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States of America

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(43rd GRSP, 19-23 May 2008
agenda item 5(a))

Side Impact Child Dummy Development

GRSP – 43rd Session
Mary Versailles

Overview

- Side Child Dummy Concepts
- Biofidelity Evaluation Preliminary Review
- Preliminary Durability Concerns
- Future Work

Overview

- **Side Child Dummy Concepts**
- Biofidelity Evaluation Preliminary Review
- Preliminary Durability Concerns
- Future Work

Side Child Dummy Concepts

- NHTSA evaluating two dummies
 - Q3s
 - Hybrid III 3 year-old with modified head/neck (HIII-3Cs)



Side Child Dummy Concepts

- Q3s Dummy
- Key Features
 - new fiberglass skull
 - improved shoulder design
 - improved pelvis design
 - improved arm design
- OSRP and NHTSA



Side Child Dummy Concepts

- Hybrid III 3Cs
- History/Development

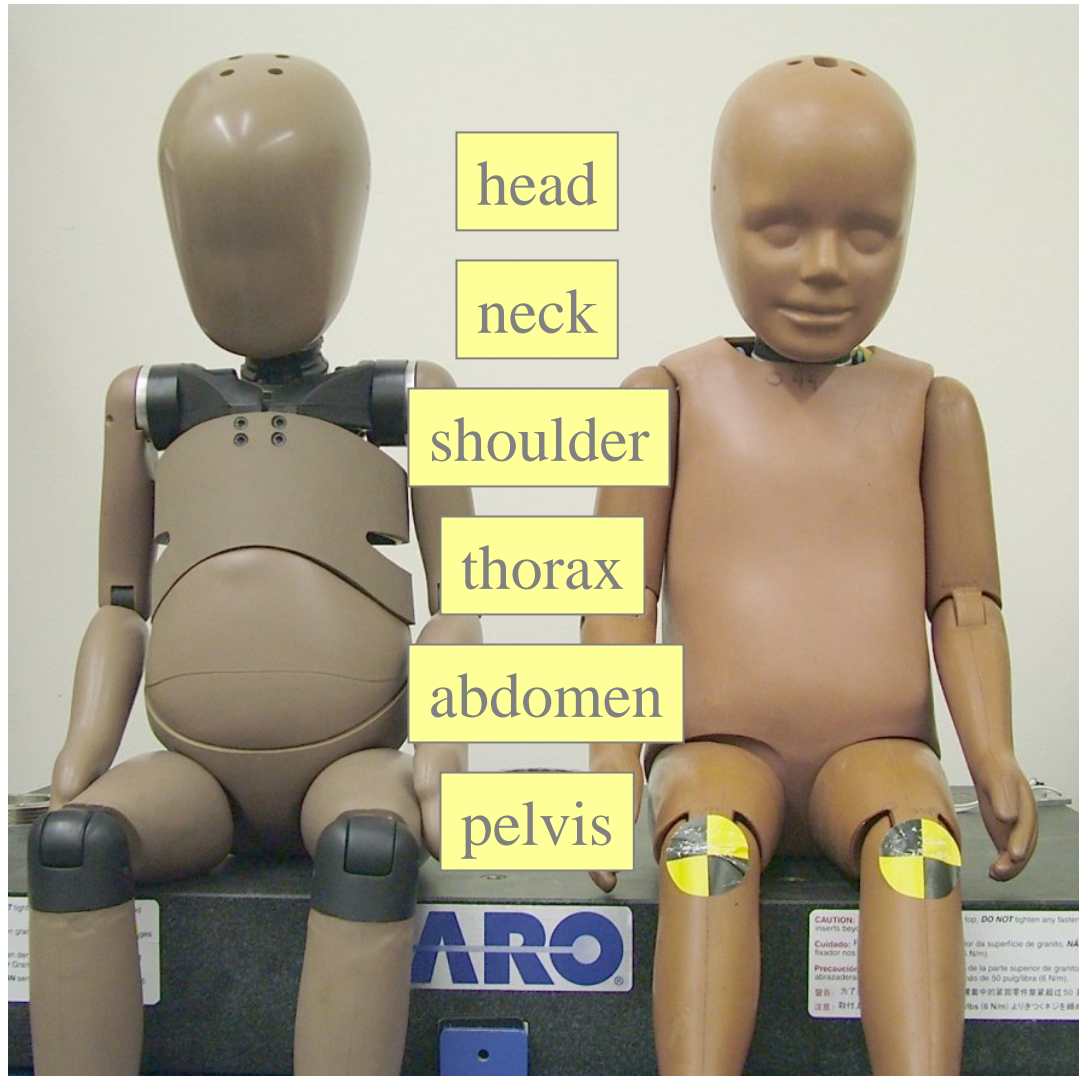


Overview

- Side Child Dummy Concepts
- **Biofidelity Evaluation Preliminary Review**
- Preliminary Durability Concerns
- Future Work

Preliminary Biofidelity Analysis

Q3s



3Cs



indicates biofidelity advantage



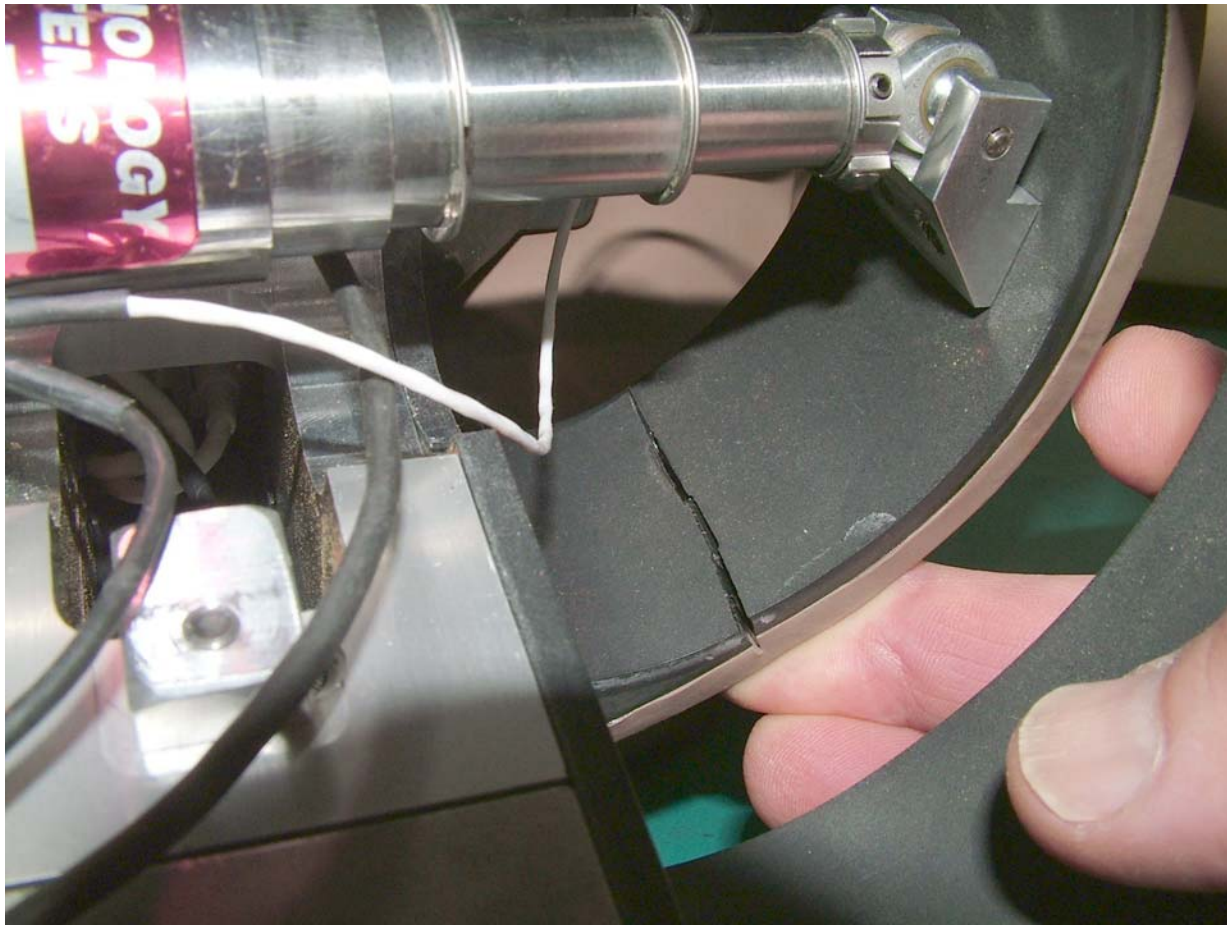
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Overview

- Side Child Dummy Concepts
- Biofidelity Evaluation Preliminary Review
- **Preliminary Durability Concerns**
- Future Work

Durability Concerns

- Thorax cracking observed after 64 pendulum impacts and 30 sled tests



Overview

- Side Child Dummy Concepts
- Biofidelity Evaluation Preliminary Review
- Preliminary Durability Concerns
- **Future Work**

Future Work

- Improve Q3s thorax durability via materials
- Incorporate 3Cs neck design into the Q3s dummy
- Assess new Q3s neck and improvements to thorax
- Conduct sled tests for additional biofidelity assessment

Thank You!
For Further Information
Contact

Dan Rhule

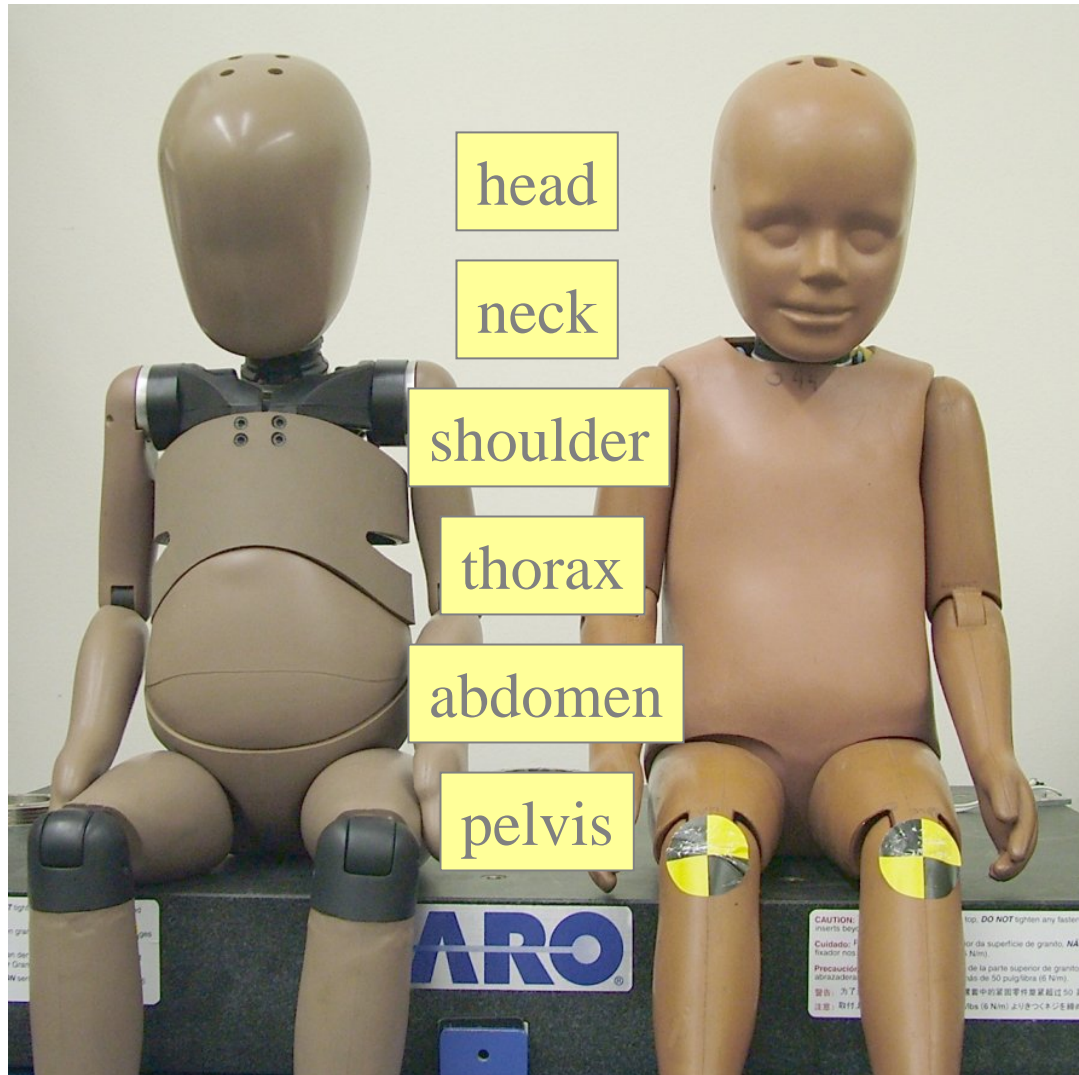
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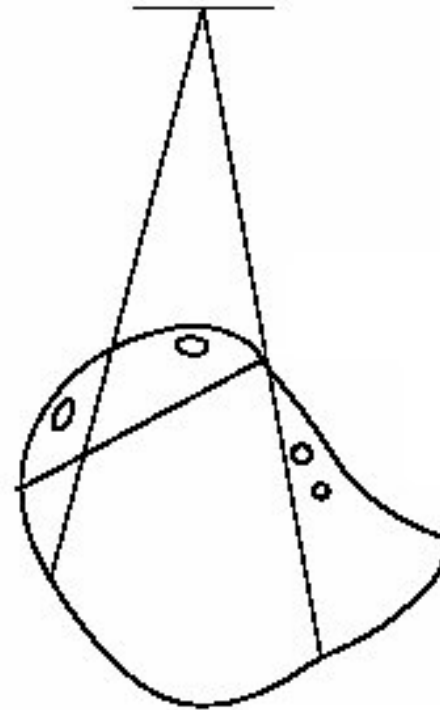
Additional Slides

