

## Deflection Responses from PMHS in Oblique Side Impact Sled Tests

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## Side Impact Loading

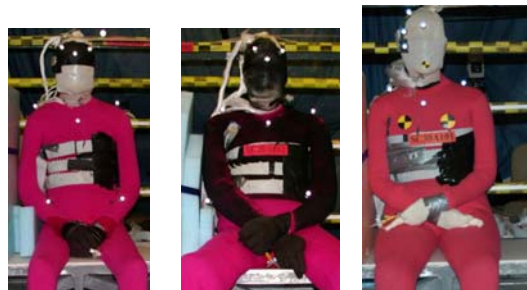


- Dummies designed for pure lateral loading
- Oblique loading identified in field data
- Did full-scale vehicle tests with PMHS
- Designed sled tests using these data
- Issue of load-wall for oblique loading

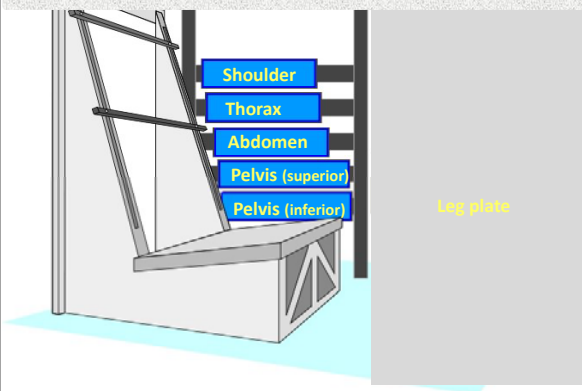
## Load-walls Used in Literature



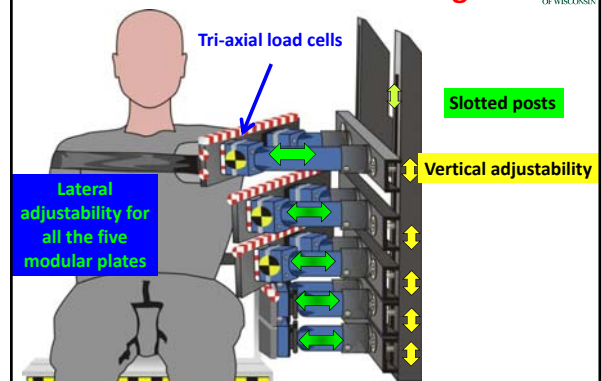
## PMHS Anthropometry



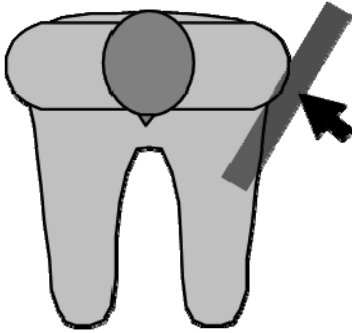
## Modular Scalable Load-wall Sled Tests



## Load-wall Features & PMHS Alignment



### Alignment – Top View



### Test Matrix



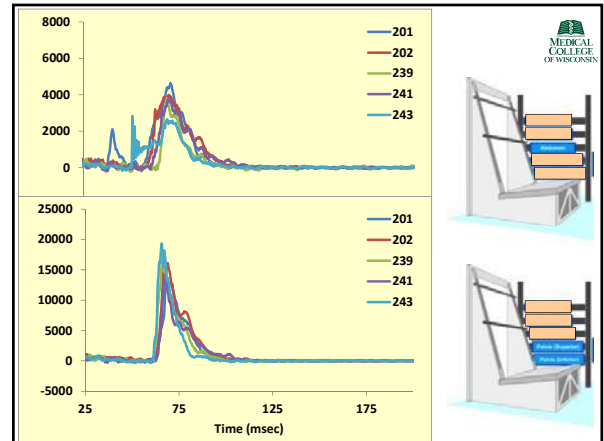
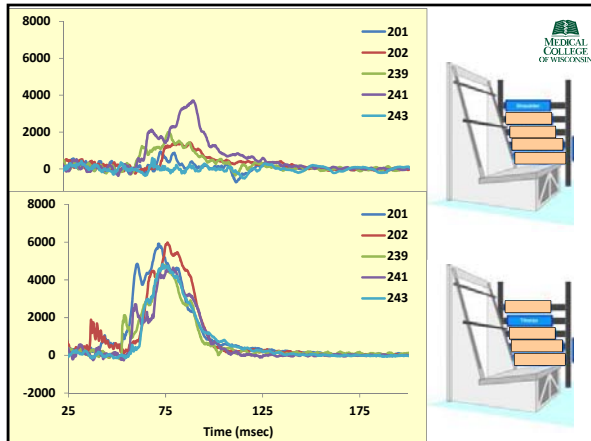
- Sled  $\Delta V$ : 6.7 m/s (24 km/h)
- Abdomen chestband – tenth rib
- Thorax chestband – xyphoid process
- Regional deflections: maximum, angle
- Compare with the lateral impact dataset



