

## **Virginia Tech – Wake Forest University Center for Injury Biomechanics 10 Year History**

Stefan M. Duma  
Virginia Tech – Wake Forest University  
Center for Injury Biomechanics

### **ABSTRACT**

The Virginia Tech – Wake Forest University Center for Injury Biomechanics (CIB) has completed 10 years of research in the fields of automobile safety, military restraints, and sports biomechanics. The CIB has grown to include 74 researchers lead by 10 faculty and 48 staff and student researchers. These researchers examine human tolerance across a range of dynamic loading environments for all body regions. The CIB is the largest university based injury biomechanics research group in the world. It includes five separate laboratory facilities with over 40,000 sq.ft. of dedicated research space. The faculty and staff have published nearly 300 journal and refereed conference papers in 10 general research areas. The objective of this paper is to summarize briefly the CIB research capabilities and accomplishments.

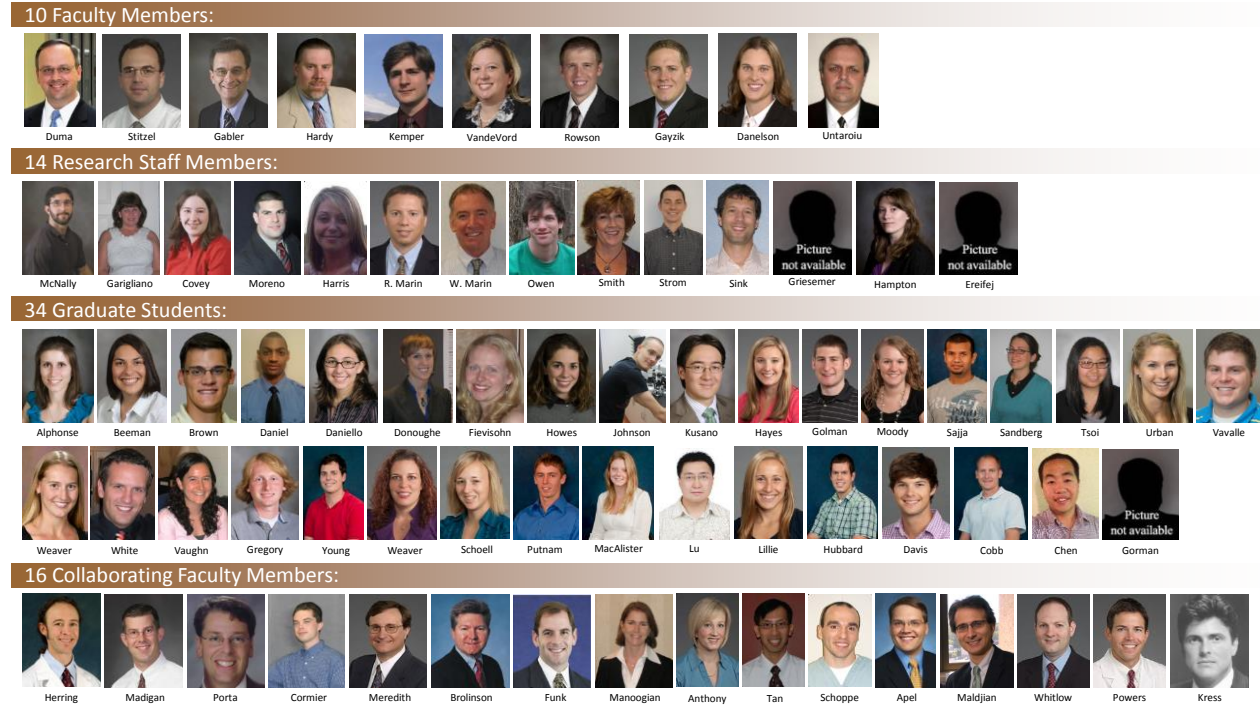
Key Words: Injury, Biomechanics, Experimental, Computational

### **FACULTY, STAFF, and STUDENTS**

The CIB was established in 2003 with Dr. Duma at Virginia Tech and Dr. Stitzel at Wake Forest University. As the program developed, faculty were recruited to join the CIB from across the country. First, Dr. Gabler was recruited from Rowan University after spending time with NHTSA. Next, Dr. Hardy was recruited from Wayne State University, and Dr. Kemper was hired after graduating at Virginia Tech. Dr. VandeVord was also recruited from Wayne State University, and Dr. Rowson joined the CIB faculty after graduating Virginia Tech. Dr. Gayzik and Dr. Danelson, who are both Wake Forest University graduates, joined the CIB faculty and are located on the Wake Forest University side of the CIB. The most recent addition was Dr. Untaroiu who was recruited from the University of Virginia. The 74 members of the CIB are organized into research groups that are championed by these 10 primary faculty members (Figure 1).