Biofidelity Evaluation



Head Biofidelity

- Frontal Drop
- Ref: Irwin (Stapp 973317)
- - 376 mm drop
- - peak resultant: 255 – 315

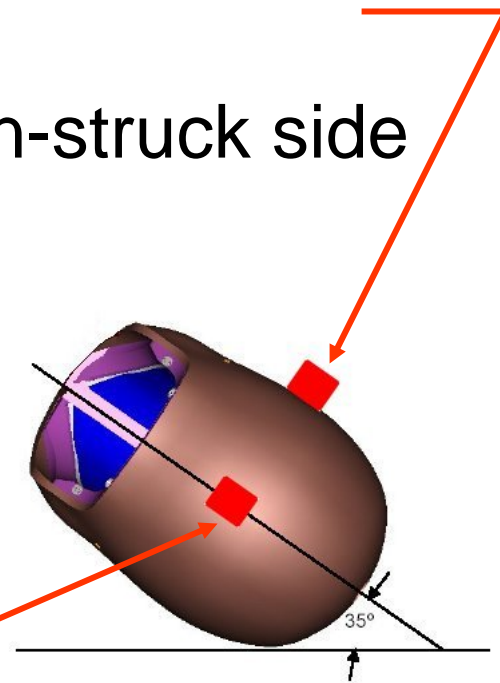


Head Biofidelity

➤ Lateral Drop

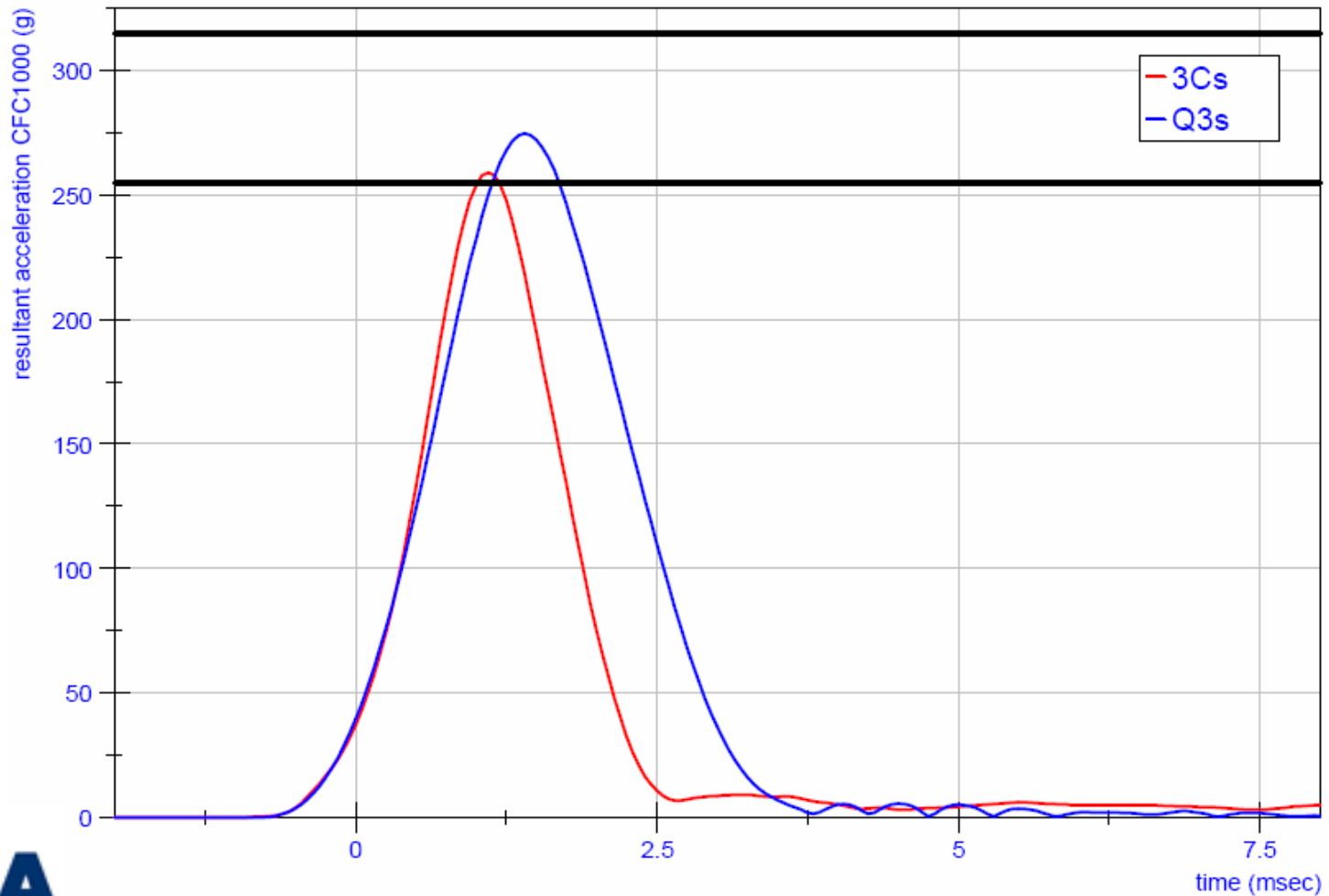
➤ Ref: Irwin (Stapp 2002-22-0016)

- 200 mm drop
- 114 – 171 g, measured at non-struck side
- 94 – 141 g, measured at CC



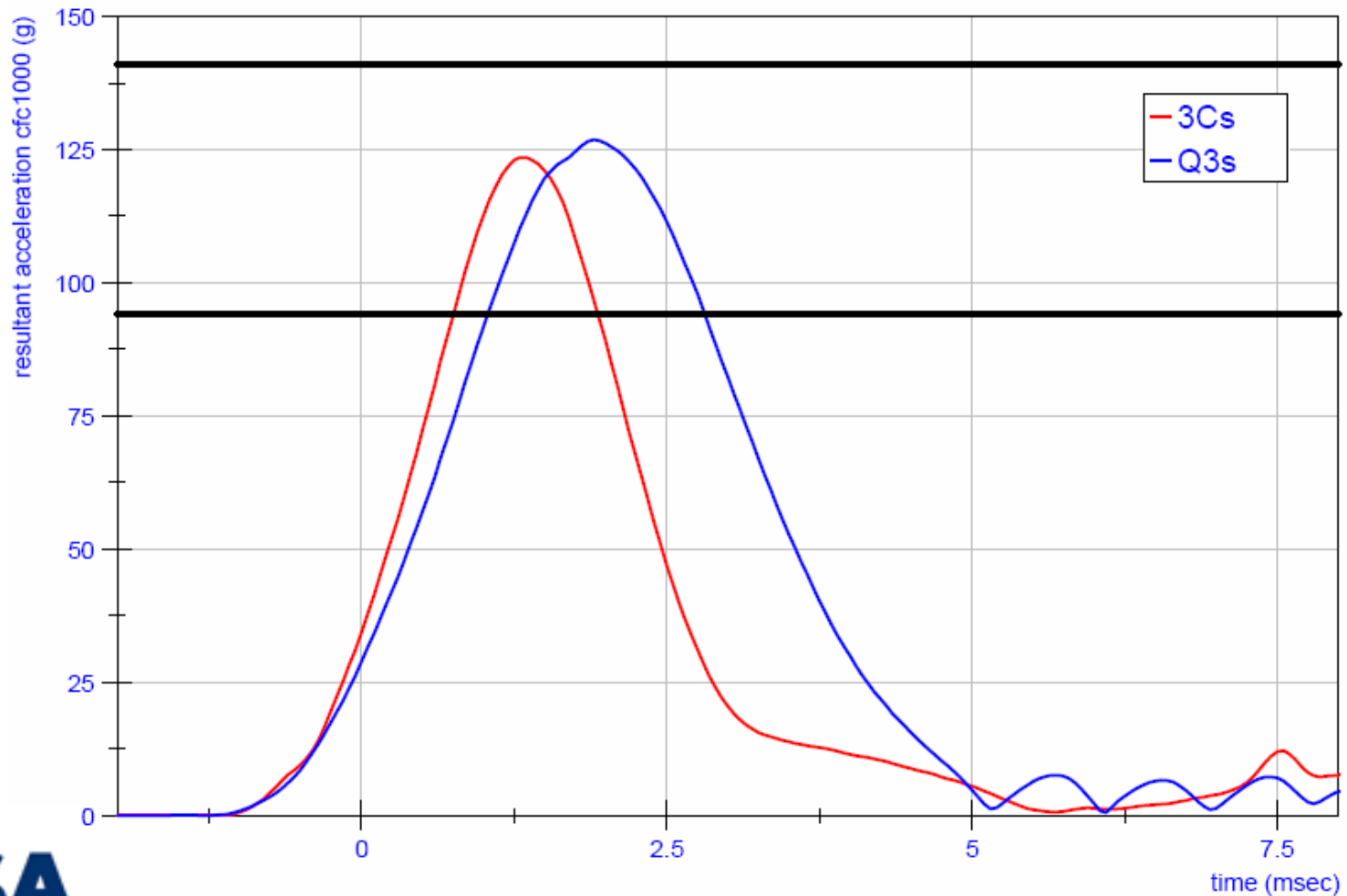
Head Biofidelity

Frontal Head Drop
376 mm Drop
Q3s vs 3Cs Response



Head Biofidelity

Lateral Head Drop
200 mm Drop
Q3s vs 3Cs Response



Neck Biofidelity

- Biofidelity References
- Lateral: Irwin (Stapp 2002-22-0016)
- Frontal: Irwin (Stapp 973317)
- Torsion: Mertz, personal communication

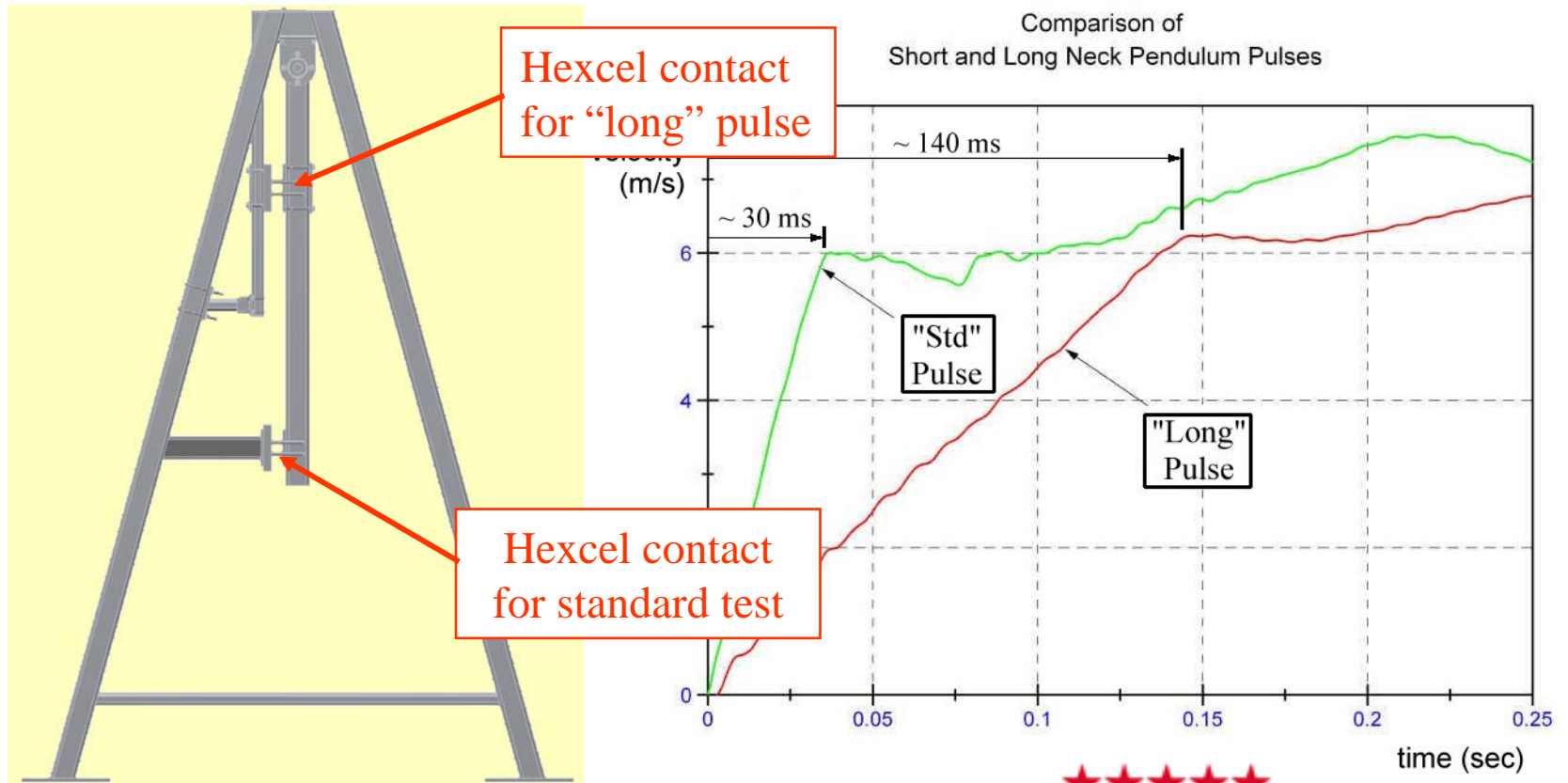


Evaluation Methods:

