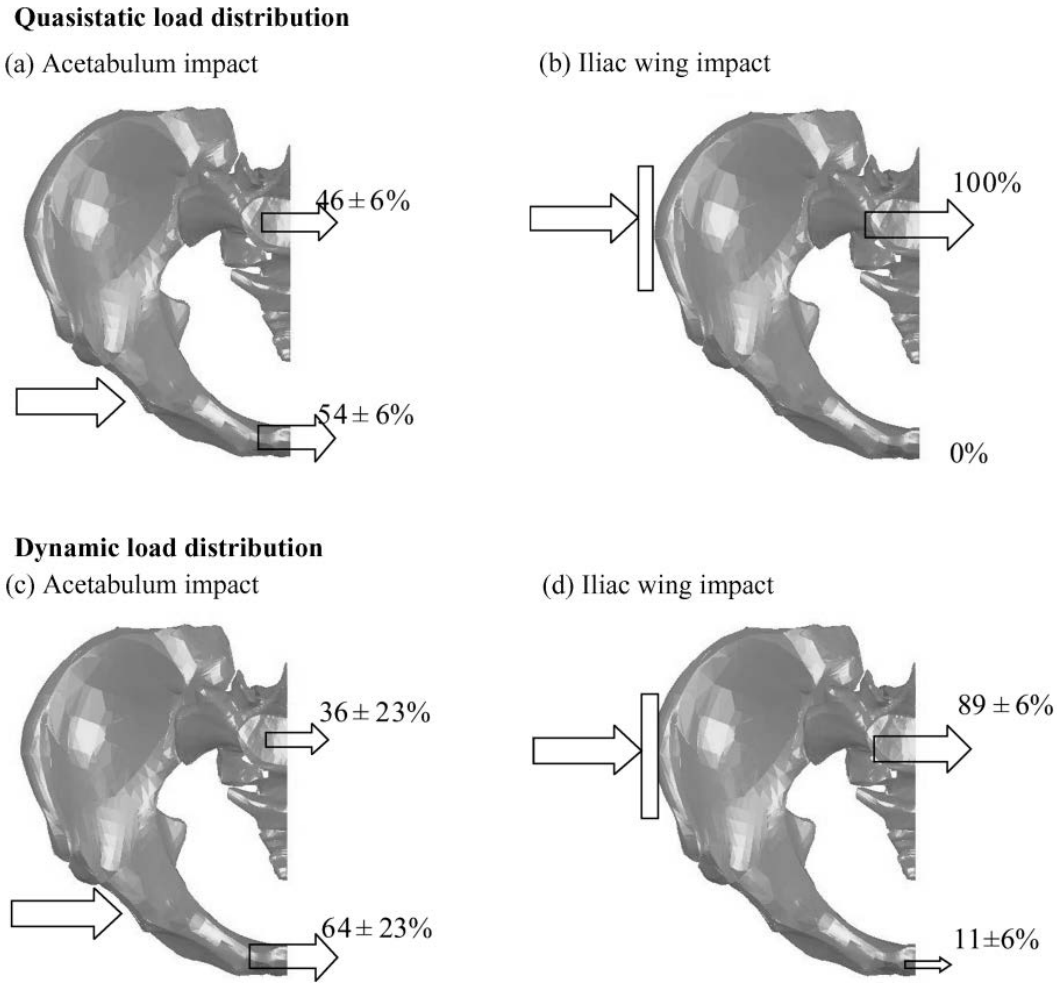


FIGURE 19. Risk of AIS >= 2 pelvis injury as a function of maximum pubic force for WorldSID.