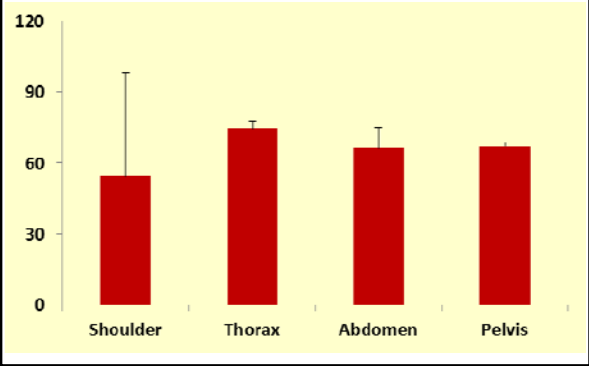
### Front View



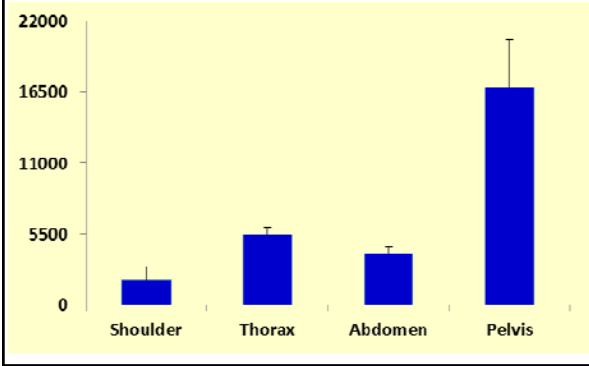
### Top View



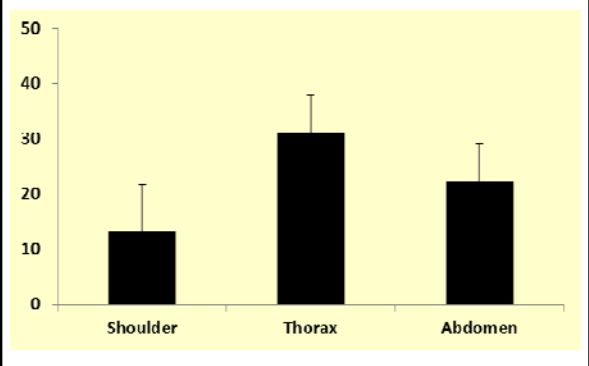
### Time of Attainment of Peak Force (ms)



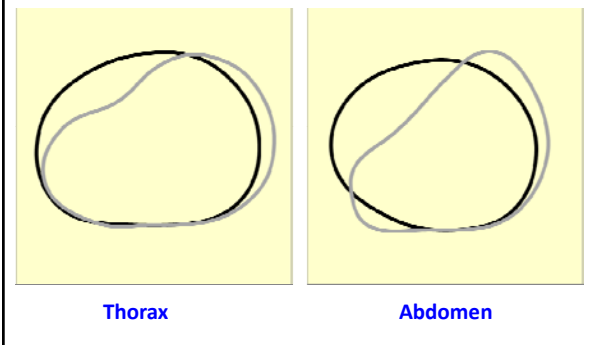
### Peak Force (N)