- Standard neck pendulum
- Modified neck pendulum
- Head/neck sled tests

Neck Biofidelity

➤ Neck Pendulum Pulse Duration Considerations



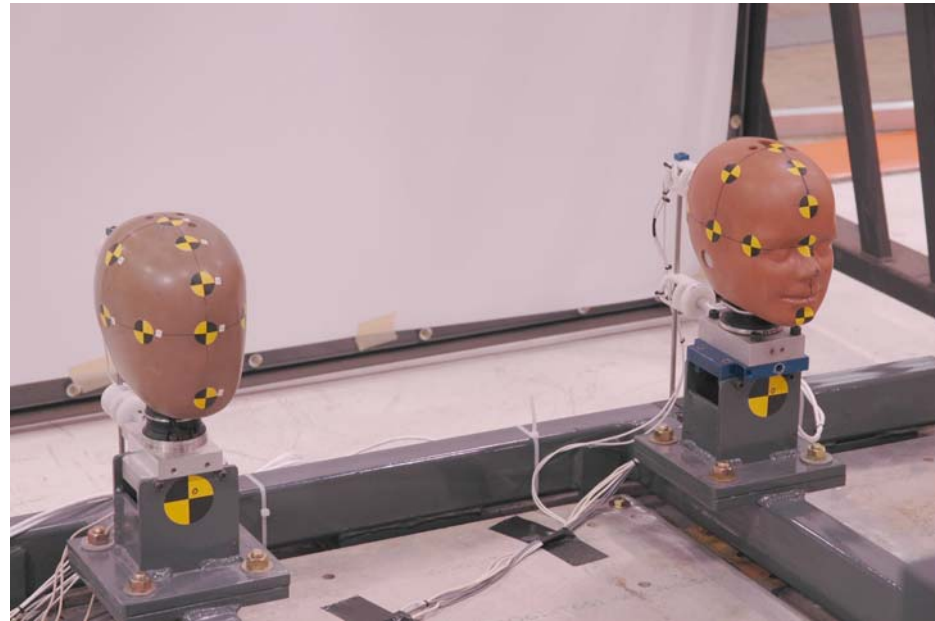
Hexcel contact for "long" pulse

Hexcel contact for standard test

Comparison of Short and Long Neck Pendulum Pulses

Neck Biofidelity

- **Head/Neck Sled Tests** – allows for longer pulses



Neck Biofidelity

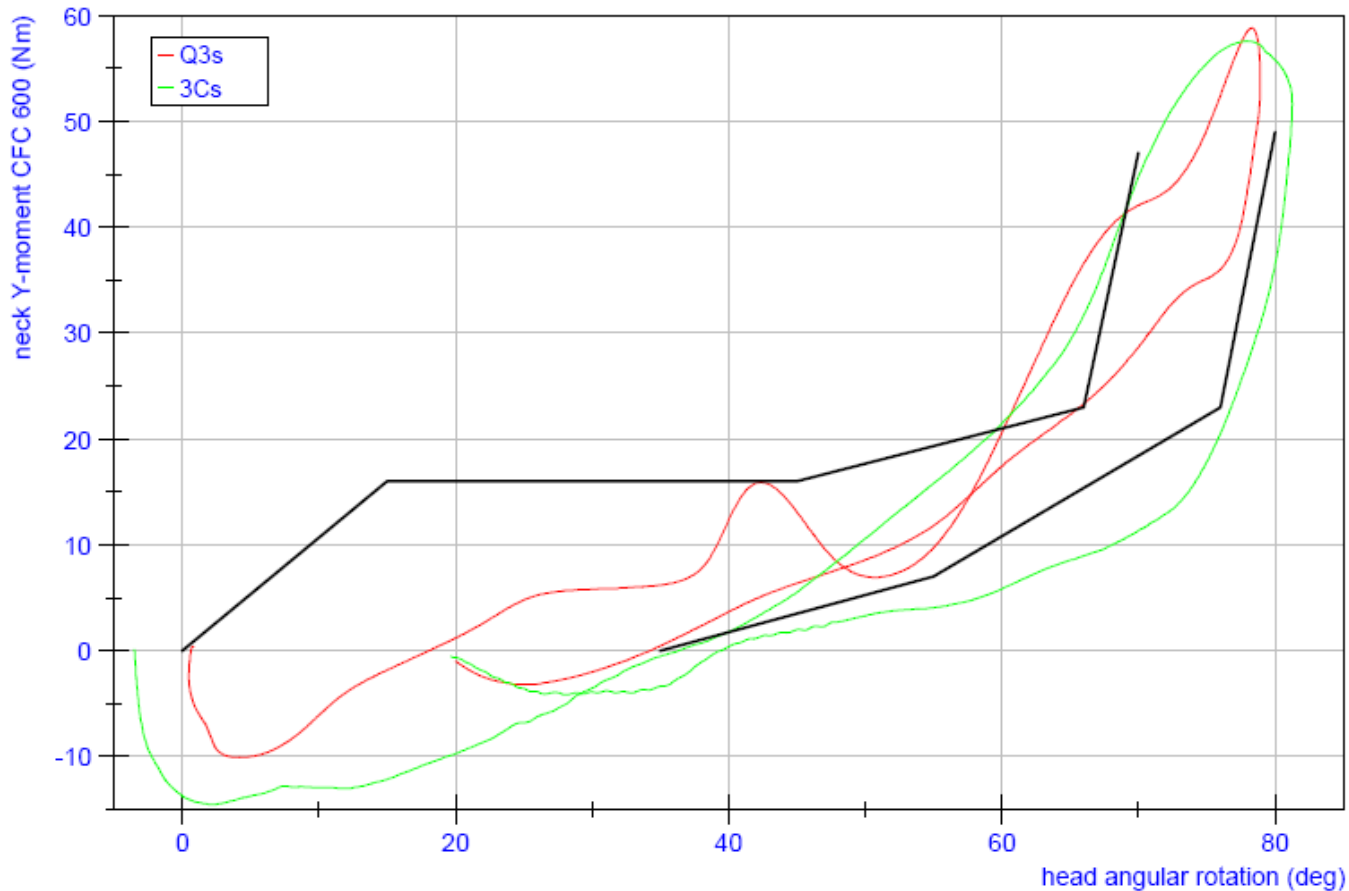
➤ Results

➤ Standard Neck Pendulum

Neck Biofidelity

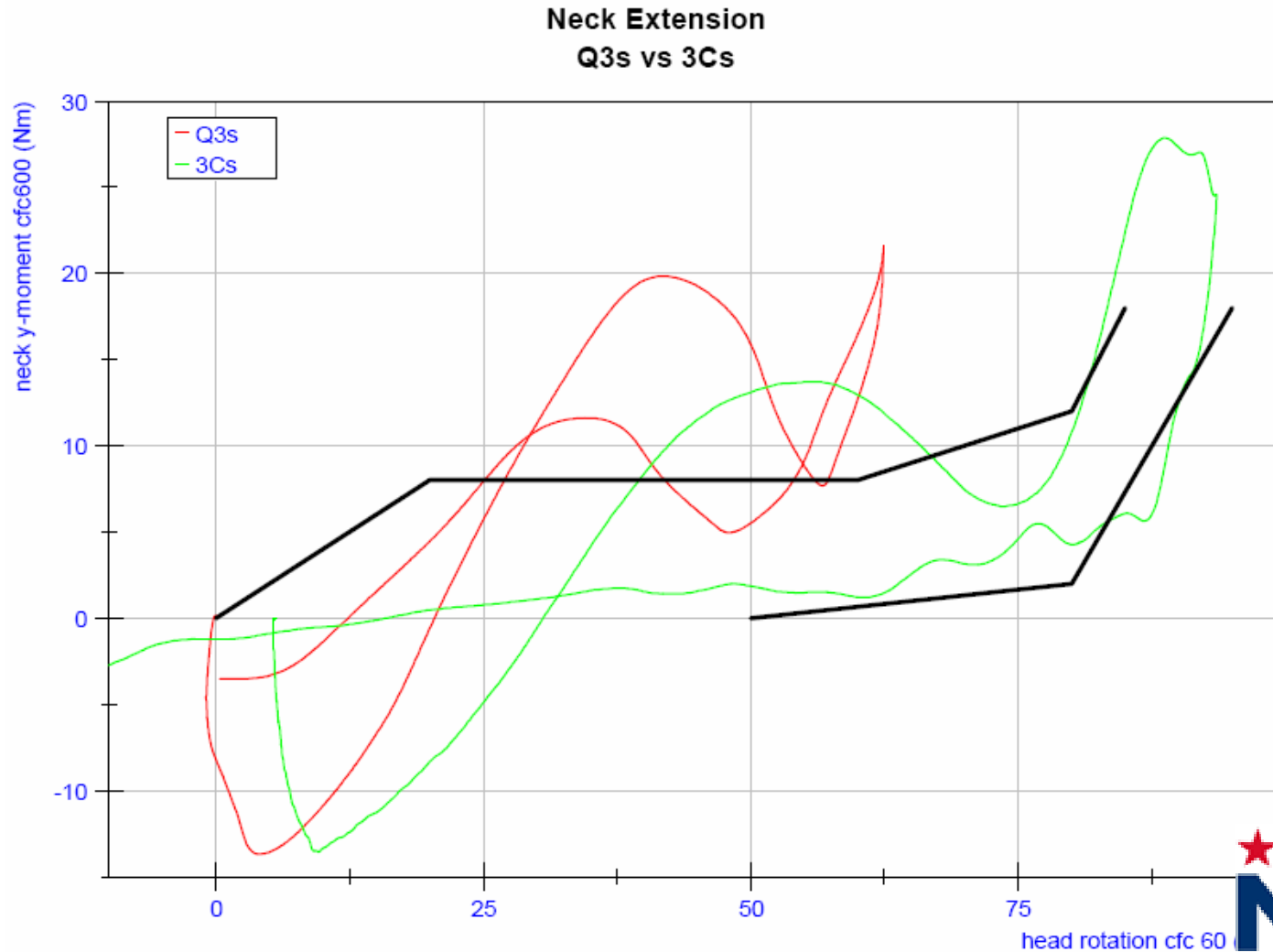
➤ Standard Neck Pendulum Results

3Cs vs Q3s
Neck Frontal Flexion