Load paths in the pelvis



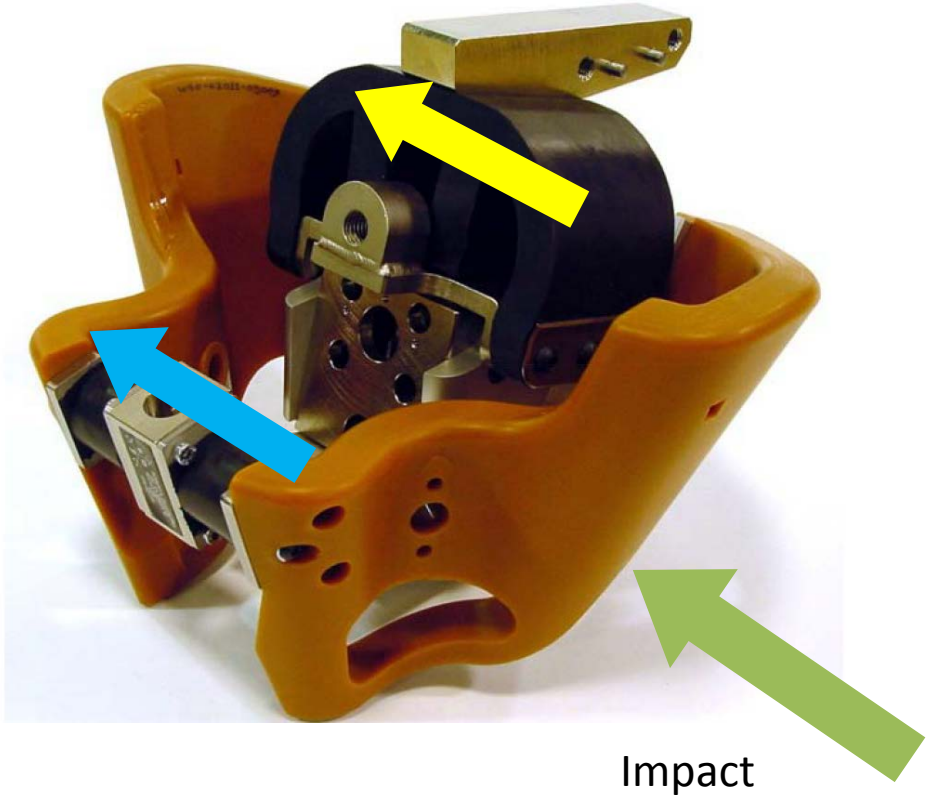
Applied loading



Results

Salzar et al, IJCrash, 2009

Can the WorldSID pelvis mimic this load distribution?



Impact

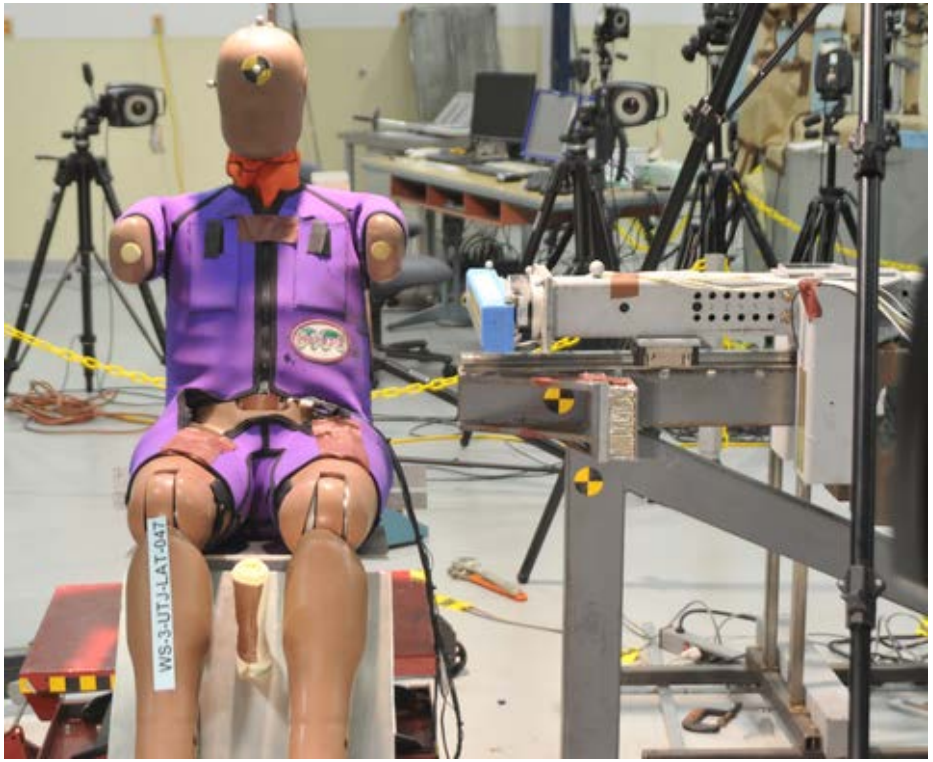
Proposed task

- Determining the injury mechanisms based on CIREN review
- Quantifying the coupling between the loads measured in the SI joint and the PS load for various impact characteristics (velocity, direction, contact) based on experiments performed with WorldSID

