



Knee Airbag Injury Risk Assessment for Children



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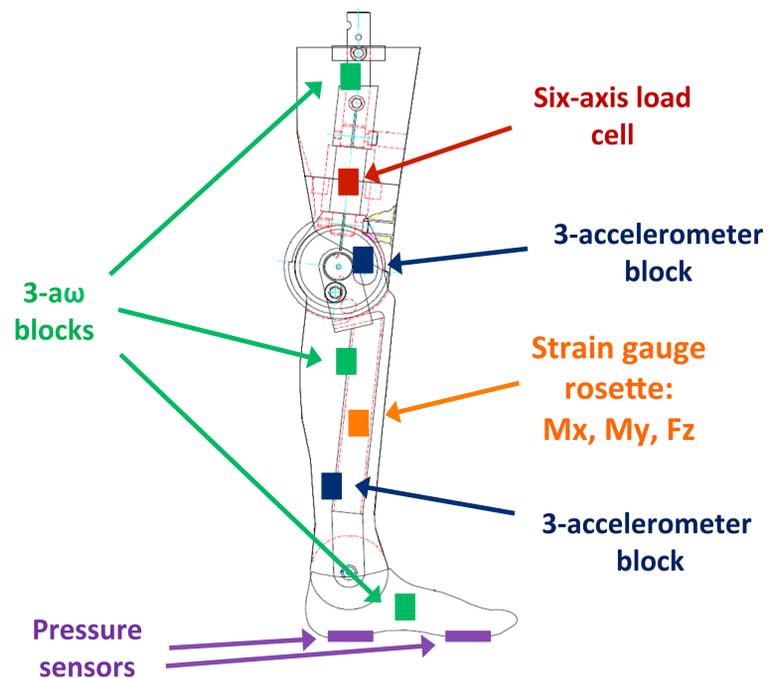
INTRODUCTION

Background: Knee bolster airbags are designed to deploy low on the dashboard to protect adult front seat occupants from injurious forces and submarining. However, little is known about how susceptible pediatric front seat occupants may be to lower extremity injuries caused by these airbags. Lower extremity injuries can be extremely debilitating the pediatric population due to potential growth plate damage and developmental delays due to long recovery periods.

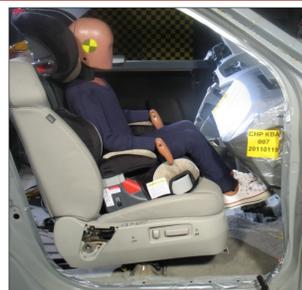
Project Goals:

- Identify realistic scenarios which may be potentially dangerous in the event of a knee airbag deployment.
- Adapt ATD instrumentation to capture useful lower extremity data.
- Compare test results to scaled pediatric injury thresholds.

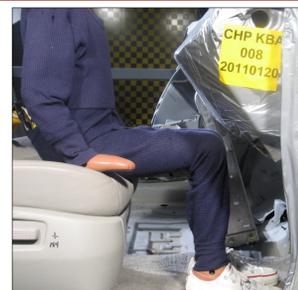
METHODS



RESULTS



Booster seat



Feet on floor



Toes on dash



Heels on dash

Key	
Green	= Below injury threshold (safe)
Yellow	= Approaching injury threshold
Red	= Past injury threshold (unsafe)

Parameter	Injury Threshold	Units	Series I					Series II					
			Femur load cell, Tibia values calculated					Femur load cell, Tibia strain gauges					
			Test 002	Test 003	Test 004	Test 005	Test 006	Test 007	Test 008	Test 009	Test 010	Test 011	Test 012
			Booster Seat	Feet on floor	Feet on floor	Toes on dash	Heels on dash	Booster Seat	Feet on floor	Toes on dash	Heels on dash	Heels on dash	Feet on floor
Femur Forces	2500	N	1150	300	1200	320	350	800	2500	700	700	1300	2600
Femur Moments	73.3	Nm	45	17	57	14	19	25	42	41	52	35	68
Tibia Forces	2400	N	--	420	2500	470	560	1800	2200	800	1100	1800	3000
Tibia Moments	57.6	Nm	--	--	--	--	--	73	40	78	80	55	37
Tibia Index	1.1	None	--	--	--	--	--	1.1	0.75	0.9	0.95	1.1	1.1

CONCLUSIONS

The largest axial loads in the long bones were seen during trials when the ATD's feet were positioned on the floor and the airbag impacted the knees. However, many positions typical of a small child in the front seat resulted in the airbag impacting the ATD's feet. This impact pattern resulted in the force of the airbag being translated through the ankle joint, tibia, then knee joint. Since the Hybrid III 6-year-old does not have biofidelic ankle or knee joints, the credibility of the data above the foot region is compromised. In these cases, the ankle struck the end of its range of motion abruptly, which created an artificial peak in the tibia and femur forces. Additionally, more work needs to be done to define accurate injury thresholds for pediatric lower extremities, as scaled values do not take into account differences in tissue mechanics or body proportions between adults and children.

PRESENTATIONS

Knee airbag injury risk assessment for children (Oral presentation). Association for the Advancement of Automotive Medicine (AAAM) Conference, Student Workshop; Las Vegas, NV. October, 2010.

Knee airbag injury risk assessment for children (Poster presentation). Injury Biomechanics Symposium; The Ohio State University. May, 2011.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the National Science Foundation (NSF) Center for Child Injury Prevention Studies at the Children's Hospital of Philadelphia (CHOP) and the Ohio State University (OSU) for sponsoring this study and its Industry Advisory Board (IAB) members for their support, valuable input and advice. The views presented are those of the authors and not necessarily the views of CHOP, OSU, the NSF, or the IAB members. Thank you also to Darrin Rankin at Honda R&D Americas.