Neck Biofidelity

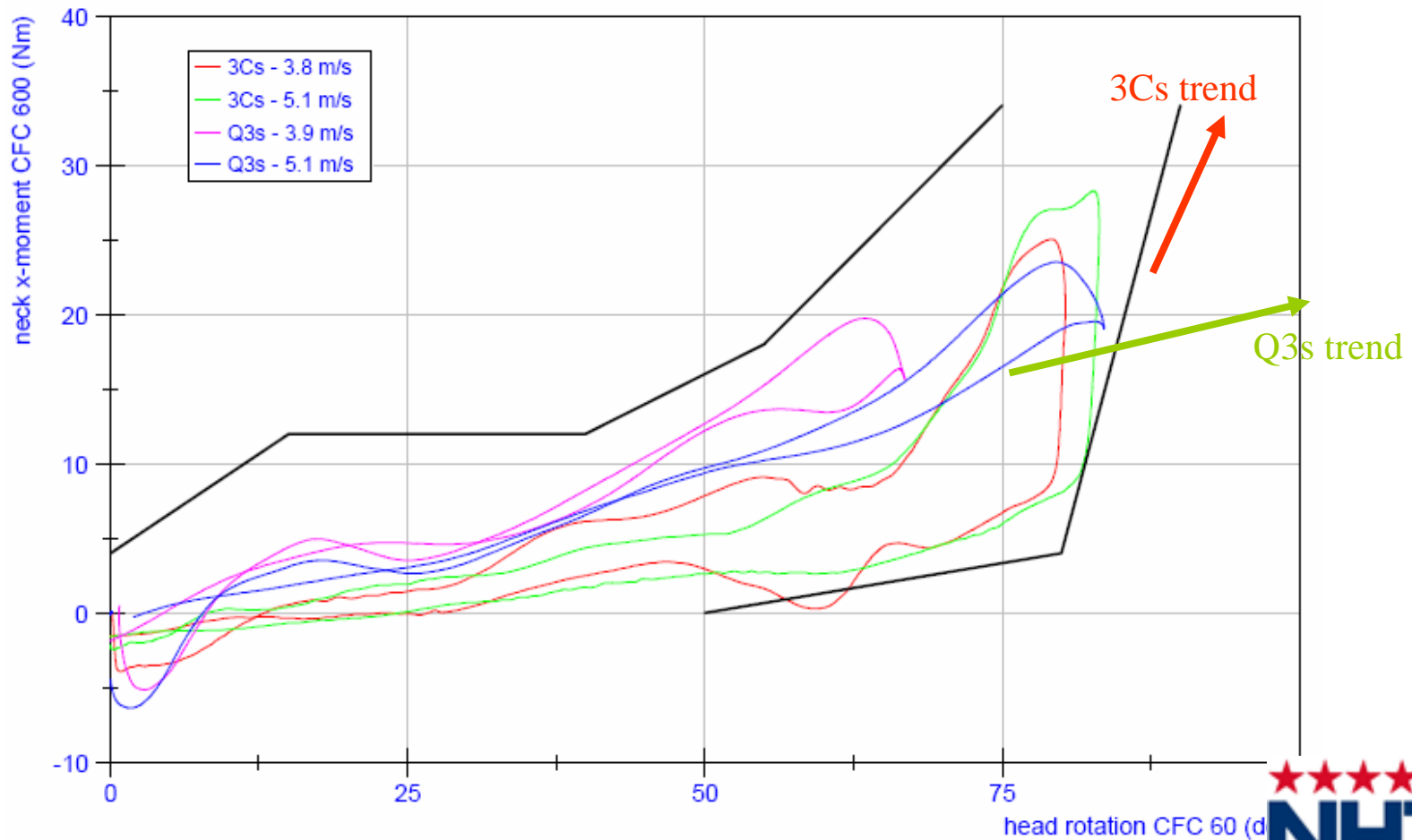
➤ Standard Neck Pendulum Results



Neck Biofidelity

➤ Standard Neck Pendulum Results

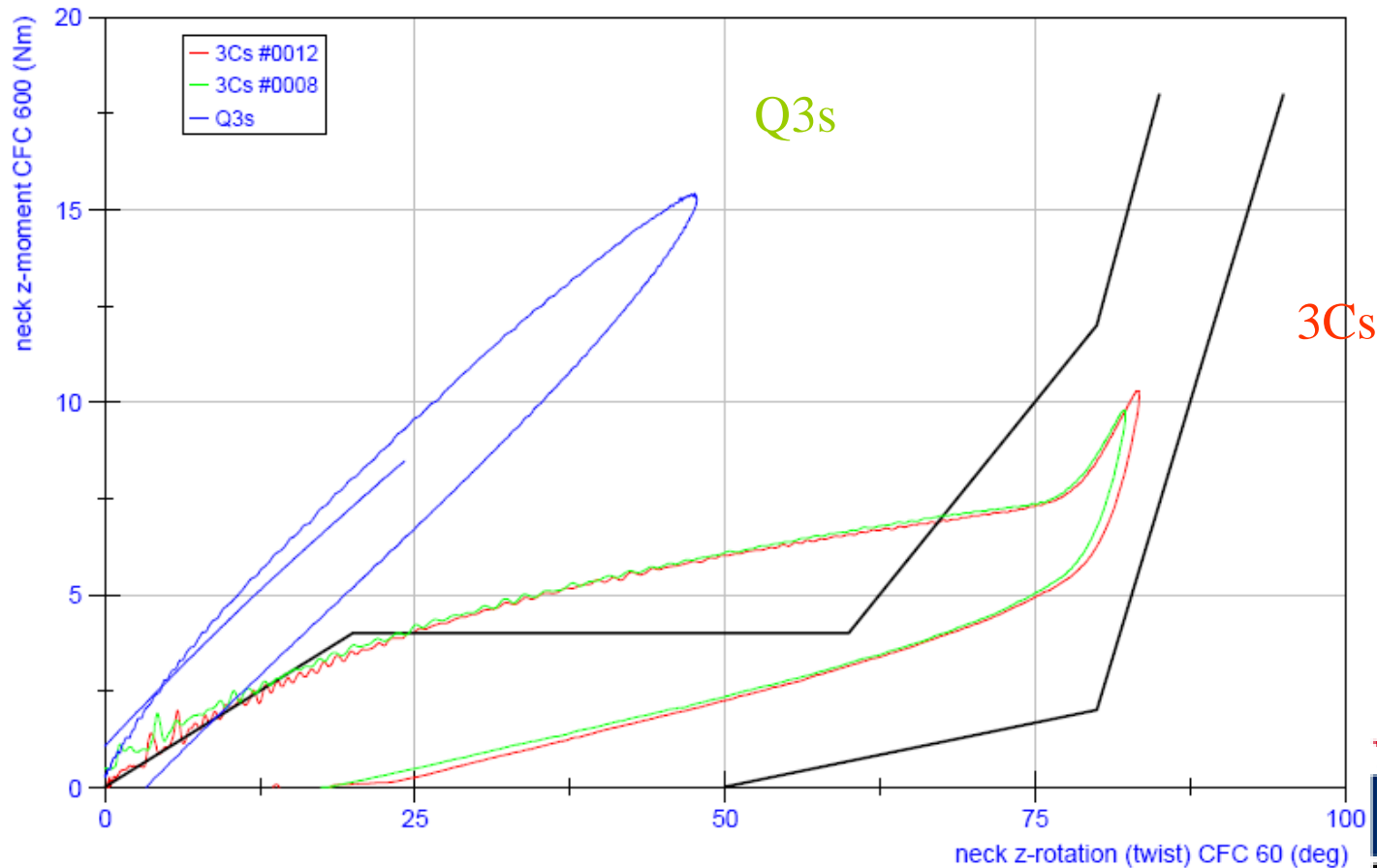
3Cs vs Q3s
Neck Lateral Flexion Response



Neck Biofidelity

➤ Standard Neck Pendulum Results

3Cs Neck vs Q3s
Neck Torsion Response



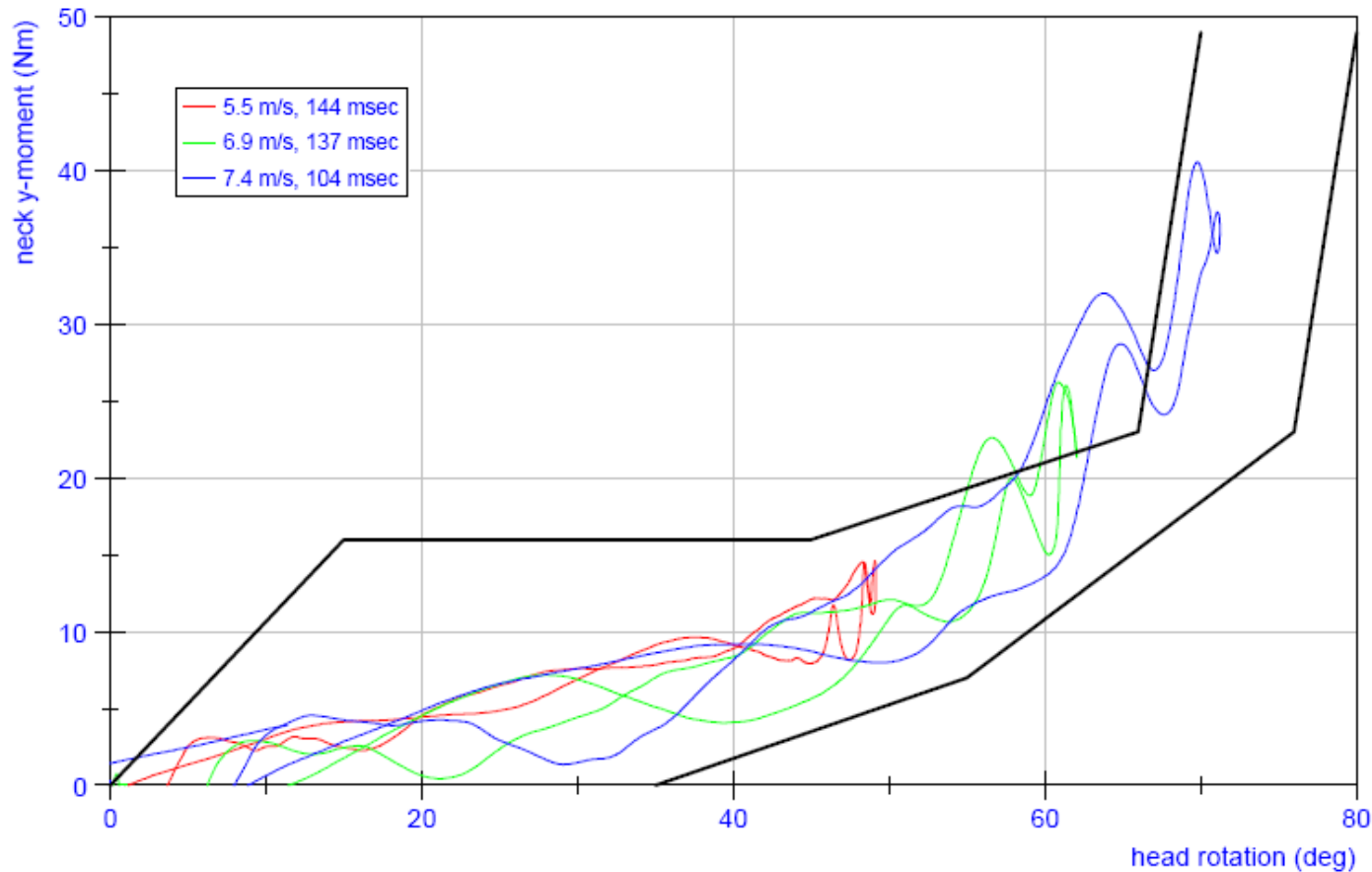
Neck Biofidelity

- Results
 - Modified, Long Pulse
 - Neck Pendulum

Neck Biofidelity

➤ Long Pulse Neck Pendulum Results

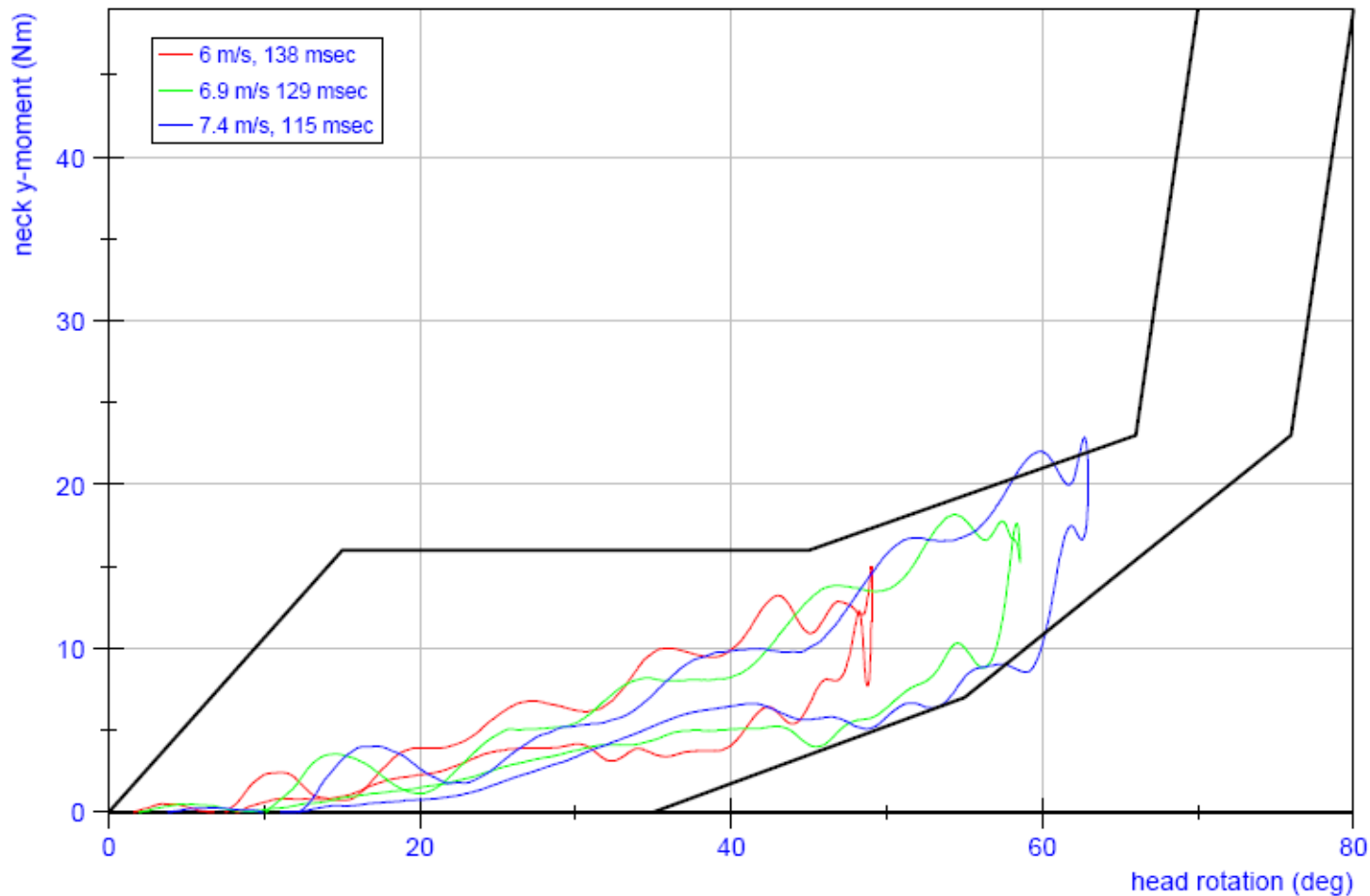
Q3s Frontal Flexion Response
Long Pulse Pendulum Test



