

Via Federal Express and Electronic Submission

June 30, 2002

Dockets Management System
U.S. Department of Transportation
Room PL 401
400 Seventh Street, SW
Washington, D.C. 20590-7938
(202) 366-9324

Re: Docket Number NHTSA-2002-11707
Federal Motor Vehicle Safety Standards – Child Restraint Systems
Proposed Rule

Dear Madam or Sir:

Many of the proposed revisions to the Federal safety standard for child restraint systems (referenced above) will provide important incremental steps to improve the safety of child restraints. Specific responses from this biomechanical engineer's perspective to the technical questions posed by the agency in its NPRM are provided later in this document. To provide appropriate context for my comments, however, I must formally express profound disappointment that the broader and more meaningful goal to improve the overall safety of children in crashes is not and will not be met in this NPRM or its side-impact companion ANPRM (Docket No. 02-12151). Moreover, I do not believe that it meets the spirit of the members of Congress, particularly Senators Fitzgerald and Lincoln, who initially proposed the Child Passenger Protection Act of 2000, which was ultimately incorporated in the TREAD Act. Nothing short of a bold paradigm shift in NHTSA's approach to this significant, yet largely forsaken population of America's motoring public is required.

INTRODUCTION

A Call to See "...The Forest...(Not Just) The Trees"

Thousands of restrained children are catastrophically injured or killed annually on America's highways and entire families are devastated because of the continuing failure to execute a "systems design" approach within the auto industry to protect children. Over 13 million children in America live in impoverished families that will never be able to afford an add-on child restraint device for their used vehicle. Solutions are known. The auto industry does not want to take responsibility for the problem they created. That's the forest.

The “trees” are the myriad of specific injury mechanisms in a variety of vehicle makes and models, in a variety of child seats and vehicle seat belts and air bags, and in a variety of crash types. A comprehensive, unified approach to incorporate child passenger safety, *a priori*, in each existing and future federal transportation standard is required. The auto industry must take full responsibility for the problem they created in child auto safety. Anything less is a band-aid approach.

Life Outside the Beltway

I applaud the recent technological advancements in motor vehicle safety in some models and certainly understand the auto and child seat industry’s interest and efforts to effect federal standards that reflect contemporary technology. The problem, however, is that the parents and caretakers of a large segment of America’s children cannot afford a current model vehicle.

The average age of automobiles and trucks in use in the United States between 1970 and 1999 has steadily increased to a high of 9.0 years in 2000.¹ Restated, the *AVERAGE* age of the motoring vehicle is 9.0 years old, which means a proportionately large segment of citizens drive vehicles significantly more than a decade old compared to the same number who buys new cars. Thus, an entire generation of children or more (considering vehicles are handed down through moderate income to poor families) will never benefit from even 2002 technology, much less 2004 or beyond. Is it then correct to develop federal standards that only apply to those who can afford new cars or even recently “previously owned” vehicles? Alternatively, is it morally responsible, in fact, is it our moral imperative, to protect the people who struggle with the realities of older technology given their economic status in our society?

More than thirteen million children (13,466,500) are living in poverty in the United States today.² That’s more than the population of Paris or London and almost twice the population of Boston, Massachusetts. One-third of the United States (16 states) have greater than 20% of their children living in poverty. Indeed, an entire swath of states across the southern region of our country (CA, AZ, NM, TX, OK, AR, LA, MS, AL, GA, FL, SC) all has child poverty rates greater than 20%. Ironically, the worst child poverty rates are directly outside the beltway in Washington, D.C. with 31% of all children living in poverty.² The NTSB appropriately recognized this pressing need of children in older model vehicles with their conference in recent years on child restraints for used vehicles with lap belts only. Why, then, do our Federal standards ignore the plight of this large segment of our American population?

¹ Source: Ward’s Communications, Ward’s Motor Vehicle Facts and Figures 2001 (compiled from The Polk Company data) <http://www.fhwa.dot.gov/ohim/onh00/onh2p3.htm> (June 30, 2002)

² Annie E. Casey Foundation, Kids Count Data Book, 2002.

The current administration actively campaigned on the promise to, “Leave no child behind.” Thus, I invite the federal government to make good on that promise.

