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

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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 $\geq 2$ pelvis injury as a function of maximum pubic force for WorldSID.
Load paths in the pelvis

Salzar et al, IJCrash, 2009
Can the WorldSID pelvis mimic this load distribution?

**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

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 risk 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