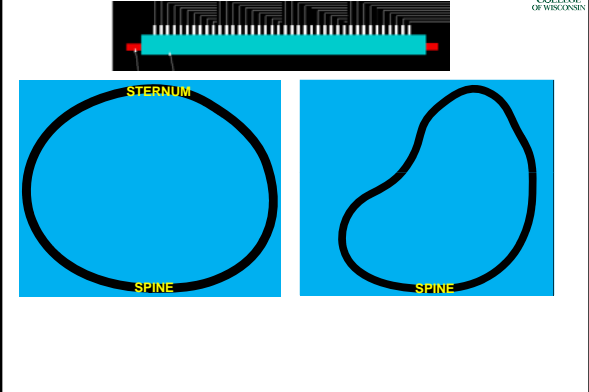
### Peak Normalized Force (%)



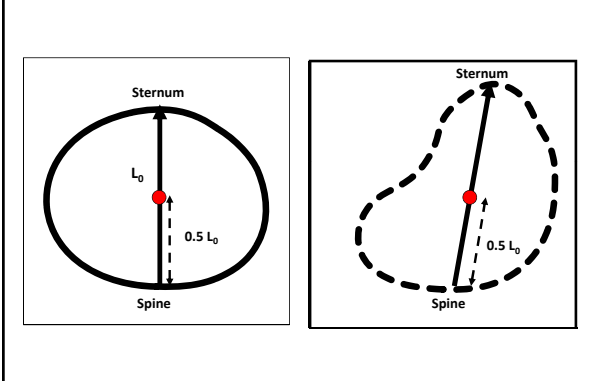
### Deflection Contours



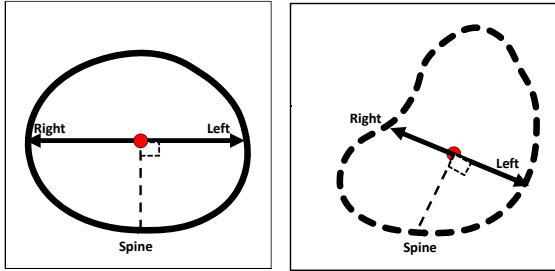
### Deflection Contours



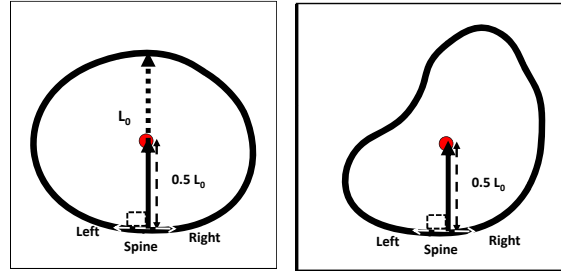
### Spine-sternum Method



### Bilateral Method



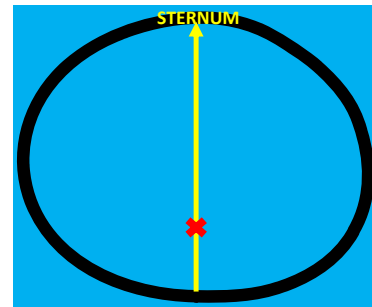