### **FACILITIES**

The CIB utilizes over 40,000 sq.ft. of dedicated research space across five separate laboratories. First, the Impact Crash Sled Laboratory is a 10,000 sq.ft. facility that houses offices, conference rooms, and several large experimental rooms. The jewel in this research showcase is a 1.4 mega newton servo-sled system that was manufactured by Seattle Safety. This sled system can replicate most any crash scenario. In addition, this facility includes a high-speed biplane X-ray suite. Other testing areas are capable of dynamically loading organ and tissue level samples. This is the only facility in the world with the unique capabilities of high rate impact testing and high rate imaging (Figure 2).



**Figure 1:** The faculty, staff, and students that comprise the Virginia Tech – Wake Forest University Center for Injury Biomechanics.



**Figure 2:** Impact Crash Sled Laboratory on the Virginia Tech campus which houses the sled and high-speed x-ray system in addition to organ and tissue level testing fixtures.

The second laboratory is the Tissue Testing Laboratory located on the fourth floor of the ICTAS building. This 7,000 sq.ft. facility is BSL2 certified and is used for biomechanical testing at the cellular level. This research is investigating blunt impact and blast loading. Additional resources are also available for evaluating motor vehicle crash data recorders. This space also provides the primary office and conference rooms for undergraduate and graduate students in the CIB on the Virginia Tech campus.

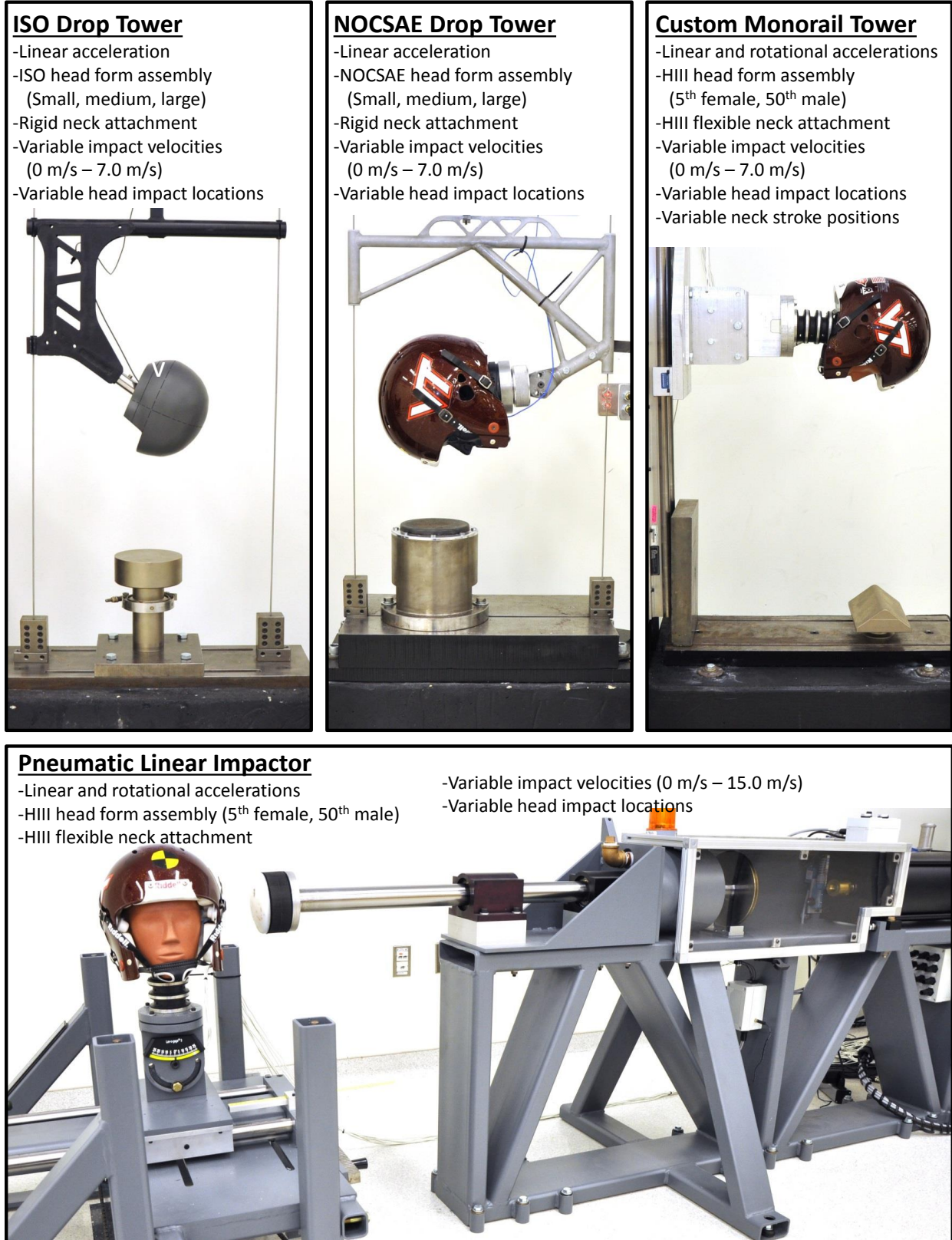
The third laboratory is the Helmet Testing laboratory located on the first floor of the ICTAS building and includes testing equipment to evaluate any type of protective head gear (Figure 3). This facility is used to generate the Virginia Tech Helmet Ratings which are released each year. The linear impactor is also useful for evaluating the effectiveness of neck collars in football impact events. A series of custom NOCSAE and Hybrid III head forms are used with instrumentation to measure both linear and rotational acceleration components.