Neck Biofidelity

➤ Long Pulse Neck Pendulum Results

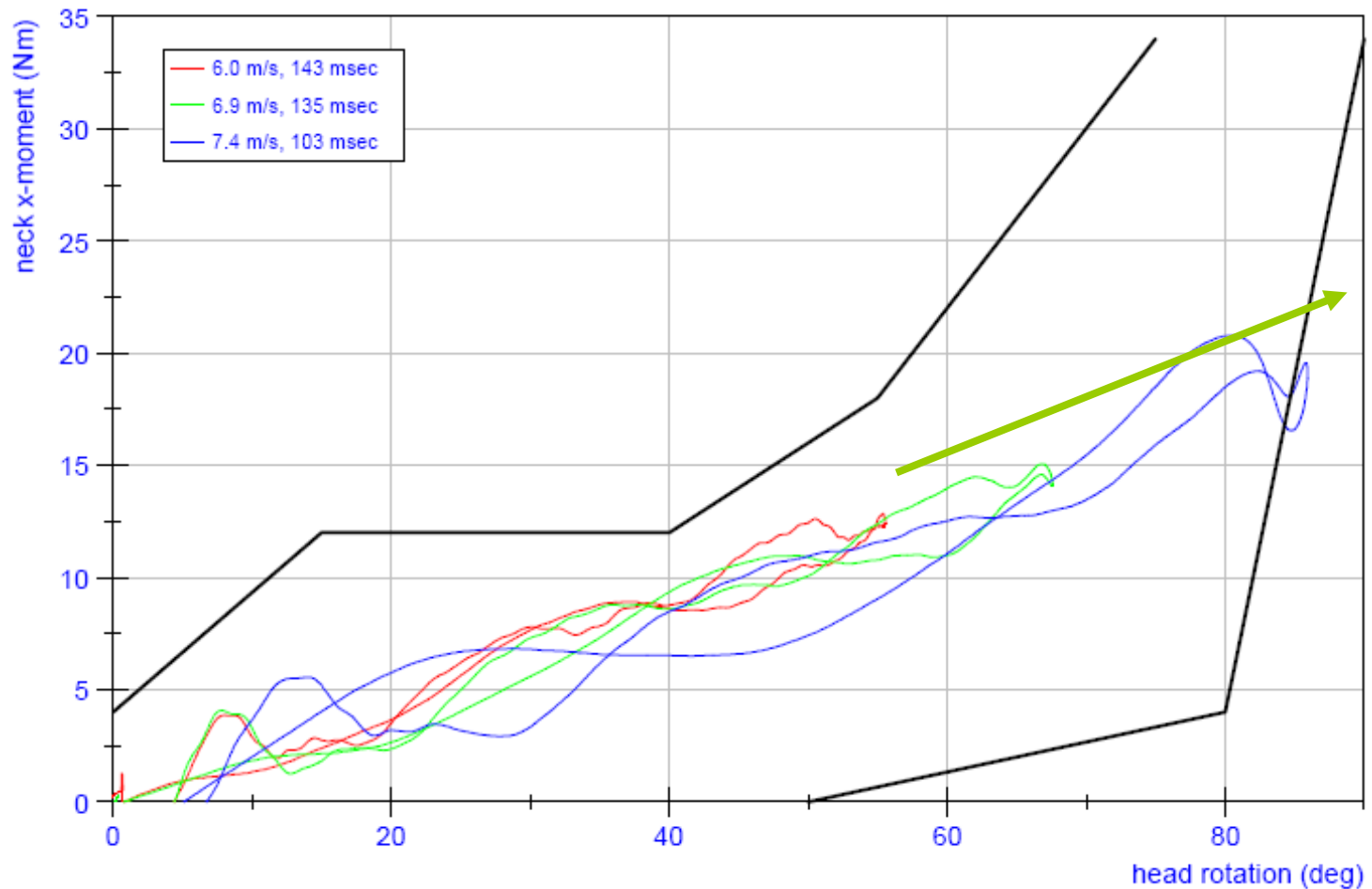
H-III 3Cs Neck Frontal Flexion Response
Long Pulse Pendulum Test



Neck Biofidelity

➤ Long Pulse Neck Pendulum Results

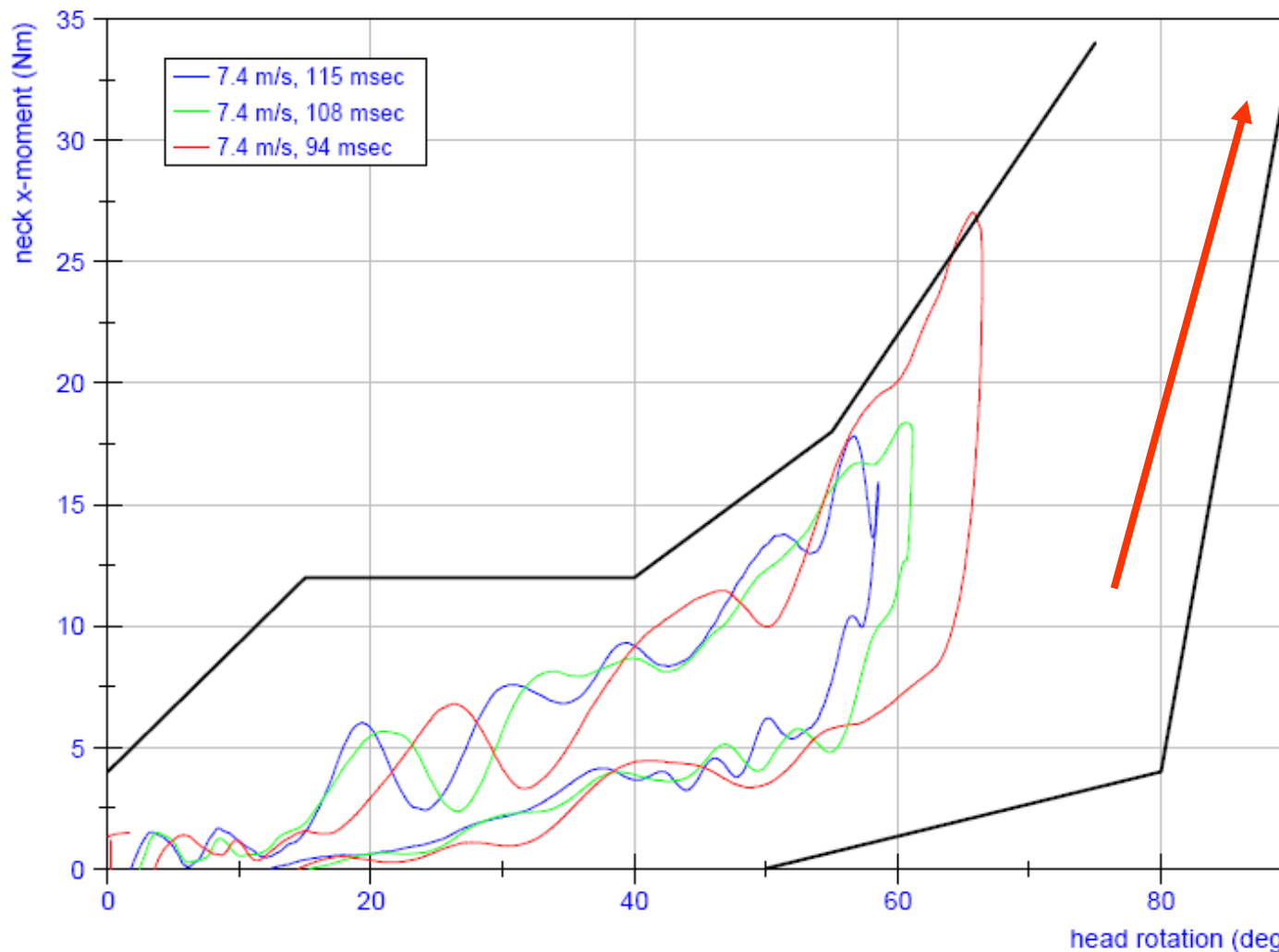
Q3s Lateral Neck Response
Long Pulse Pendulum Test



Neck Biofidelity

➤ Long Pulse Neck Pendulum Results

3Cs Lateral Neck Response
Long Pulse Pendulum Test



Neck Biofidelity

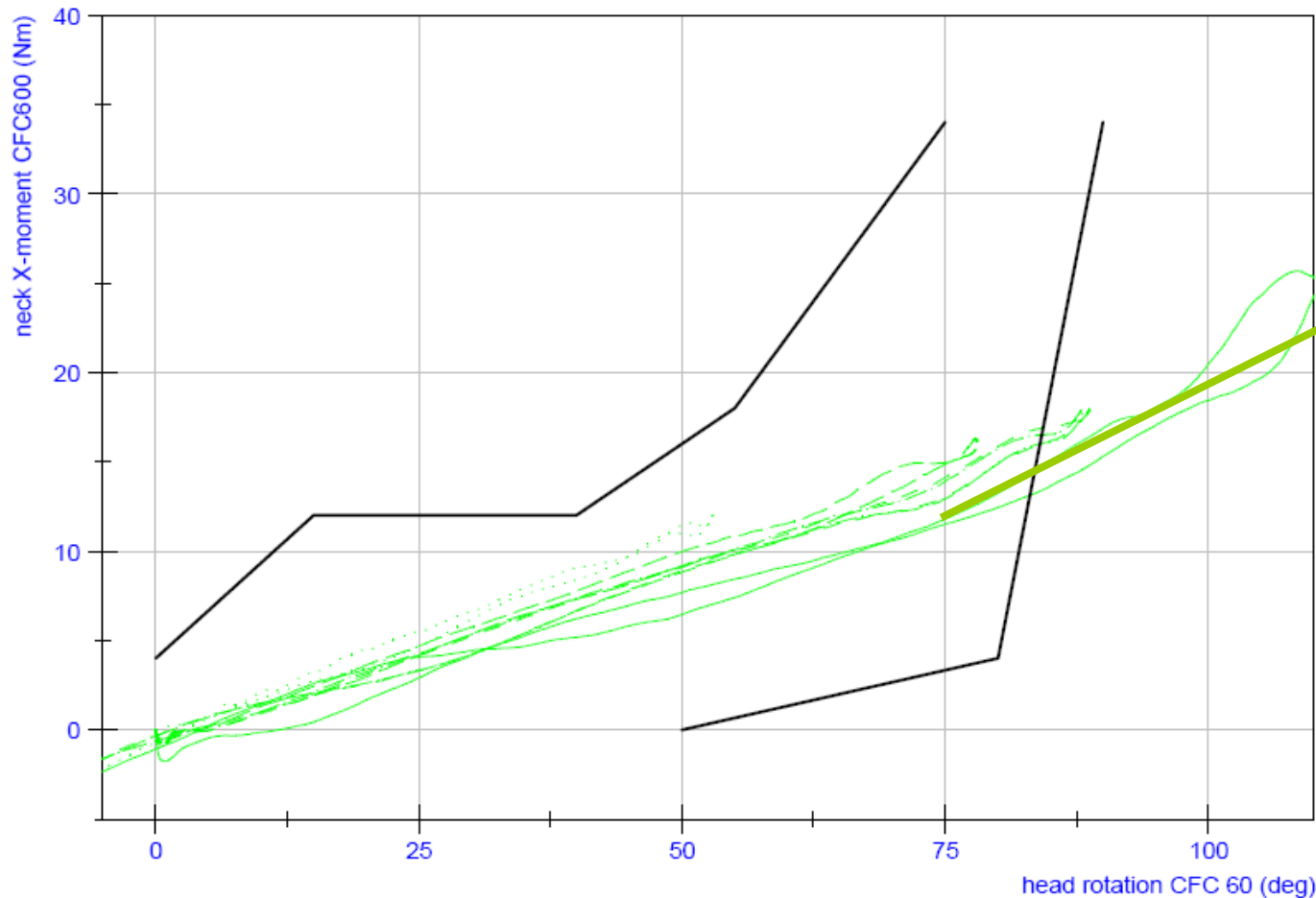
➤ Results

➤ Head/Neck Sled Tests

Neck Biofidelity

➤ Head/Neck Sled Test Results

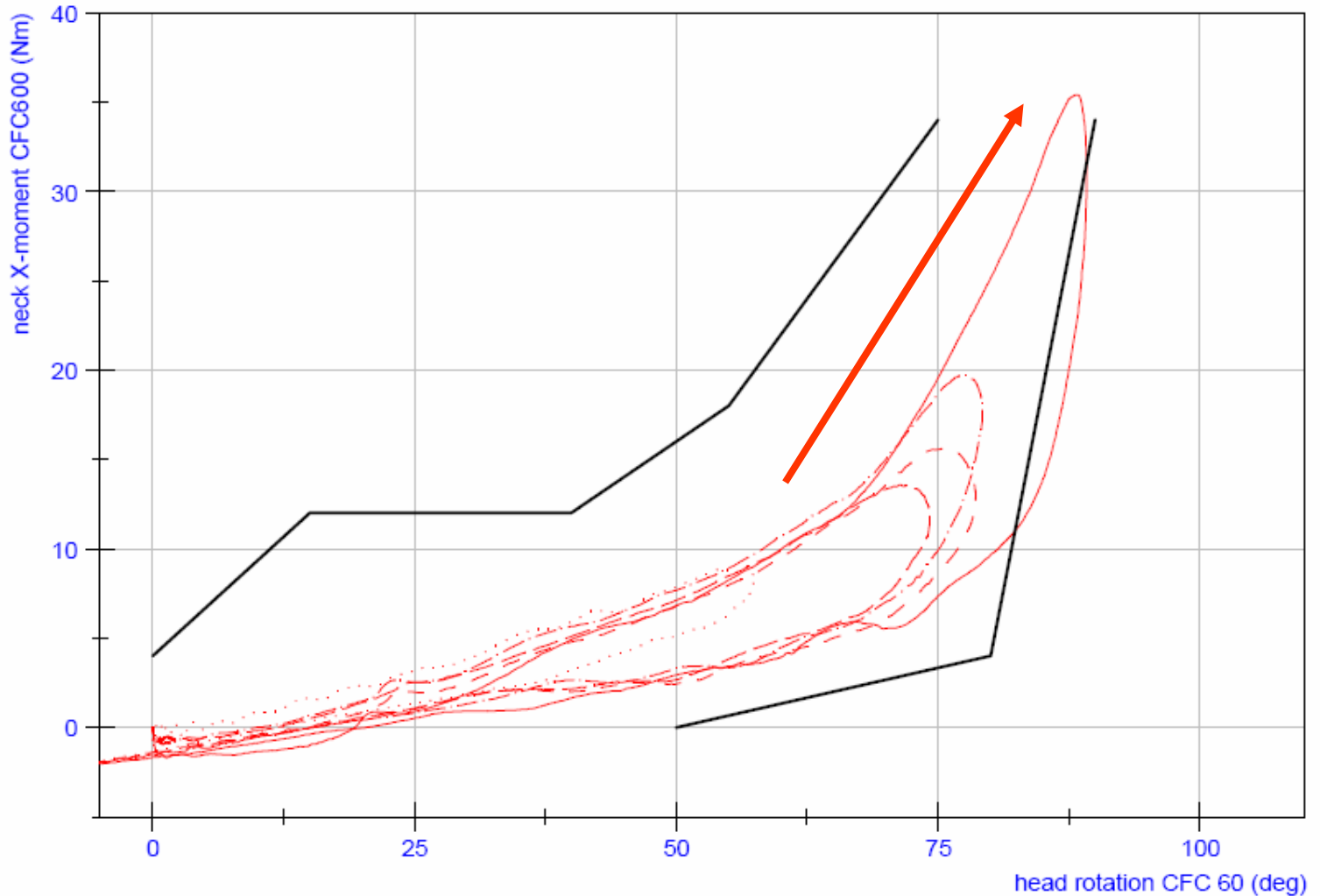
Head and Neck Sled Tests
Response of Q3s Neck and Head