### Spine Box Method



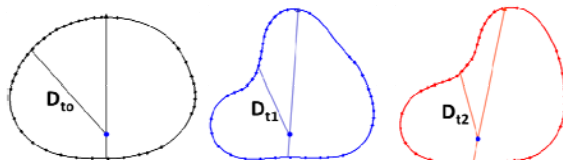
### Vertebra Method



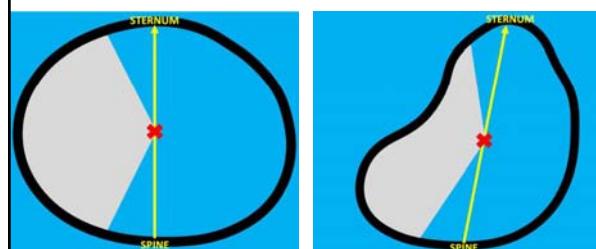
### Vertebra Method

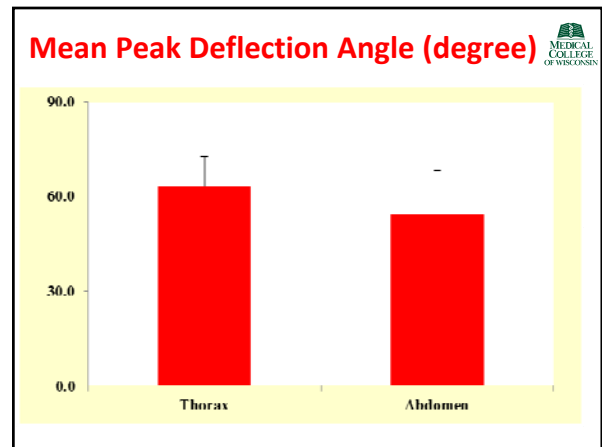
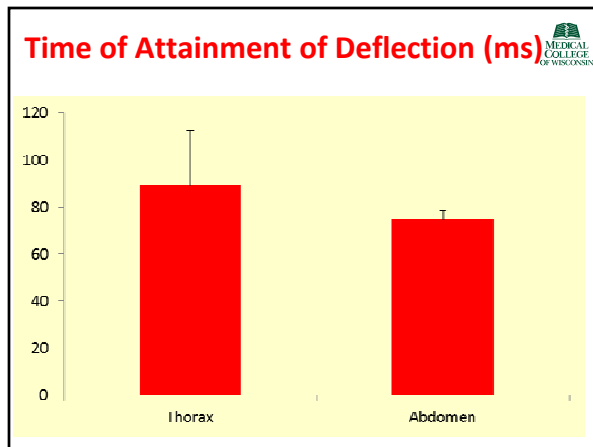
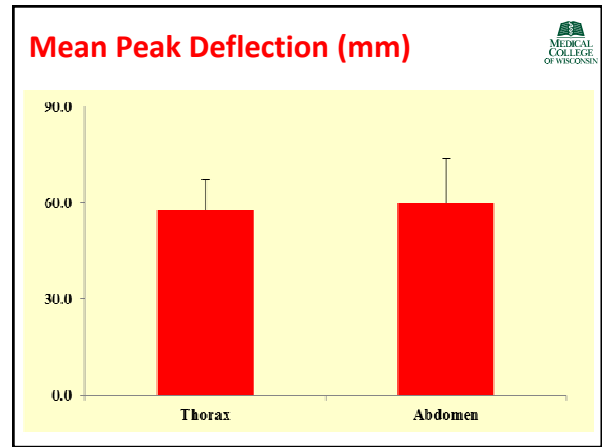
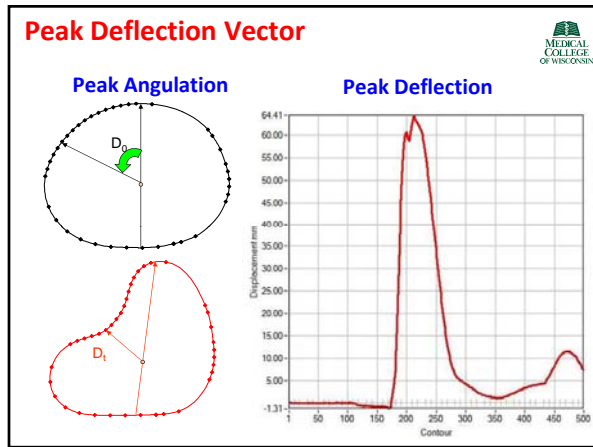
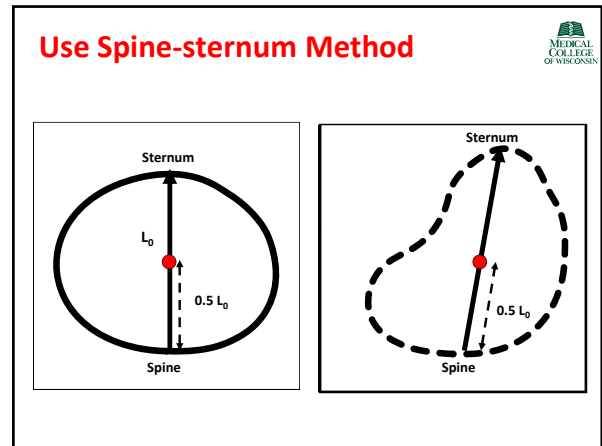
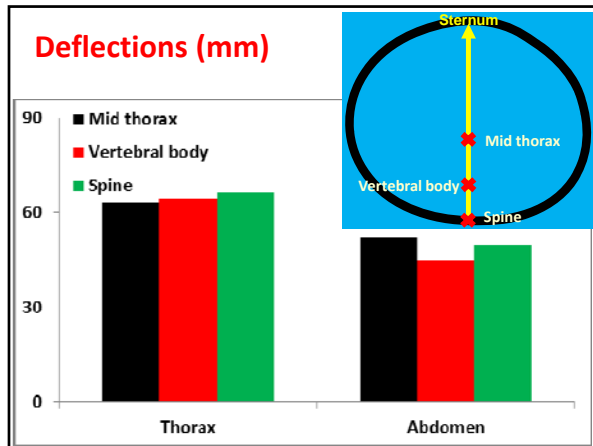