The fourth laboratory is the newest addition on the Virginia Tech campus and it is called the Shock Tube Laboratory. This facility houses a one-of-a-kind large shock tube with a test chamber diameter of over four feet (Figure 4). The shock tube is used to investigate the brain injury biomechanics associated with blast loading. In addition, there is a second shock tube with a one foot diameter test chamber for smaller scale testing. Both of these systems can be utilized to develop blast instrumentation as well as to evaluate the effectiveness of blast protective equipment.

The fifth laboratory is located at Biotech Place at the Wake Forest University. This facility houses tissue testing devices as well as extensive computational modeling capabilities. The CIB faculty and students at Wake Forest University use this building as their primary office and conference room venues. In close proximity to the medical center, the CIB runs their Crash Injury Research and Engineering Network (CIREN) from this space. In addition, the CIB leads the Global Human Body Models Consortium (GHBMC) from this location in conjunction with the other external university partners.

## **RESEARCH**

Over the past decade, the CIB has performed research in 10 general areas. First, the CIB has investigated brain injuries relative to sport impacts, automobile safety, and military restraints [1-51]. Second, the FOCUS head form was developed as well as associated facial fracture injury criteria [52-62]. Third, extensive research was performed on eye injury biomechanics and corresponding modeling of eye injuries [63-99]. Fourth, neck injuries and spine biomechanics and modeling were examined [100-113]. Fifth, thoracic injuries and bone fracture detection experiments were performed for the thorax and pelvis [114-147]. Sixth, tissue testing was performed to quantify the properties of human organs [148-183]. Seventh, research was performed to examine pregnant occupant biomechanics in automobile crashes [184-202]. Eighth, experiments were performed on the upper extremity including fracture tolerance data and skin abrasions [203-234]. Ninth, the lower extremity was evaluated for injury response in sports and automobile safety [235-251]. Tenth, whole body kinematics was evaluated as well as injury coding for motor vehicle crash event, motorcycle crashes, and event data recorder analysis [252-323].



**Figure 3:** Head impact testing devices located in the Helmet Testing Laboratory.



**Figure 4:** The new Shock Tube Laboratory includes custom shock testing capabilities including this large four foot cross section shock tube.



**Figure 5:** The recently opened Biotech Place at Wake Forest University houses extensive experimental and computational facilities for CIB faculty and students.