1. Recall or retrofit all existing vehicles and add-on child seats that are unsafe for children, including but not limited to vehicles containing lap belts and low shield booster seats.
Think about it. What other industry is allowed to leave clearly documented, unsafe consumer products in the stream of commerce?
2. Provide add-on child restraint devices to consumers at auto industry expense, to make their existing fleet of vehicles safe for children until they are anatomically mature enough to ride safely in adult seat belts.
Think about it. What other industry is allowed to market a product that requires another industry to get involved to make the original product minimally safe?
3. Require mandatory integrated child seats in all new passenger vehicles transporting children and/or require the industry to internally develop or contract with existing child seat manufacturers to develop high quality, add-on child seats that are tested and certified to perform safely with their specific fleet of vehicles.
Think about it. Does the auto industry sell a new car without tires? Of course not. Why then should they sell a new car without the components necessary to protect child passengers?
4. Overhaul the entire Motor Vehicle Safety Standards to provide for child-specific injury criteria to be met in every passenger seated position, including front and rear center positions, in frontal, side, and rear impacts as well as rollover collision environments.
Think about it. Isn't it at the very least, misleading to sell “family vehicles” that haven't been tested and certified as safe for children?

Finally, the current NPRM states, “Child restraints are highly effective in reducing the likelihood of death and or serious injury in motor vehicle crashes.” Yet, child restraint effectiveness for children between the ages of 1-4 years old is cited as 54 percent in passenger cars and 59 percent in light trucks. Assuming that these data represent survivable crashes, what other business can survive; much less prosper, with an apparent 40% failure rate? And the NPRM says nothing with respect to effectiveness of restraint effectiveness for children older than 4 years old. Nor does it address the safety needs of any child who weighs more than 65 pounds.

RESPONSE TO TECHNICAL QUESTIONS IN THE NPRM

Injury Criteria

The institution of chest deflection criteria in FMVSS 213 is appropriate. Though no significant reports of chest injury in children have yet occurred, prudence and systems engineering dictates that excessive chest deflection be monitored to prevent the introduction of “new” injury mechanisms in the quest to prevent other injury mechanisms with improved restraint design. The conservative criteria should mimic the safe chest compression level advocated by medical practitioners in the established (CPR) resuscitation of pediatric patients: compress no more than 1/3 the chest depth, irrespective of age. Thus, the injury criteria should be guided strictly by the anthropometry (chest depth) of the most vulnerable child (5th percentile) for the stated age group.

The neck injury criteria are certainly subject to debate. What is incontrovertible, however, is the influence of head-neck-torso angle in sustaining a devastating high cervical spine (“Spinal Cord Injury Without Radiographic Abnormality -SCIWORA”) injury resulting in child quadriplegia and/or death. When the head, neck and torso become aligned with the principal deceleration vector in a car crash, due to inadequate torso restraint, even at relatively low force/acceleration magnitudes, nonreversible, paralyzing stretch injuries to the spinal cord occur. Children in lap belts, low shield booster seats and those whom have “rolled out” of 3-pt shoulder belts (to remain restrained by lap belt only) all have been reported to experience devastating high cervical spine injuries (Refer to References).

For almost 30 years, the scientific/medical community has known that children are subject to catastrophic cervical spine injuries in crashes if their kinematics places their head, neck and torso in alignment with the crash PDOF. From a basic science perspective, Leventhal (1960) first reported C1 distraction injuries when a tensile load was placed on the cervical spine of infants during birth in an axial direction along the long axis of the spine.³ Burke (1974) reported that birth injuries to the spinal cord among young children were similar in neurological outcome and anatomical morphology to SCIWORA Syndrome observed among children in motor vehicle crashes.”⁴

Low shield booster seats that provide no torso restraint should be removed from the market. All other add-on child seats should be judged in terms of the angle of head-neck-torso alignment allowed by the restraint system relative to the risk of head contact and/or high cervical spine injury. Nij does not appear to predict cervical distraction injuries in children based upon sled tests conducted and/or analyzed in association with reconstruction of a crash involving a 6 year

³ Leventhal, HR: “Birth injuries of the spinal cord,” J. Pediatrics, 56(4):447-453, 1960.

⁴ Burke, DC. “Traumatic Spinal Paralysis in Children.” Paraplegia. 11:268-276, 1974.

old, ventilator-dependent child.⁵ Instead, the duration of the axial distraction load as influenced by the presence or absence of adequate torso restraint appears to be a more valid predictor of SCIWORA injuries among children in the absence of head contact.

Test conditions

Without exception, all proposed test protocols and design criteria must protect the most vulnerable, not the “average” or the greatest market need. I speak as a biomechanical engineer, a certified CPS technician, businesswoman and product manufacturer. To do less is an abdication of corporate social responsibility and appropriate government oversight.