### Vertebra Method



### Peak Deflections

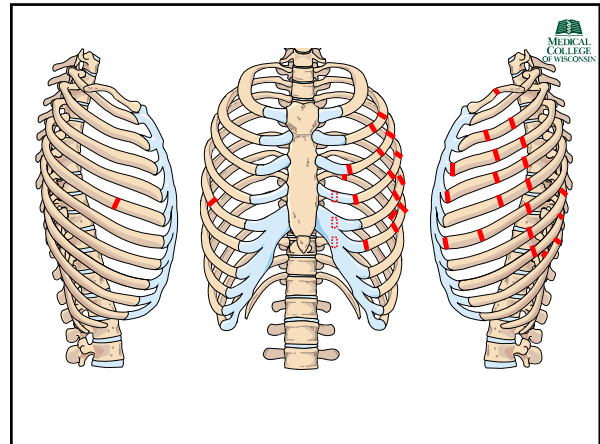




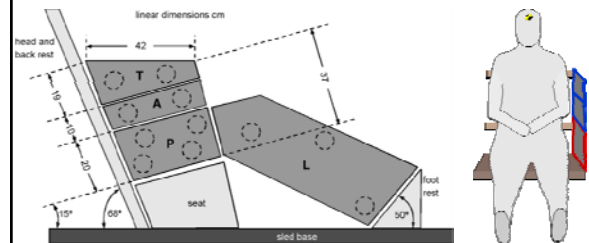
## Injuries and AIS



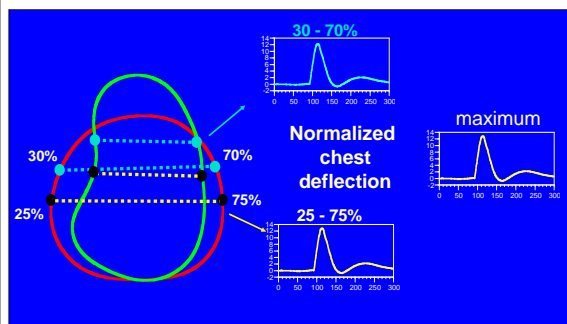
ID	AIS	Summary
1	4	Left rib fractures left 2-3; 4-5; right rib fractures 1, 4, 5; and pleural trauma
2	3	Left rib fractures 2-5 and 8-9; and L2, L4 transverse process fractures
3	3	Left rib fractures 2-4 and 9-10; and 12
4	4	Left rib fractures 2-6; 8-10, right rib 5; laceration of the spleen
5	3	Left rib fractures 2-4 and 9