**REFERENCES**

1. Rowson, S. and S. M. Duma. Brain injury prediction: Assessing the combined probability of concussion using linear and rotational head acceleration. *Ann Biomed Eng.* 41(5):873-82, 2013.
2. Beckwith, J. G., R. M. Greenwald, J. J. Chu, J. J. Crisco, S. Rowson, S. M. Duma, S. P. Broglio, T. W. McAllister, K. M. Guskiewicz, J. P. Mihalik, S. Anderson, B. Schnebel, P. G. Brolinson and M. W. Collins. Timing of concussion diagnosis is related to head impact exposure prior to injury. *Med Sci Sports Exerc.* 45(4):747-54, 2013.
3. Beckwith, J. G., R. M. Greenwald, J. J. Chu, J. J. Crisco, S. Rowson, S. M. Duma, S. P. Broglio, T. W. McAllister, K. M. Guskiewicz, J. P. Mihalik, S. Anderson, B. Schnebel, P. G. Brolinson and M. W. Collins. Head impact exposure sustained by football players on days of diagnosed concussion. *Med Sci Sports Exerc.* 45(4):737-46, 2013.
4. Rowson S and Duma SM, "The temperature inside football helmets during head impact: a five year study of collegiate football games," *Proceedings of the Institution of Mechanical Engineers, Part P: Journal of Sports Engineering and Technology.* 227(1):12-19, 2013.
5. Weaver, A.A., Danelson, K.A., Stitzel, J.D. "Modeling Brain Injury Response for Rotational Velocities of Varying Directions and Magnitudes." *Annals of Biomedical Engineering*, 2012 September; 40(9): 2005-2018, doi:
6. Rowson, S. and S. M. Duma. The Virginia Tech response. *Ann Biomed Eng.* 40(12):2512-8, 2012.
7. Daniel, R.W., Rowson, S., and Duma, S.M., Head Impact Exposure in Youth Football. *Ann Biomed Eng.* 2012. 40(4): p. 976-981.
8. Urban, J.E., Whitlow, C.W., Edgerton, C.A., Maldjian, J.A., Powers, A.K., Stitzel, J.D. "Motor Vehicle Crash-Related Subdural Hematoma from Real-World Head Impact Data." *Journal of Neurotrauma*, 2012 Dec 10; 29(18): 2774-81. Doi: 10.1089/neu.2012.2373 PMID: 22928543 (In process)
9. Duhaime, A. C., J. G. Beckwith, A. C. Maerlender, T. W. McAllister, J. J. Crisco, S. M. Duma, P. G. Brolinson, S. Rowson, L. A. Flashman, J. J. Chu and R. M. Greenwald. Spectrum of acute clinical characteristics of diagnosed concussions in college athletes wearing instrumented helmets. *J Neurosurg.* 117(6):1092-9, 2012.
10. Rowson S, Duma SM, Beckwith JG, Chu JJ, Greenwald RM, Crisco JJ, Brolinson PG, Duhaime AC, McAllister TW, and Maerlender AC. Rotational Head Kinematics in Football Impacts: An Injury Risk Function for Concussion. *Annals of Biomedical Engineering.* 40(1): 1-13. 2012.
11. Beyer JA, Rowson S, and Duma SM. Concussions Experienced by Major League Baseball Catchers and Umpires: Field Data and Experimental Baseball Impacts. *Annals of Biomedical Engineering.* 40(1): 150-159. 2012.
12. Funk JR, Rowson S, Daniel RW, and Duma SM. Validation of Concussion Risk Curves for Collegiate Football Players Derived from HITS Data. *Annals of Biomedical Engineering.* 40(1): 79-89. 2012.
13. McAllister TW, Flashman LA, Maerlender A, Greenwald RM, Beckwith JG, Tosteson TD, Crisco JJ, Brolinson PG, Duma SM, Duhaime AC, Grove MR, Turco JH, Cognitive effects of one season of head impacts in a cohort of collegiate contact sport athletes. *Neurology* 2012.
14. Crisco, J. J., B. J. Wilcox, J. T. Machan, T. W. McAllister, A. C. Duhaime, S. M. Duma, S. Rowson, J. G. Beckwith, J. J. Chu and R. M. Greenwald. Magnitude of head impact exposures in individual collegiate football players. *J Appl Biomech.* 28(2):174-83, 2012.
15. Rowson, S., Duma, S.M., Development of the STAR evaluation system for football helmets: integrating player head impact exposure and risk of concussion. *Annals of Biomedical Engineering.* 39(8):2130-2140, 2011.
16. Crisco JJ, Wilcox BJ, Beckwith JG, Chu JJ, Duhaime AC, Rowson S, Duma SM, Maerlender AC, McAllister TW, and Greenwald RM. Head Impact Exposure in Collegiate Football Players. *Journal of Biomechanics.* 44(15): 2673-2678. 2011.
17. Duma, S.M., Rowson, S., Past, present, and future of head injury research. *Exercise and Sport Sciences Reviews.* 39(1):2-3, 2011.
18. Kimpara, H., Nakahira, Y., Iwamoto, M., Rowson, S., Duma, S.M., Head injury prediction methods based on 6 degree of freedom head acceleration measurements during impact. *International Journal of Automotive Engineering.* 2(2):13-19, 2011.
19. Rowson, S., Beckwith, J.G., Chu, J.J., Leonard, D.S., Greenwald, R.M., Duma, S.M. A six degree of freedom head acceleration measurement device for use in football. *Journal of Applied Biomechanics.* 27(1):8-14, 2011.