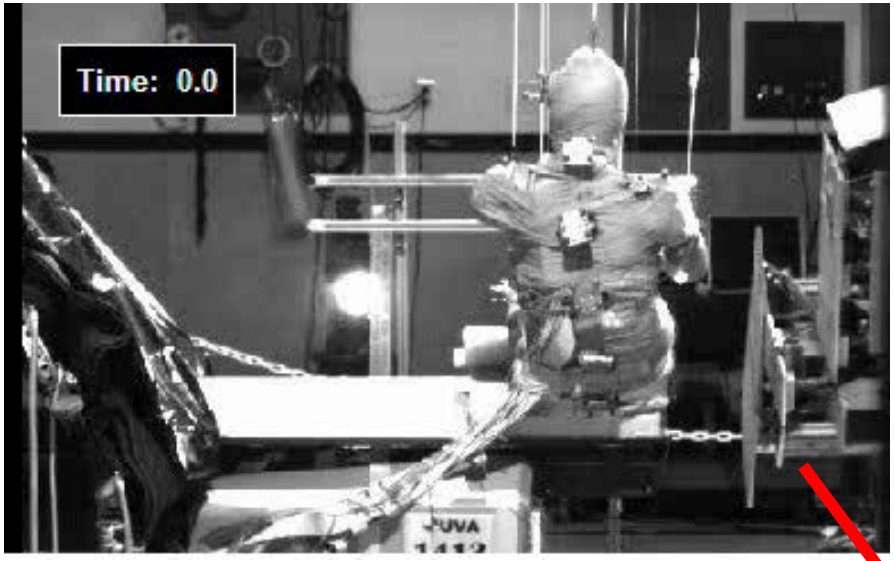
Matching PMHS/WorldSID tests
Impactor tests

In Petitjean et al (2009), WorldSID data were scaled to match PMHS data when the dummy data were not performed at the same velocity.

Proposed task
Performing impactor tests with WorldSID to match the PMHS data available (various impactor shape, velocity, mass)

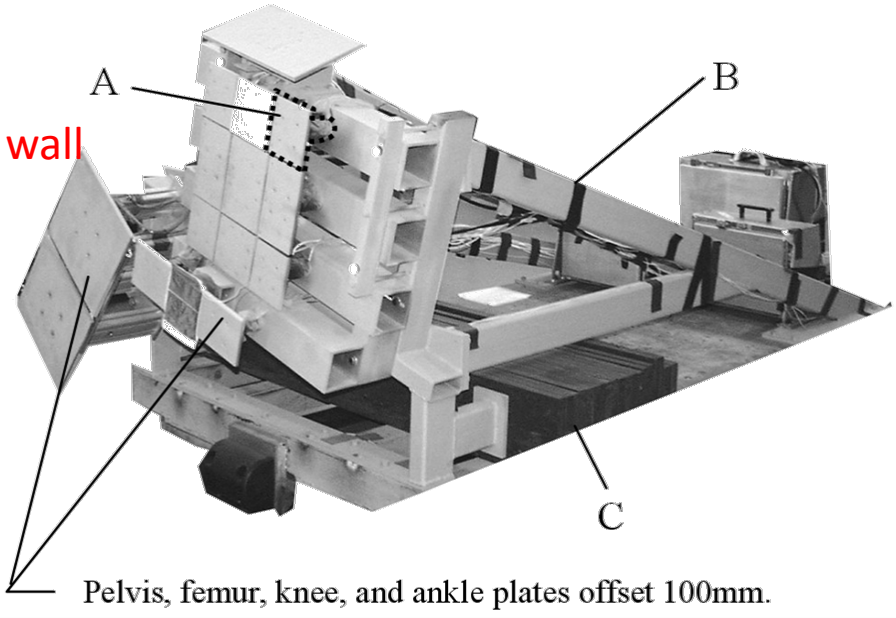


Matching PMHS/WorldSID tests
Sled impact tests



4.3 m/s

Load wall



Pelvis, femur, knee, and ankle plates offset 100mm.

Wall instrumented will load cells
Offset plate for the pelvis.
No pelvis injuries.

Proposed task
Reproduce this loading condition with WorldSID

Lessley et al, Stapp, 2010

Injury Risk Curves

Injury severity will be evaluated based on their AIS score.
Data from matched WorldSID/cadaver tests available in the literature will be added to the data generated in this project.

Proposed task
Developing injury rick curves (IRC) for the pelvic acceleration
Developing IRC either independently for the anterior (PS) and posterior (SI joint) and the associated fractures, or for the pelvis as a whole if the loads in the SI joint and PS are coupled.
PMHS data might need to be adjusted for age and anthropometry

Summary

3 tasks

1. Identification of injuries mechanisms, impact conditions and pelvis injuries

   CIREN review, pelvic injury mechanisms, sensitivity analysis

2. Impactor and sled tests with WorldSID

   Matching dummy tests (no scaling)

3. Development of injury risk curve(s)

   The outcomes of task 1 will allow to determined whether independent IRC can be developed for the SI joint and PS