## Comparison with Pure Lateral Tests

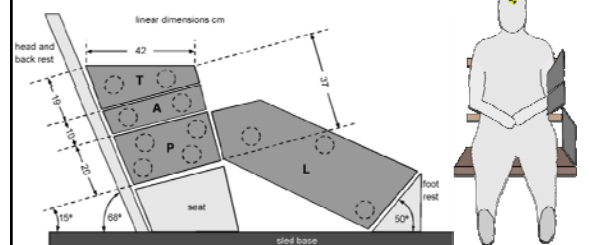


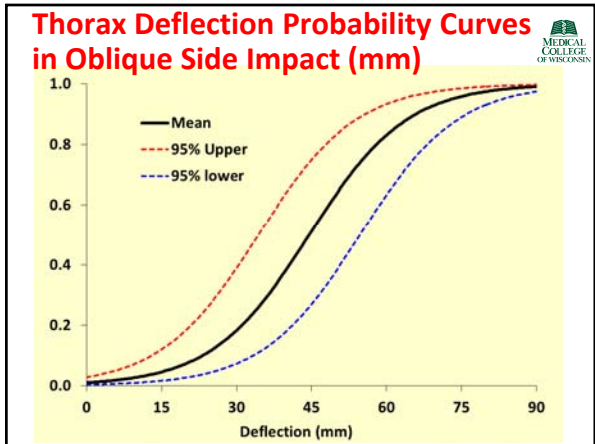
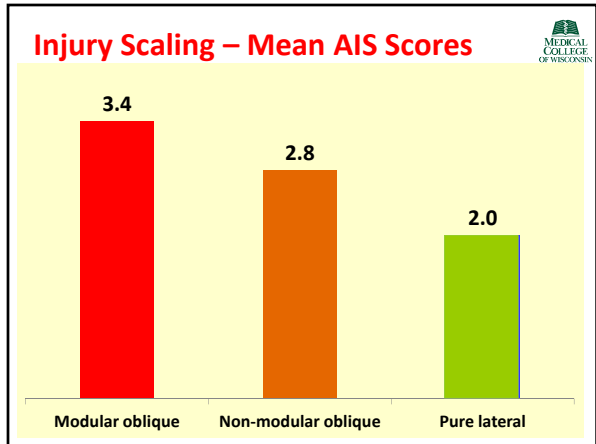
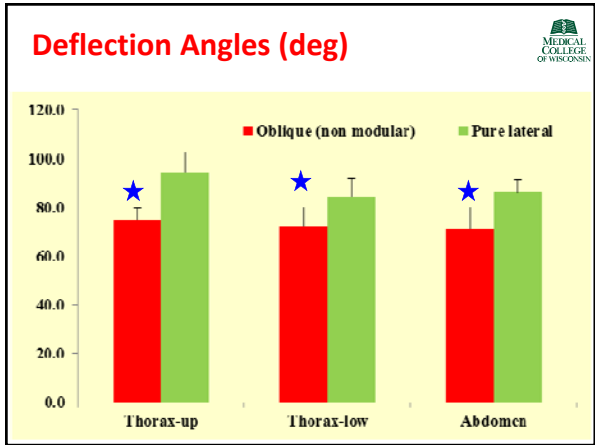
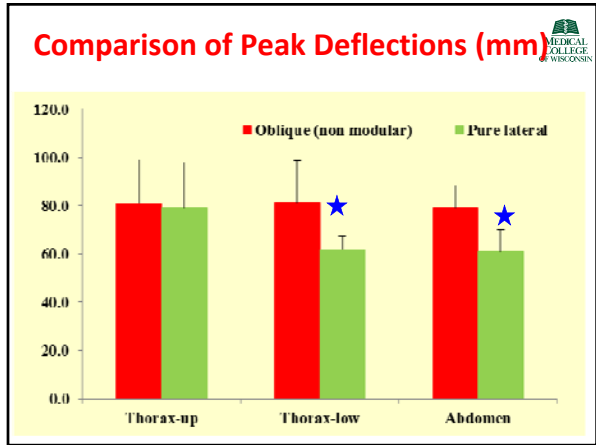
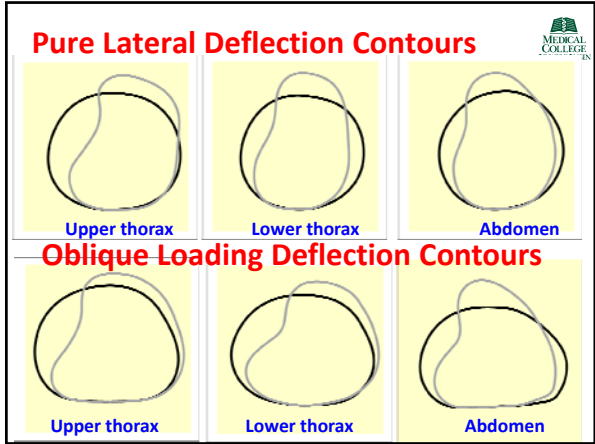
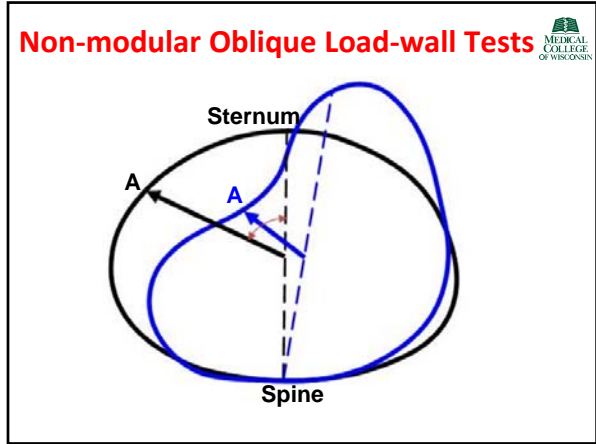
## Peak Deflections – Pure Lateral Impact