20. Rowson, S., McNally, C., Duma, S.M., Can footwear affect Achilles tendon loading? *Clinical Journal of Sport Medicine*. 20(5):344-349, 2010.
21. Shain, K., Madigan, M.L., Rowson, S., Bisplinghoff, J., Duma, S.M., Analysis of the ability of catcher's masks to attenuate head accelerations on impact with a baseball. *Clinical Journal of Sport Medicine*. 20(6):422-427, 2010.
22. Crisco, J.J., Fiore, R., Beckwith, J.G., Chu, J.J., Brolinson, P.G., Duma, S., McAllister, T.W., Duhaime, A.C., Greenwald, R.M., Frequency and Location of Head Impact Exposures in Individual Collegiate Football Players. *Journal of Athletic Training*. 45(6):549-559, 2010.
23. Rowson, S., Brolinson, P.G., Goforth, M.W., Dietter, D. and Duma, S., Linear and angular head accelerations measurements in collegiate football. *Journal of Biomechanical Engineering*. 131(6):061016, 2009.
24. Rowson, S., McNeely, D.E., Brolinson, P.G., and Duma, S.M., Biomechanical analysis of football neck collars. *Clinical Journal of Sports Medicine*. 18(4):316-321, 2008.
25. Duma, S.M., Manoogian, S.J., Bussone, W., Brolinson, P.G., Goforth, M.W., Donnenwerth, J.J., Greenwald, R.M., Chu, J.J., and Crisco, J.J., Analysis of real-time head accelerations in collegiate football players. *Clinical Journal of Sports Medicine*. 15(1):3-8, 2005.
26. Lillie, EM; Urban, JE; Stitzel, JD. "Evaluation of the Extent and Distribution of Diffuse Axonal Injury from Real World Motor Vehicle Crashes." *Biomed Sci Instrum*. 2013 Apr 5; 49:297-304.
27. Urban, JE; Maldjian, JA; Whitlow, CT; Stitzel, JD. "A Method to Investigate the Size and Shape Variation of the Lateral Ventricles with Age." *Biomedical Sciences and Instrumentation*, 2012;48:447-53.
28. Loftis, K.L., Moreno, D.P., Tan, J., Gabler, H.C., Stitzel, J.D. "Utilizing Computed Tomography Scans for Analysis of Motorcycle Helmets in Real-World Crashes." *Biomedical Sciences and Instrumentation*, 2011; 48.
29. Takhounts, E. G., V. Hasija, S. A. Ridella, S. Rowson and S. M. Duma. Kinematic rotational brain injury criterion (bric). *Enhanced Safety of Vehicles*. 11-0263-0, 2011.
30. Bussone, W.R., Duma, S.M., The effect of gender and body size on angular accelerations of the head observed during everyday activities. *Biomed Sci Instrum*. 46:166-174, 2010.
31. Danelson KA, Gordon ES, David LR, Stitzel JD. Using a three dimensional model of the pediatric skull for pre-operative planning in the treatment of craniosynostosis - *biomed 2009*. *Biomed Sci Instrum*. 2009;45:358-63.