Neck Biofidelity

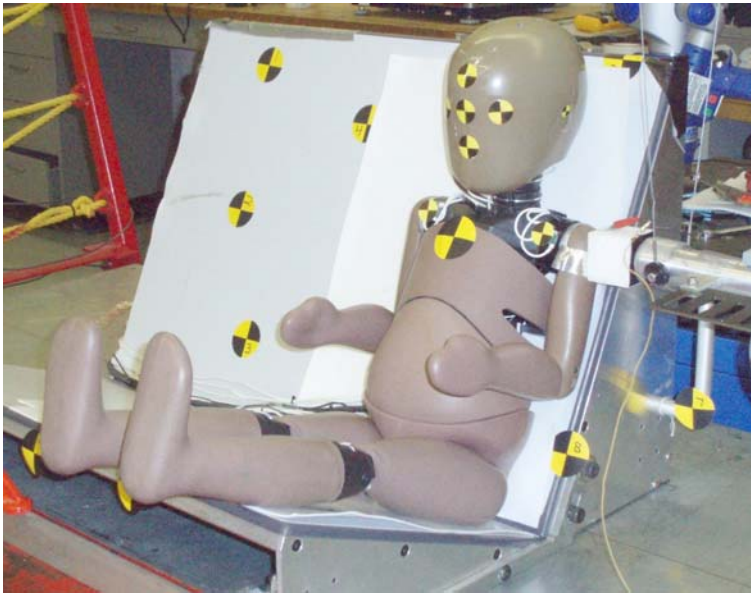
➤ Head/Neck Sled Test Results

Head and Neck Sled Tests
Response of 3Cs Neck and Head



Shoulder Biofidelity

- Reference #1: Irwin (Stapp 2002-22-0016)
 - Lateral impact
 - 1.7 kg impactor at 4.5 m/s
- Reference #2: Bolte (Stapp 2003-22-0003)
 - Lateral & oblique padded impact
 - 1.7 kg impactor at 4.5 m/s

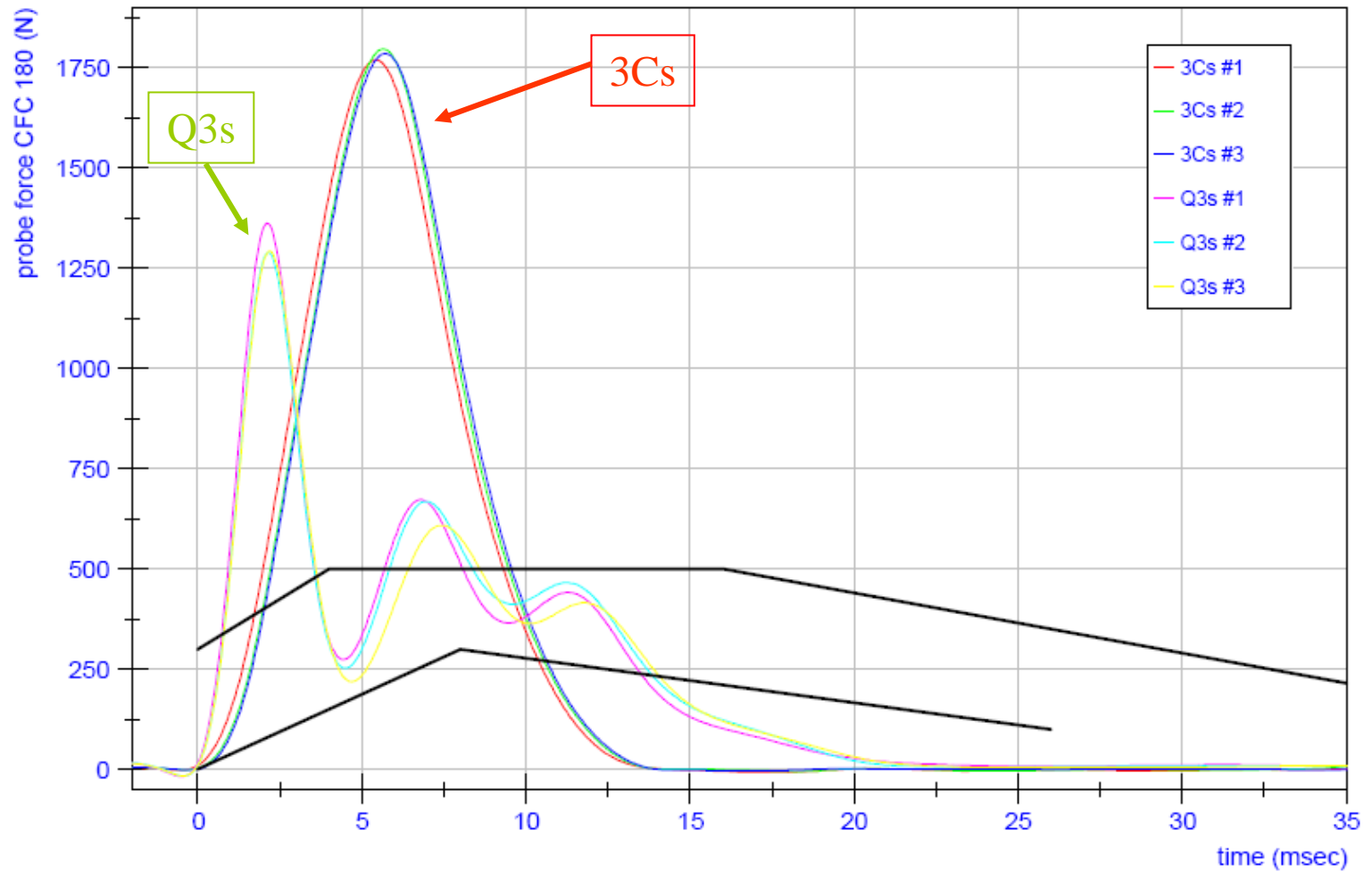


Shoulder Biofidelity

- Results
- Irwin Impact

Shoulder Biofidelity

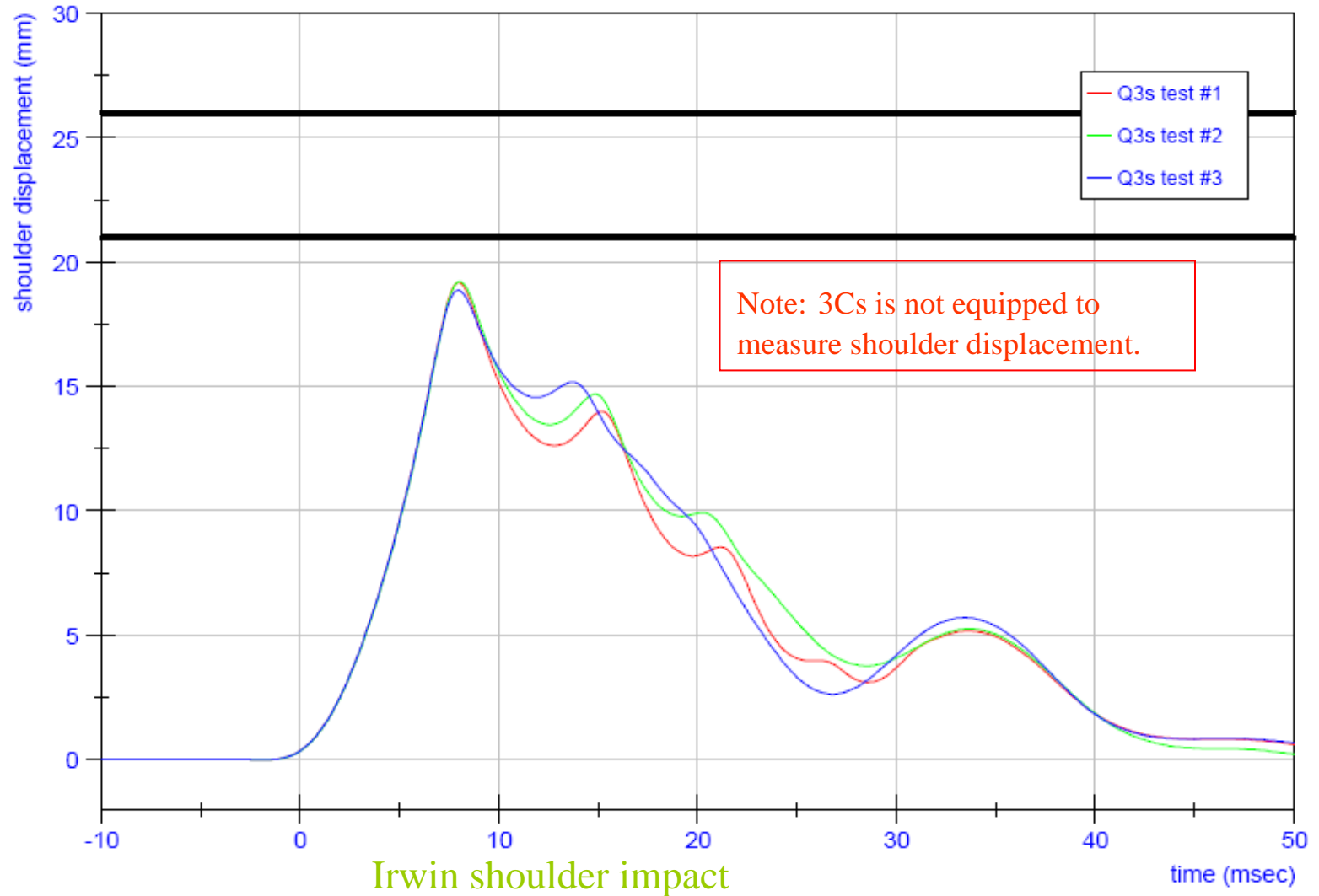
Shoulder Biofidelity - Hybrid III 3Cs vs Q3s
1.7 kg impactor at 4.5 m/s



Irwin shoulder impact

Shoulder Biofidelity

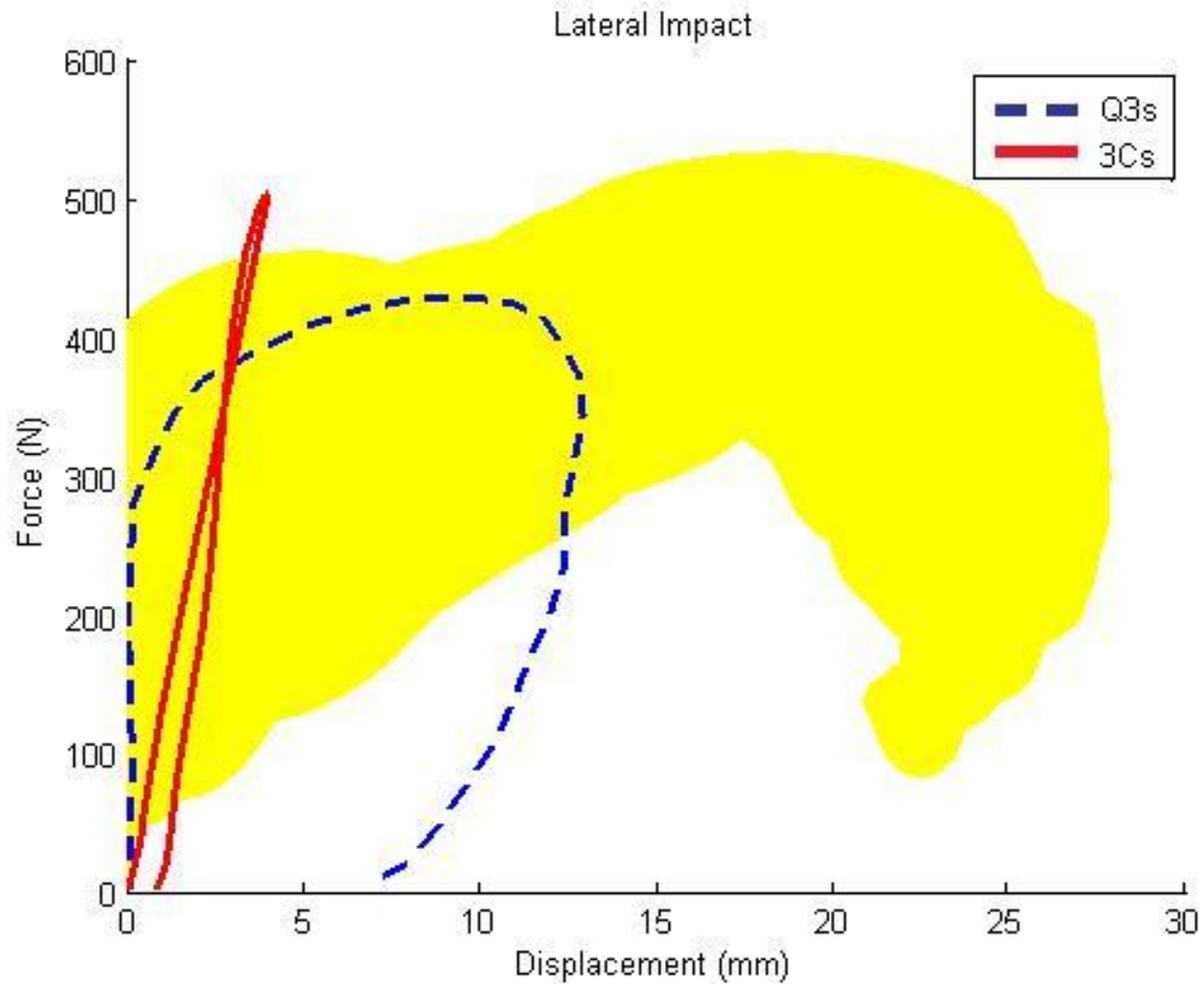
Shoulder Biofidelity - Irwin Test
1.7 kg impactor at 4.5 m/s