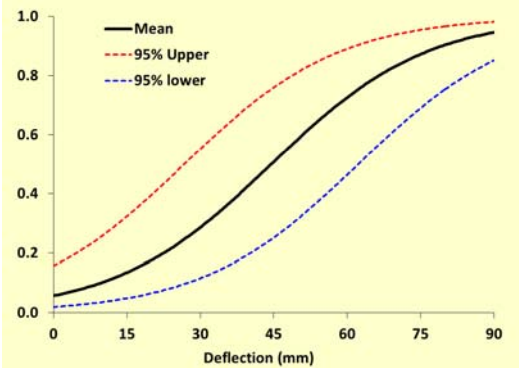
Maltese et al. 1997-2003

## Non-modular Oblique Load-wall Tests

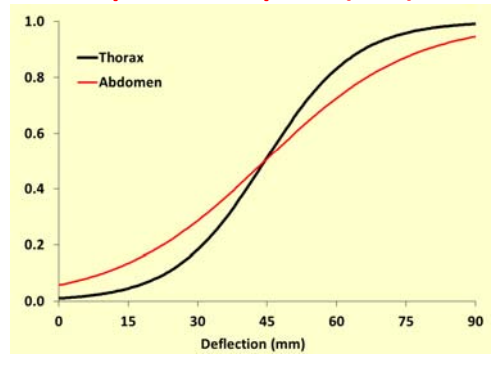




### Abdomen Deflection Probability Curves in Oblique Side Impact (mm)



### Deflection Probability Curves in Oblique Side Impacts (mm)



### Summary

- Designed modular and size-scaled load-walls
- Conducted antero-lateral oblique load tests
- Thoracic and abdomen deflections (mm, deg)
- Compared with pure lateral impact sled tests
- Analysis of deflection data from 15 PMHS tests
- Lower thorax deflections are greater in oblique
- Abdomen deflections are also greater in oblique
- Deflection angulations are also different in oblique
- Oblique loading ⇔ different from pure lateral impact
- Oblique injury criteria ⇔ different from pure lateral

### Acknowledgments

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 Steve De...  
**Thank you**  
 ...TS...  
 ...07-H-00173  
 ...VA Medical Research