32. Paolini BM, Danelson KA, Geer CP, Stitzel JD. Pediatric head injury prediction: investigating the distance between the skull and the brain using medical imaging - *biomed 2009*. *Biomed Sci Instrum*. 2009;45:161-6.
33. Rowson, S., McNally, C., and Duma, S.M., In situ measurement of Achilles tendon tension during dorsiflexion. *Biomed Sci Instrum*. 45:18-23, 2009
34. Duma, S. M. and S. Rowson (2009). "Every newton hertz: A macro to micro approach to investigating brain injury." *Conf Proc IEEE Eng Med Biol Soc* 1: 1123-1126. DOI: 10.1109/IEMBS.2009.5333423
35. Rowson, S., Goforth, M.W., Dietter, D., Brolinson, P.G., and Duma, S.M., Correlating cumulative sub-concussive impacts in football with player performance. *Biomed Sci Instrum*. 45:113-118, 2009.
36. Danelson, K.A., Yu, M., Gayzik, F.S., Geer, C.P., Slice, D.E., Stitzel, J.D., Geometric scaling factors for the pediatric brainstem. *Biomed Sci Instrum*. 44: 153-8, 2008.
37. Rowson, S., McNeely, D.E., and Duma, S.M., Force Transmission to the Mandible by Chin Straps During Head Impacts in Football. *Biomed Sci Instrum*. 44:195-200, 2008.
38. Takhounts, E.G., Ridella, S.A., Hasija, V., Tannous, R.E., Campbell, J.Q., Malone, D., Danelson, K.A., Stitzel, J.D., Rowson, S., and Duma, S.M., Investigation of traumatic brain injuries using the next generation of simulated injury monitor (SIMon) finite element head model. *Stapp Car Crash Journal*. 52:1-31, 2008.
39. Stitzel JD, Kilgo PD, Danelson KA, Geer CP, Pranikoff T, Meredith JW. "Age thresholds for increased mortality of three predominant crash induced head injuries," *Annu Proc Assoc Adv Automot Med*, vol. 52, pp. 235-44, 2008.
40. Danelson, K.A., Geer, C.P., Stitzel, J.D., Slice, D.E., and Takhounts, E.G, "Age and gender based biomechanical shape and size analysis of the pediatric brain," *Stapp Car Crash J*, 52:59-81, 2008.
41. Danelson, K.A., Loftis, K.L., Yu, M.M., Gayzik, F.S., Geer, C.P., Slice, D.E., Stitzel, J.D. "Geometric Shape Scaling Factors for the Pediatric Brain Based on Morphometric Analysis," *SAE Int. J. Passeng. Cars- Electron. Electr. Sys*. 1(1): 605-611, 2008.
42. Rowson, S., McNeely, D.E., and Duma, S.M., Differences in Hybrid III and THOR-NT Neck Response in Extension Using Matched Tests with Football Neck Collars. *Biomed Sci Instrum*. 44:165-170, 2008.
43. Loftis, K.L., Geer, C.P., Danelson, K.A., Slice, D.E., Stitzel, J.D. "Analysis of Pediatric Head Anthropometry using Computed Tomography for Application to Head Injury Prediction," *Biomedical Sciences and Instrumentation*, 2007; 43, 86-90.