1. NHTSA very appropriately has taken the position that the FMVSS 213 crash pulse is not too severe because it is similar to the crash pulse of vehicles commonly marketed as “family vehicles,” specifically, sport utility vehicles (SUVs), minivans and light trucks. The remaining test conditions also must consistently reflect this safety philosophy.
2. The seat bottom cushion angle should represent the average angle of the average age vehicle in the U.S. (i.e. 9 years old), not contemporary vehicles. Older model vehicles have seat cushions that are more horizontal and do not contain any anti-submarining structural components. The proposed regulation would increase the seat bottom cushion angle to 15 degrees, which will tend to artificially “pass” a child seat that would otherwise fail a head excursion requirement in an older model vehicle.
3. The bottom of the proposed seat cushion should reflect the shortest length, not the average. The large base of many of the current child seats precludes their use on even “average” seat lengths. The NPRM cites data in support of its length selection that will result in 36% of the seats being outside the range. Any vehicle whose seat length is less than the test length and thereby rendered at risk for poor child seat performance must be clearly labeled as such (e.g. rear seats in many extended cab pickup trucks).
4. Decisions with respect to seat cushion stiffness must be made on the side of conservatism since this variable has such a critical influence on child seat performance relative to head excursion. The cushion stiffness must reflect the softer seats of the majority of used vehicles on the road today – not contemporary seats.

⁵ Refer to the technical content of the testimony of Martha Bidez, Verne Roberts and Murray Mackay in the case of Rainford/Walker v Ford (West Palm Beach, FL)

5. The spacing between restraint anchorages directly influences the amount of slack that is available during a crash to allow dynamic movement of the child seat relative to the vehicle seat. This slack promotes increased head excursion and the possibility of impact with the restraint buckle that may lead to complete ejection of the child restraint. Thus, the child restraints should be tested at the maximum (not average) anchorage spacing now allowed for auto manufacturers in any seat position.
6. The seat back of the seat assembly should remain flexible to simulate the “worst case” scenario for head excursion, which is typical in SUVs and minivans. To rigidize the seat back, yet use a crash pulse typical of SUVs is inconsistent and not a conservative approach to child safety.
7. To upgrade the standard without carrying the weight limitation to at least 80 pounds is wrong. There is no incremental compromise position on this as the entire safety community agrees that 80 lbs. is a minimum weight threshold before adult seat belts may be used. No legitimate reasons exist for not incorporating a biofidelic 10-year-old Hybrid III dummy in the upgraded standard. If the 10-year-old dummy that is presently marketed by First Technology Safety Systems (FTSS) is not acceptable, then get it fixed. The auto industry, NHTSA and FTSS are filled with capable, bright engineers that can clearly meet this goal if NHTSA is appropriately inflexible enough to take the right stand on this critical issue.
8. The auto manufacturers must conduct full-scale crash tests with currently available child seats tested in every seat position available for transporting children. If the standards accept and promulgate the concept that full scale crash tests are required to insure safety for 50th percentile male adults, then cold logic demands that the same standard of safety be used to protect those passengers who are more vulnerable than 50th percentile male adults. The time has come to abandon the excuses and do what is right to protect our children.

Consumer Education

Consumers must be provided clear, compelling information (warnings) on the physical compatibility of child restraint and vehicle seats on a model-by-model basis. Each auto manufacturer must be solely responsible and held accountable for informing their potential customers of the best way to protect their child passengers based on valid and accurate test data with the automaker’s vehicles. Any exception to this policy increases the potential harm to America’s child passengers. For those who would demur from this action, I call attention to the significant corporate outcry when food manufacturers were

required to affix detailed nutritional labeling to allow consumers to make educated choices with the purchase of their food products. Notwithstanding the time and cost involved, the companies were required to comply with this new, extensive labeling requirement. If the government thinks caregivers have a right to be informed about the fat content in the fast food hamburger their child eats, isn't it reasonable to suggest that caregivers should be informed in detail about hidden dangers in cars that could kill their children?