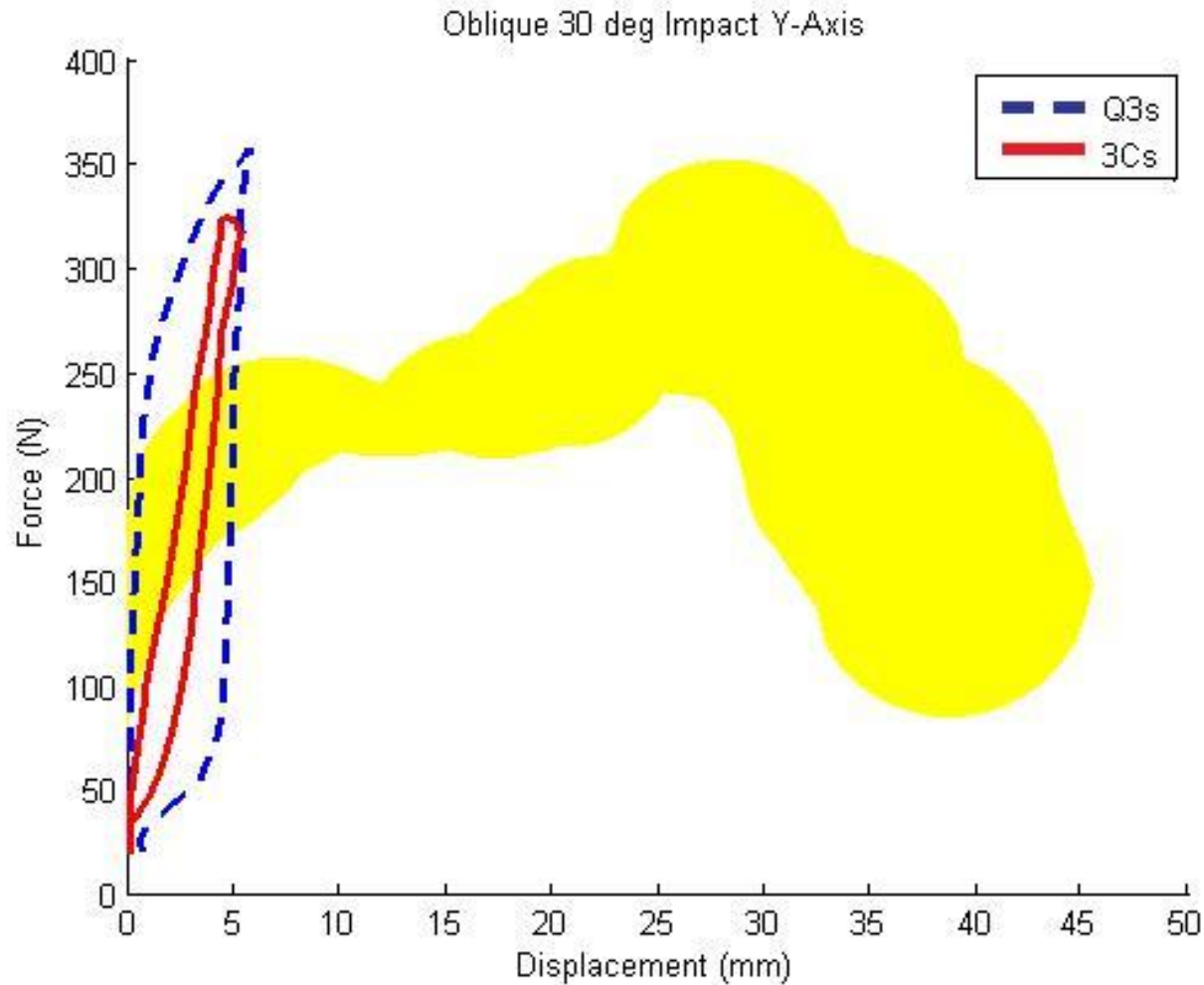
Shoulder Biofidelity

- Results
- Bolte Test
- Padded Shoulder Impacts

Shoulder Biofidelity

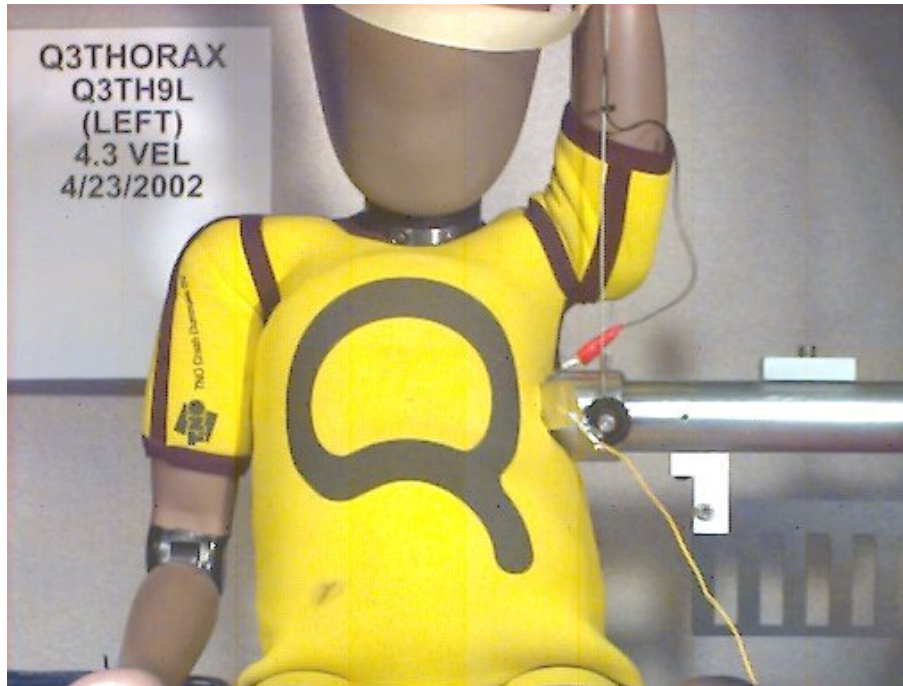


Shoulder Biofidelity



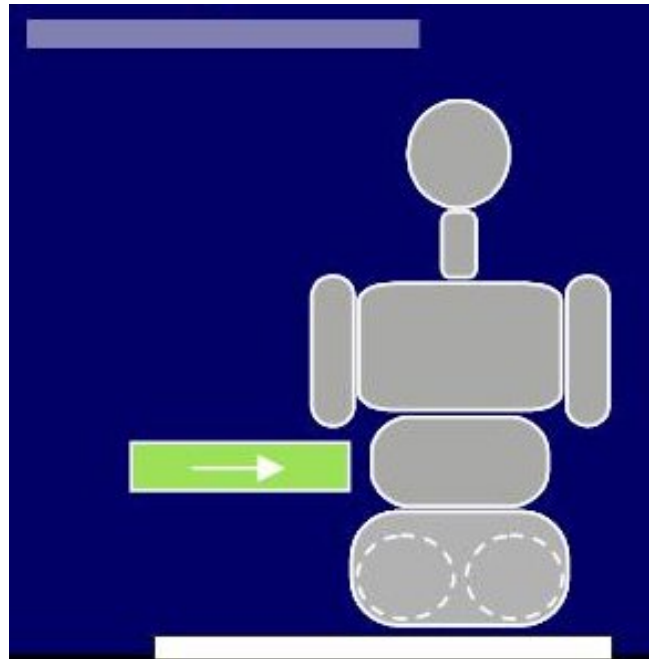
Thorax Biofidelity

- Reference: Irwin (Stapp 2002-22-0016)
- Lateral impact to thorax w/ 1.7 kg impactor at 4.3 and 6.0 m/s



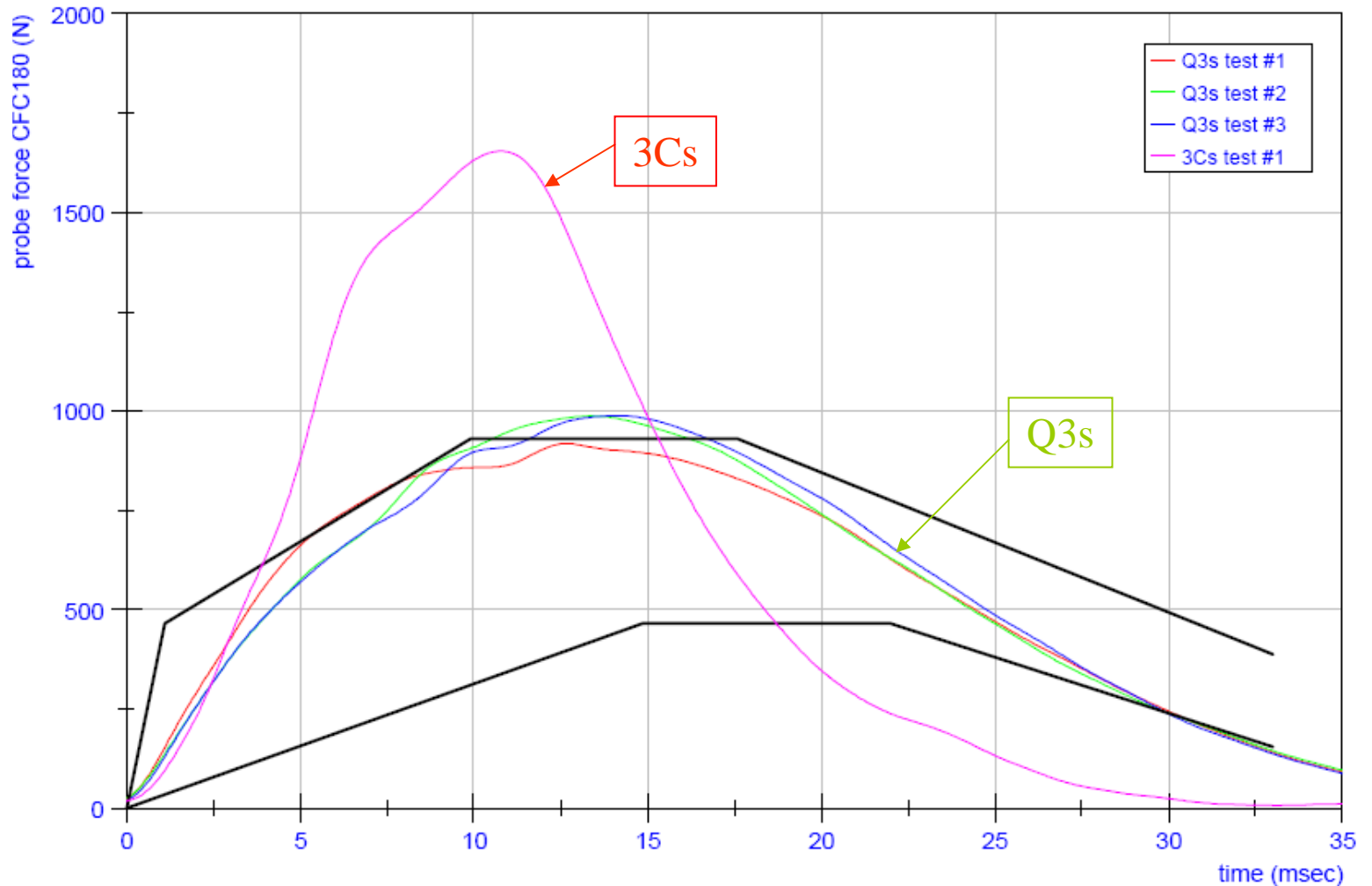
Abdomen Biofidelity

- Reference: FTSS White Paper “Pendulum Response Corridors for 3 year-old Child Side Impact Dummies.” Moss and Elhagediab. 2001
- 30° oblique impact to abdomen w/ 3.8 kg impactor at 4.8 and 6.8 m/s