44. Funk, J.R., Duma, S.M., Manoogian, S.J., and Rowson, S., Biomechanical risk estimates for mild traumatic brain injury. *Annals of Advances in Automotive Medicine*. 51:343-361, 2007.
45. Rowson, S., McNeely, D.E., and Duma, S.M., Lateral Bending Biomechanical Analysis of Neck Protection Devices Used in Football. *Biomed Sci Instrum*. 43:200-205, 2007.
46. Manoogian, S.J., McNeely, D.E., Duma, S.M., Brolinson, P.G., and Greenwald, R.M., Head Acceleration is Less than 10 Percent of Helmet Acceleration in Football Impacts. *Biomed Sci Instrum*. 42:383-388, 2006.
47. Ng, T.P., Bussone, W.R., and Duma, S.M., The Effect of Gender and Body Size on Linear Accelerations of the Head Observed During Daily Activities. *Biomed Sci Instrum*. 42:25-30, 2006.
48. Seimetz, C.N., Kemper, A.R., and Duma, S.M., An Investigation of Cranial Motion through a Review of Biomechanically Based Skull Deformation Literature. *International Journal of Osteopathic Medicine*, 15: 152-165, 2012.
49. Seimetz, C.N., Kemper, A.R., and Duma, S.M., An Investigation of Cranial Motion through a Review of Biomechanically Based Skull Deformation Literature- Reply. *International Journal of Osteopathic Medicine*, (In Press).
50. Slice, D.E. and Stitzel, J.D. "Landmark-based Geometric Morphometrics and the Study of Allometry", S.A.E. conference on Digital Human Modeling for Design and Engineering, (DHM) June, 2004, Oakland University, Rochester, MI. Pub. No.: 04DHM-36. (Republished in June, 2005 by the S.A.E. in the 2004 Transactions Journal of Aerospace: 199-207.)
51. Duma, S.M., Rudd, R.W., Crandall, J.R., A protocol system for testing biohazardous materials in an impact biomechanics research facility. *American Industrial Hygiene Association Journal*. 60(5):629-634, 1999.
52. Cormier, J., Manoogian, S., Bisplinghoff, J., Rowson, S., Santago, A., McNally, C., Duma, S.M., Bolte, J., The tolerance of the Maxilla to blunt impact. *Journal of Biomechanical Engineering*. 133(6):064501, 2011.
53. Cormier, J., Manoogian, S., Bisplinghoff, J., Rowson, S., Santago, A., McNally, C., Duma, S.M., Bolte, J., The tolerance of the frontal bone to blunt impact. *Journal of Biomechanical Engineering*. 133(2):021004, 2011.
54. Crowley, J.S., Brozoski, F.T., Duma, S.M., Kennedy, E.A., Development of the facial and ocular countermeasures safety (FOCUS) headform. *Aviation Space and Environmental Medicine*. 80(9):831, 2009.
55. Cormier, J., Manoogian, S., Bisplinghoff, J., Rowson, S., Santago, A., McNally, C., Duma, S.M., Bolte, J., The tolerance of the nasal bone to blunt impact. *Annals of Advancement of Automotive Medicine*. 54:3-14, 2010.
56. Cormier, J., Manoogian, S., Bisplinghoff, J., Rowson, S., Santago, A., McNally, C., Duma, S.M., Bolte, J., Biomechanical response of the human face and corresponding biofidelity of the FOCUS headform. *International Journal of Passenger Cars – Mechanical Systems*. 3(1):842-859, 2010.
57. Cormier, J.M. and Duma, S.M., Epidemiology of Facial Fractures in Automotive Collisions. *Annals of Advances in Automotive Medicine*. 53:169-176, 2009.
58. Kennedy, E., Duma, S., The effects of the extraocular muscles on eye impact force-deflection and globe rupture response. *Journal of Biomechanics*. 41(16):3297-3302, 2008.
59. Cormier, J.M., Manoogian, S.J., Bisplinghoff, J.A., McNally, C., and Duma, S.M., The Use of Acoustic Emission in Facial Fracture Detection. *Biomed Sci Instrum*. 44:147-152, 2008.
60. Manoogian, S.J., Kennedy, E.A., Wilson, K.A., and Duma, S.M., Prevention of Facial Fractures from Night Vision Goggle Impact. *Biomed Sci Instrum*. 42:13-18, 2006.
61. Cormier, J.M., Stitzel, J.D., Hurst, W.J., Porta, D.J., Jones, J., and Duma, S.M., Predicting Zygoma Fractures from Baseball Impact. *Biomed Sci Instrum*. 42:142-147, 2006.
62. Cormier, J.M., Manoogian, S.J., Bisplinghoff, J.A., Rowson, S., Santago, A.C., McNally, C., Duma, S.M., and Bolte, J.H., Biomechanical Response of the Human Face and Corresponding Biofidelity of the FOCUS Headform. *Journal of Passenger Cars – Mechanical Systems*. 119(6):\_2010-01-1317, 2010.
63. Alphonse, V.D., Kemper, A.R., Strom, B.T., Beeman, S.M., and Duma, S.M., Exposure to Fireworks and Eye Injuries—Reply. *Journal of the American Medical Association*, 308(15):1523-1524, 2012.
64. Alphonse, V.D., Kemper, A.R., Strom, B.T., Beeman, S.M., and Duma, S.M., Mechanisms of Eye Injuries from Fireworks. *Journal of the American Medical Association*, 308(1): 33-34, 2012.
65. Duma, S.M., Jill A. Bisplinghoff, Danielle M. Senge, Craig McNally, and Vanessa D. Alphonse. Evaluating the Risk of Eye Injuries: Intraocular Pressure During High Speed Projectile Impacts. *Current Eye Research*, 37(1): 43-49, 2012.
66. Duma, S.M., Bisplinghoff, J.A., Senge, D.M., McNally, C., Alphonse, V.D., Eye Injury Risk from Water Stream Impact: Biomechanically Based Design Parameters for Water Toy and Park Design. *Current Eye Research* 37(4):279-285, 2012.
67. Weaver, A.A., Loftis, K.L., Duma, S.M., Stitzel, J.D., Biomechanical modeling of eye trauma for different orbit anthropometries. *Journal of Biomechanics*. 44(7):1296-1303, 2011.