In closing, I call upon NHTSA, the Alliance of Automotive Manufacturers (AAM) and the Juvenile Product Manufacturer's Association (JPMA) to do what is right, not what is minimal and cheap, to meet the long overdue goal of protecting child passengers in crashes. The Federal Record is replete with past obstructionist tactics on the part of AAM, JPMA and its individual members to prevent meaningful, comprehensive upgrades to the federal standards. As an expert in the field of biomechanical engineering, I have seen shameful behavior on the part of auto and child seat manufacturers – all largely cloaked by protective orders not available to public eyes. Lawsuits will stop when these two industries collaborate and do what is right to protect America's children. I, for one, will welcome that day when it arrives. For I have seen one too many, needlessly ventilator-dependent, quadriplegic 6-year-olds.

Sincerely,

Martha Warren Bidez, Ph. D.

REFERENCES

1. Agran, PF. "Traumatic Injuries Among Children Using Lap Belts and Lap/Shoulder Belts in Motor Vehicle Collisions." 31st Annual Proceedings of the AAAM; New Orleans, LA; September 28-30, 1987.
2. Agran, PF and Winn, DG. "Injuries Among 4 to 9 year old Restrained Motor Vehicle Occupants by Seat Location and Crash Impact Site." 32nd Annual Proceedings of the AAAM; Seattle, WA; September 12-14, pp. 39-51, 1988.
3. Bailey, DK. "The Normal Cervical Spine in Infants and Children." *Radiology*. 59:712-719, 1952.
4. Baker, DH and Berdon, WE. "Special Trauma Problems in Children." *Radiol. Clin. N. Amer.* 4:289-305, 1966.
5. Burke, DC. "Traumatic Spinal Paralysis in Children." *Paraplegia*. 11:268-276, 1974
6. Bidez, MW and Syson, SR: Kinematics, Injury Mechanisms and Design Considerations for Older Children in Adult Torso Belts," SAE 2001-01-0173.
7. Beusenbergh, MC et al. "Status of Injury Biomechanics for the Development of Crash Dummies." SAE 933104.
8. Cassan, F. B.; Page, M.; Pincemaille, Y; Kallieris, D; Tarriere, C. "Comparative Study of Restrained Child Dummies and Cadavers in Experimental Crashes." SAE 933105
9. Cheshire, DJE. "The Paediatric Syndrome of Traumatic Myelopathy Without Demonstrable Vertebral Injury." *Paraplegia* 15:74-85, 1977-78.
10. Conry, BG and CM Hall. "Cervical spine fractures and rear car seat restraints." *Archives of Disease in Childhood*, 62:1267-1268, 1987.
11. Cromack, JR and HH Ziperman. "Three-Point Belt Induced Injuries: A Comparison Between Laboratory Surrogates and Real World Accident Victims." SAE 751141.
12. Culver, C.; Naeathery, R. and H. Mertz. "Mechanical Necks with Humanlike Responses." SAE 720959.
13. Dejeammes, M.; Tarriere, C.; Thomas, C. and Kallieris, D. "Exploration of Biomechanical Data Towards a Better Evaluation of Tolerance for Children Involved in Automotive Accidents." SAE 840530
14. Dunlap, JP; Morris, M. and Thompson, RG. "Cervical-Spine Injuries in Children." *J. Bone Jt. Surg.* 40-A(3):681-686, 1958.
15. Fuchs, S; Barthel, MJ; Flannery, AM and KK. Christoffel. "Cervical Spine Fractures Sustained by Young Children in Forward-Facing Car Seats." *Pediatrics* 84(2): 348-354, 1989.
16. Givens, TG; Polley, KA; Smith, GF and Hardin, WD: "Pediatric Cervical Spine Injury: A Three-Year Experience" *J. Trauma*, 41(2):310-314, 1996.
17. Glaeser, K. "New Test Conditions for Child Restraint Systems," Proceedings, 36th Stapp Car Crash Conference, 1992, pp. 69-79
18. Glasauer, FE and Cares, HL. "Biomechanical Features of Traumatic Paraplegia in Infancy." *J. Trauma*. 13:166-170, 1973.

