Adaptive Seat to Reduce Neck Injuries for Female and Male Occupants

Biomechanical Data for a Computational Model of an Average Female

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VTI, Swedish National Road and Transport Research Institute

6th World Congress of Biomechanics
1-6 August 2010, Singapore
Statistics – Whiplash injuries

- App. **70% of the costs** of all injuries leading to permanent medical impairment for the insurance companies

- **Costs: > 4 billion €** in Europe (estimated on insurance costs)

- Recent developed anti-whiplash systems

- Impact directions
Whiplash – Risk of injuries

Females have up to 3 times larger risk of injuries than males.
ADSEAT the project

Aims
- Provide guidance in how to reduce the risk of whiplash injuries by enhanced understanding of injury criteria and development of seat evaluation tools.
- Budget: 3.45 million Euros, 2.5 million Euros from the European Commission, FP7.
- 12 partner
- Duration: 42 months, 2009-2013
### ADSEAT partners

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<tr>
<th>Partner Number</th>
<th>Partner name</th>
<th>Partner short name</th>
<th>Country</th>
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Work Packages

WP1 Real-world data, 
Dr Wolfram Hell, LMU

WP2 Biological tests, 
Prof. Mats Svensson, Chalmers

WP3 Computational modelling, 
Mr Paul Lemmen, FTSS

WP4 Injury criteria / thresholds, 
Dr Kai-Uwe Schmitt, AGU

WP5 Seat evaluation guidelines, 
Prof. Hermann Steffan, GUT

WP6 Management and WP7 Dissemination, 
Dr Astrid Linder, VTI
Rear impacts – volunteer test


Results - Horizontal displacement

Head

T1

Head relative to T1

5 km/h

7 km/h

Time [ms]
Results

- The head x-acceleration peaks were on average higher and earlier for the females.

- The head, T1, and head relative to T1 x-displacement peaks were on average lower and earlier.

- The initial head-to-head restraint distance was on average smaller for the females, resulting in earlier head-to-head restraint contact time for the females.

- Larger rebound motion for the females.
ADSEAT

Average female
Stature to be defined
Weight in ADSEAT

BioRID
50th percentile male
Stature: ~1.77 m
Weight: 77.7 kg

6th World Congress of Biomechanics 1-6 August 2010
EvaRID Anthropometrical Specifications

Stature: 161.8 cm
Weight: 62.3 kg
Sitting Height: 84.4 cm

Schneider et al (1983)

Detailed anthropometric data
- Length of limbs
- Weight and volume of various body parts

Diffrient et al. (1974), Young et al. (1983) and Schneider et al. (1983)
Schneider et al. 1983

Phase 1
- Definition of dummy sizes

Phase 2
- Seated posture
- Seat casting
  Seat/Subject interface contours
- Fabrication of contoured hard seats

Phase 3
- Surface landmarks and contours
- Seated anthropometry

<table>
<thead>
<tr>
<th>HANES study (Abraham et al 1979)</th>
<th>95th perc Male</th>
<th>50th perc Male</th>
<th>50th perc Female</th>
<th>5th perc Female</th>
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<tbody>
<tr>
<td>Stature [cm]</td>
<td>186.9</td>
<td>175.3</td>
<td>161.8</td>
<td>151.1</td>
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<tr>
<td>Weight [kg]</td>
<td>102.3</td>
<td>77.3</td>
<td>62.3</td>
<td>47.3</td>
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<td>Sitting height [cm]</td>
<td>96.6</td>
<td>90.1</td>
<td>84.4</td>
<td>78.1</td>
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N=8 N=8 N=8 N=8 N=8 N=8 N=8 N=8

Data not analyzed

N=25 N=25 N=25
Dummy Specifications - Weight and Volume

Young et al. 1983
Dummy Specifications – Joint Locations

Diffrient et al. 1974
Work in process: BioRID and EvaRID Comparisons
Presentation of results 2010

IRCOBI conference, 15-16 September, Hannover

Kullgren A & Krafft M:
GENDER ANALYSIS ON WHIPLASH SEAT EFFECTIVENESS: RESULTS FROM REAL-WORLD CRASHES

Carlsson A, Siegmund G P; Linder A, Svensson MY:
MOTION OF THE HEAD AND NECK OF FEMALE AND MALE VOLUNTEERS IN REAR IMPACT CAR-TO-CAR TESTS AT 4 AND 8 KM/H


EvaRID a dummy model representing females in rear end impacts
Acknowledgments

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IIHS, Insurance Institute for Highway Safety

VTI, Swedish National Road and Transport Research Institute

Data provided by:
MEA Forensic Engineers & Scientists
Thank you for your attention

www.vti.se/adseat