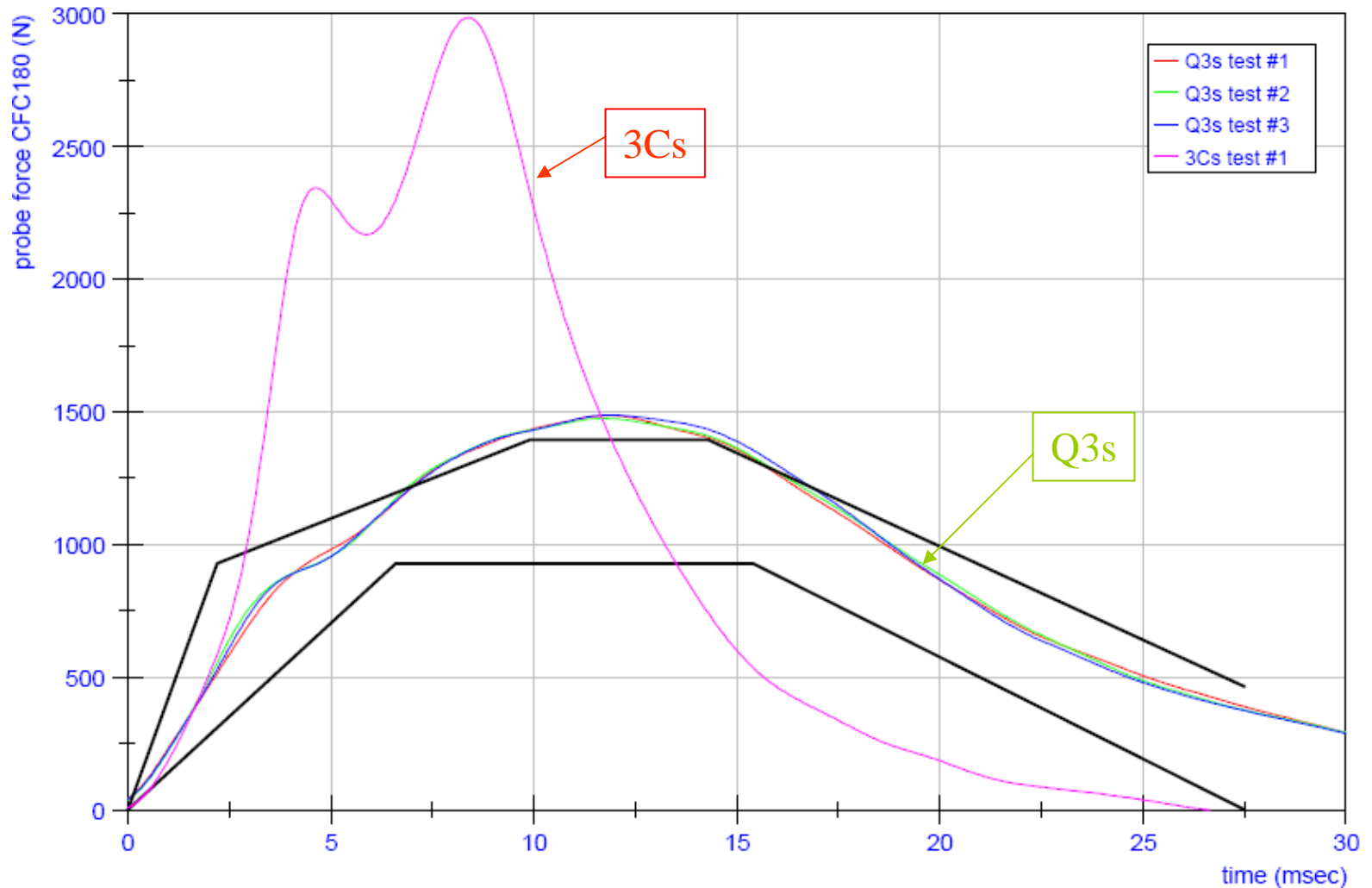
Abdomen Biofidelity

Abdomen Biofidelity
30 degree Oblique Impact
3.8 kg probe at 4.8 m/s



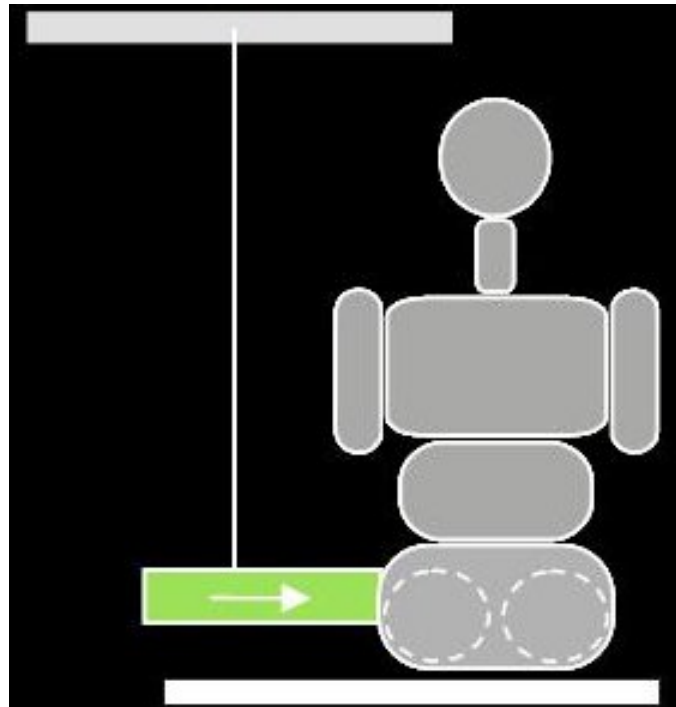
Abdomen Biofidelity

Abdomen Biofidelity
30 degree Oblique Impact
3.8 kg probe at 6.8 m/s



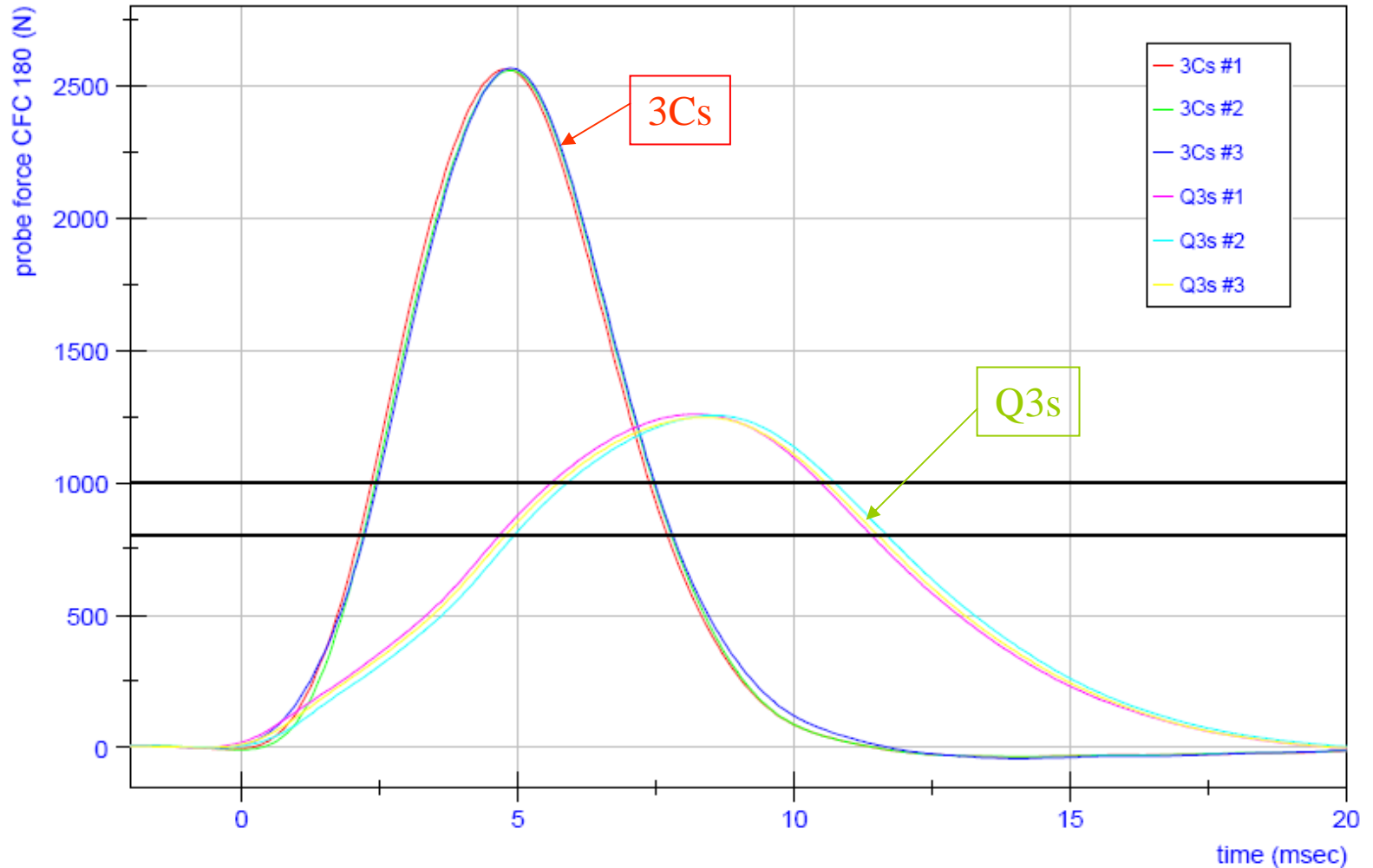
Pelvis Biofidelity

- Reference: Irwin (Stapp 2002-22-0016)
- Lateral impact to pelvis w/ 2.27 kg impactor at 4.5 m/s



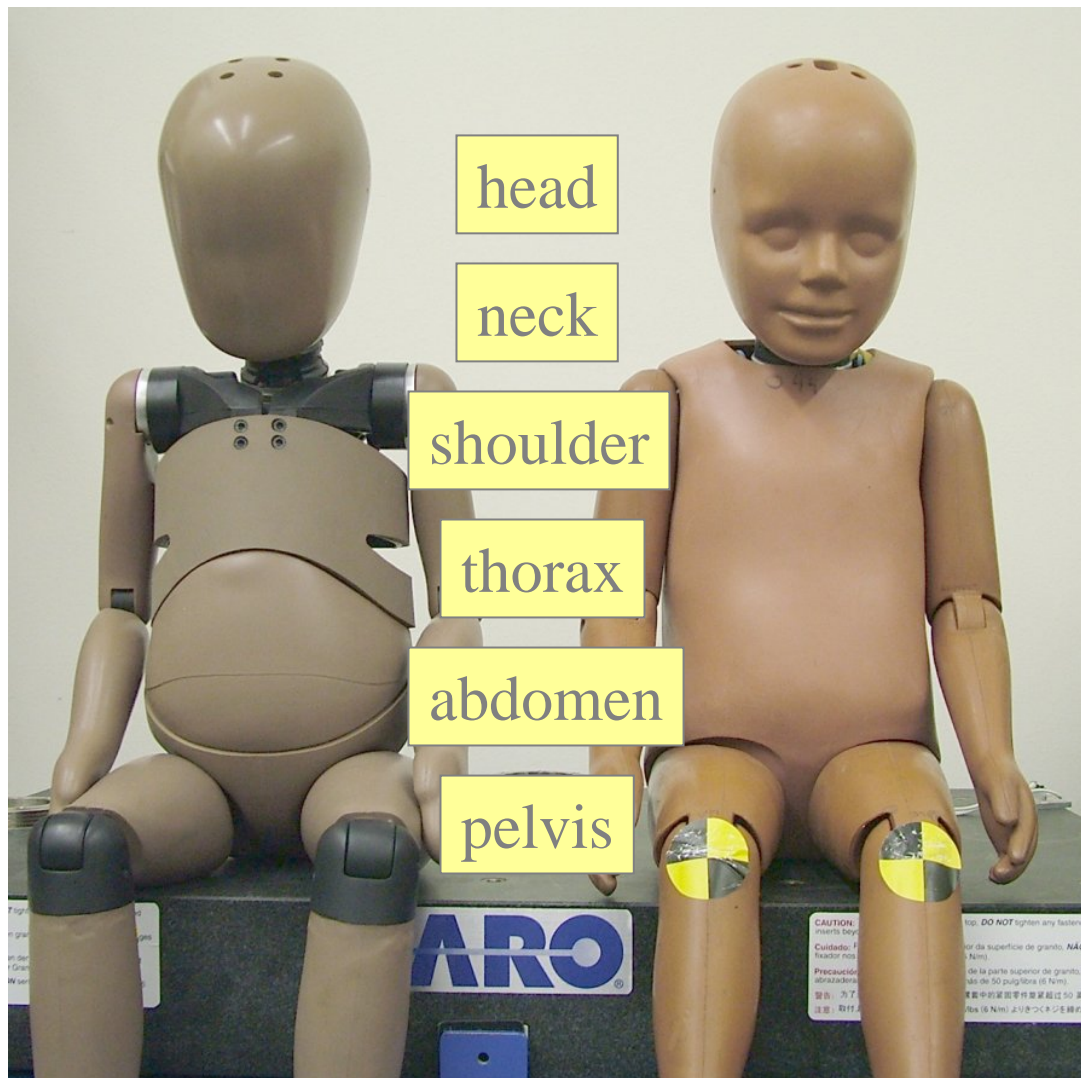
Pelvis Biofidelity

Pelvis Biofidelity - Hybrid III 3Cs vs Q3s
2.27 kg impactor at 4.5 m/s



Preliminary Biofidelity Analysis

Q3s



3Cs



indicates biofidelity advantage



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Certification Procedures

- Adapted procedures to use Bench Seat
- Developed a Thorax with Arm Test
- Introduced Increased Mass Impactor