19. Gotschall, CS, Better, AI, Bulas, D, Eichelberger, Bentz, F and Warner, M. "Injuries to Children Restrained in 2- and 3-Point Belts." 42nd Annual Proceedings of the AAAM, October 5-7, 1998.
20. Haberl, J; Eichinger, S; and W. Wintershoff. "New Rear Safety Belt Geometry – A Contribution to Increase Belt Usage and Restraint Effectiveness." SAE 870488.
21. Hamilton, J.B. "Seat belt injuries." British Medical Journal, 4:485-486, 1968.
22. Henderson, M.; Brown, J. and Paine, M. "Injuries to Restrained Children" Proceedings of the 38th Annual Meeting of the Association for the Advancement of Automotive Medicine; Lyon, France, pp. 75- 87, September 21-23, 1994.
23. Henderson, M.; Brown, J. and Griffiths, M. "Children in Adult Seat Belts and Child Harnesses: Crash Sled Comparisons of Dummy Responses." SAE 973308.
24. Henderson, M.; Brown, J. and Griffiths, M. "Children in Adult Seat Belts and Child Harnesses." Final Report, Federal Office of Road Safety, Department of Transport and Communications, Canberra, 1997.
25. Horsch, JD; Schneider, DC; Kroell, CK and Raasch, FD. "Response of Belt Restrained Subjects in Simulated Lateral Impact." SAE 791005.
26. Horsch, JD. "Occupant Dynamics as a Function of Impact Angle and Belt Restraint. SAE 801310.
27. Huelke, DF; Mendelsohn, RA; States, JD and JW Melvin. "Cervical Fractures and Fracture dislocations Sustained without Head Impact." J. Trauma, 18(7): 533-538, 1978.
28. Huelke, DF; Mackay, GM; Morris, A; Bradford, M: "Car Crashes and Non-Head Impact Cervical Spine Injuries in Infants and Children" SAE 920562.
29. Huelke, DF; Mackay, GM; Morris, A. and M. Bradford. "A Review of Cervical Fractures and Fracture-Dislocations Without Head Impacts Sustained by Restrained Occupants." *Accid. Anal. And Prev.* 25(6):731-743, 1993.
30. Janssen, E.G.; Huijskens, C.G., Verschut, R. and Twisk, D. Cervical Spine Loads Induced in Restrained Child Dummies II SAE 933102
31. Johnston, C., Rivara, FP, Soderberg, R. "Children in car crashes: analysis of data for injury and use of restraints." *Pediatrics* 936:960, 1994.
32. Kallieris, D., Barz, J. Schmidt, G., Heess, G. and Mattern, R. "Comparison Between Child Cadavers and Child Dummy by Using Child Restraint Systems in Simulated Collisions." SAE 760815
33. Kallieris, D and G. Schmidt. "Neck Response and Injury Assessment Using Cadavers and the US-SID for Far-Side Lateral Impacts of Rear Seat Occupants with Inboard-Anchored Shoulder Belts." SAE 902313.
34. Klinich, K.D. and Burton, R.W. "Injury Patterns of Older Children in Automotive Accidents," SAE 933082.
35. Kokoska, ER; Keller, MS; Rallo, MC and Weber, TR: "Characteristics of Pediatric Cervical Spine Injuries." *J. Ped. Surg.* 36(1):100-105, 2001.

36. Langwieder K. and Hummel T. "Neck Injuries to Restrained Children" IRCOBI, 1989.
37. Leventhal, HR: "Birth injuries of the spinal cord," J. Pediatrics, 56(4):447-453, 1960.
38. Lowne, R., Gloyns P. and Roy P. "Fatal Injuries to Restrained Children Aged 0-4 years in Great Britain 1972-86." 11th ESV Conference, Washington DC 1987.
39. Lynch, J.M.; Meza, MP; Pollack, IF and Adelson, PD: "Direct Injury to the Cervical Spine of a Child by a Lap-Shoulder Belt Resulting in Quadriplegia: Case Report." J. Trauma. 41(4): 747-749, 1996.
40. Meaney, D. and Thibault, L., "Physical Studies of Cortical Brain Deformation in Response to High Strain Rate Inertial Loading", Proceedings of The 1990 International IRCOBI Conference on The Biomechanics of Impacts, September 1990, pp. 215-224.
41. Mertz, HJ and Prasad, P. "Improved Neck Injury Risk Curves for Tension and Extension Moment Measurements of Crash Dummies." SAE 2000-01-SC05.
42. Mertz, HJ; Prasad, P. and AL Irwin. "Injury Risk Curves for Children and Adults in Frontal and Rear Collisions." SAE 973318
43. Mertz, H.J. and Weber, D.A. "Interpretations of the responses of a 3-year-old child dummy relative to child injury potential." 1982 ESV Conference, Kyoto, Japan.
44. Mertz, H.J. "Development Status and Injury Limits for Hybrid III, 10-year-old Dummy." Presentation before the SAE HIII Dummy Family Task Group; May 15, 2001.
45. National Safe Kids Campaign; Occupant Protection Laws Across the Nation; Washington D.C. Summer 2000.
46. National Transportation Safety Board. "Performance of Lap Belts in 26 Frontal Crashes. NTSB/SS-86/03.
47. Neville, BGR "Hyperflexion Cervical Cord Injury in a Children's Car Seat." Lancet, July 11, 1981, p. 103.
48. Newman, J.A. and Dalmotas, D. "Atlanto-Occipital Fracture Dislocation in Lap-Belt Restrained Children." SAE 933099
49. Pang, D. and JE Wilberger, Jr. "Spinal cord injury without radiographic abnormalities in children." J. Neurosurg. 57:114-129, 1982.
50. Pang, D. and IF Pollack. "Spinal Cord Injury without Radiographic Abnormality in Children – The SCIWORA Syndrome." J. Trauma. 29(5):654-664, 1989.
51. Papavasiliou, V. "Traumatic Subluxation of the Cervical Spine During Childhood." Orthop. Clin. N. Amer. 9(4): 945-954, 1978.
52. Pintar, FA; Sances, Jr. A; Yoganandan, N.; Reinartz, J; Malman, DJ; Suh, JK; Unger, G.; Cusick, JF and Larson, SJ.: "Biodynamics of the Total Human Cadaveric Spine." SAE 902309
53. Planath, I., et al., "Synthesis of Data Towards Neck Protection Criteria for children," 1992 IRCOBI, September 1992, pp. 155-166

54. Prasad, P. and Daniel, R.P. "A biomechanical analysis of head, neck, and torso injuries to child surrogates due to sudden torso acceleration. SAE 841656.
55. Saldeen, T. "Fatal Neck Injuries Caused by Use of Diagonal Safety Belts." J. Trauma 7(6): 856-862, 1967.
56. Sances, A.; Myklebust, J; Cusick, et al."Experimental Studies of Brain and Neck Injury." SAE 811032.
57. Slavik, DH: "Cervical Distraction Injuries to Children" SAE 973306.
58. Smrcka, Joe. "Dummies: Past & Present". First Technology Safety Systems (www.ftss.com) July 28, 2001.
59. Stalnaker, R.L. "Spinal Cord Injuries to Children in Real World Accidents." SAE 933100
60. Stalnaker, R.L., Mendix, K.K., Rojanavanich, V., 1992, "The Unified Head Injury Theory," Proceedings of the ASME 1992 European Joint Conference on Engineering Systems (ESDA) June 1992, pp 105-114.
61. Stalnaker, R.L. "Inconsistencies in State Laws and Federal Regulations Regarding Child Restraint Use in Automobiles," SAE 933087
62. Sturtz, G. "Biomechanical Data of Children" SAE 801313
63. Taylor, AR and W. Blackwood: "Paraplegia in Hyperextension Cervical Injuries with Normal Radiographic Appearances." J. Bone Jt. Surg. 30(2): 245-248, 1948.
64. Taylor, AR: The Mechanism of Injury to the Spinal Cord in the Neck Without Damage to the Vertebral Column" J. Bone Jt. Surg. 33(4): 543-547, 1951.
65. Taylor, TKF and JH Bannister. "Seat Belt Fractures of the Cervical Spine." J. Bone Jt. Surg. 58-B(3): 328-331, 1976.
66. Thibault, L., et al., "The Strain Dependant Pathophysiological Consequences of Inertial Loading on Central Nervous System Tissue", Proceedings of the 1990 International IRCOBI Conference on The Biomechanics of Impacts, September 1990, pp. 191-202.
67. Trosseille, Xavier and Tarriere, Claude. "Neck Injury Criteria for Children from Real Crash Reconstructions, " SAE 933103.
68. Williams, N; Rose, GK and Goodman, AM: "Lap-style seat belt associated with high cervical cord injury in a child." Injury 24(3):209-210, 1993.
69. Winston, FK; Durbin, DR; Bhatia, E.; Werner, J and W Sorenson."Patterns of inappropriate restraint for children in crashes." Proceedings of the IRCOBI, Barcelona, Spain, 1999.
70. Wismans J., Maltha J., Melvin, J.W., Stalnaker R.L. "Child restraint evaluation by experimental and mathematical simulation." SAE 791017
71. Yoganandan, N.; Pintar, F.; Butler, J.; Reinartz, J.; Sances, A. and Larson, S.J. "Dynamic Response of Human Cervical Spine Ligaments." Spine 14(10): 1102-1109, 1989.