68. Weaver, A.A., Kennedy, E.A., Duma, S.M., Stitzel, J.D., Evaluation of Different Projectiles in Matched Experimental Eye Impact Simulations, *Journal of Biomechanical Engineering*. 133(3):031002, 2011.
69. Weaver, A.A., Loftis, K.L., Tan, J.C., Duma, S.M., Stitzel, J.D., CT Based Three-Dimensional measurement of Orbit and Eye Anthropometry. *Investigative Ophthalmology & Visual Science*. 51(10):4892-4897, 2010.
70. Bisplinghoff, J.A., McNally, C., Manoogian, S.J., and Duma, S.M., Dynamic material Properties of the Human Sclera. *Journal of Biomechanics*. 42(10):1493-1497, 2009.
71. Bisplinghoff, J.A., McNally, C., and Duma, S.M., High-rate internal pressurization of human eyes to predict globe rupture. *Archives of Ophthalmology*. 127(4):520-523, 2009.
72. Kennedy, E.A., and Duma, S.M., The effects of the extraocular muscles on eye impact force-deflection and globe rupture response. *Journal of Biomechanics*. 41(16):3297-3302, 2008.
73. Stitzel, J.D., Hansen, G.A., Herring, I.P., and Duma, S.M., Blunt trauma of the aging eye: injury mechanisms and increasing lens stiffness. *Archives of Ophthalmology*. 123(6):789-794, 2005.
74. Duma, S.M., Ng, T.P., Kennedy, E.A., Stitzel, J.D., Herring, I.P. and Ferenc, K., Determination of significant parameters for eye injury risk from projectiles. *Journal of Trauma*. 59:960-964, 2005.
75. Stitzel, J., A. Kemper and S. Duma. Myopia and hyperopia's effect on probability of globe rupture due to a foreign body impact. *Investigative Ophthalmology & Visual Science*. 46:2005.
76. Duma, S.M., Rath, A.L., Jernigan, M.V., Stitzel, J.D., and Herring, I.P., The Effects of Depowered Airbags on Eye Injuries in Frontal Automobile Crashes. *American Journal of Emergency Medicine*. 23(1):13-19, 2005.
77. Duma, S.M., and Jernigan, M.V., The effects of airbags on orbital fracture patterns in frontal automobile crashes. *Ophthalmic Plastic and Reconstructive Surgery*. 19(2):107-111, 2003.
78. Power, E., Duma, S., Stitzel, J., Herring, I., West, R., "Investigation of Ocular Injuries from High Velocity Objects in an Automobile Collision," SAE Transactions: Journal of Passenger Cars, Vol. 112, Section 6, pp. 2019-2027, 2003.
79. Power, E.D., Duma, S.M., Stitzel, J.D., Herring, I.P., West, R.L., Bass, C.R., Crowley, J.S., and Brozoski, F.T., Computer Modeling of Airbag Induced Ocular Injury in Pilots Wearing Night Vision Goggles. *Aviation Space and Environmental Medicine*. 73(10):1000-1006, 2002.
80. Duma, S.M., Jernigan, M.V., Stitzel, J.D., Herring, I.P., Crowley, J.S., Brozoski, F.T., and Bass, C.R., The Effect of Frontal Airbags on Eye Injury Patterns in Automobile Crashes. *Archives of Ophthalmology*. 120(11):1517-1522, 2002.
81. Duma, S.M., and Crandall, J.R., Eye Injuries from Air Bags with Seamless Module Covers. *Journal of Trauma*. 48(4):786-789, 2000.
82. Vinger, P.F., Duma, S.M., and Crandall, J.R., Baseball Hardness as a Risk Factor for Eye Injuries. *Archives of Ophthalmology*. 117:354-358, 1999.
83. Duma, S.M., Kress, T.A., Porta, D.J., Woods, C.D., Snider, J.N., Fuller, P.M., and Simmons, R.J., Air Bag Induced Eye Injuries: A Report of 25 Cases. *The Journal of Trauma*. 41(1):114-119, 1996.
84. Alphonse VD, Kemper AR, Rowson S, Duma SM. Eye injury risk associated with remote control toy helicopter blades. *Biomed Sci Instrum*. 2012
85. Bisplinghoff, J.A., and Duma, S.M., Evaluation of eye injury risk from projectile shooting toys using the FOCUS headform. *Biomed Sci Instrum*. 45:107-112, 2009.
86. Taylor, L. A., Danelson, K. A., Gayzik, F. S., Loftis, K.L., Stitzel, J.D. "Physical Model Reproduction from CT Scans Classified According to Gender, Ethnicity, and Age." *Biomedical Sciences and Instrumentation*, 2009; 45: 370-5.
87. Kennedy, E.A., Stitzel, J.D., and Duma, S.M., Matched Experimental and Computational Simulations of Paintball Eye Impacts. *Biomed Sci Instrum*. 44:243-248, 2008.
88. Bisplinghoff, J.A., McNally, C., Yang, S., Herring, I.P., Brozoski, F.T., and Duma, S.M., High rate internal pressurization of the human eye to determine dynamic rupture pressure. *Biomed Sci Instrum*. 44:117-122, 2008.
89. Bisplinghoff, J.A., McNally, C., Brozoski, F.T., and Duma, S.M., Dynamic Material Property Measurements of Human Eyes. *Biomed Sci Instrum*. 44:177-182, 2008.
90. Kennedy, E.A., Inzana, J.A., McNally, C., Duma, S.M., Depinet, P.J., Sullenberger, K.H., Morgan, C.R., and Brozoski, F.T., Development and validation of a synthetic eye and orbit for estimating the potential for globe rupture due to specific impact conditions. *Stapp Car Crash Journal*. 51:381-400, 2007.
91. Kennedy, E.A., McNally, C., and Duma, S.M., Experimental Techniques for Measuring the Biomechanical Response of the Eye During Impact. *Biomed Sci Instrum*. 43:7-12, 2007.
92. Kennedy, E.A., Ng, T.P., and Duma, S.M., Evaluating Eye Risk Injury of Airsoft Pellet Guns by Parametric Risk Functions. *Biomed Sci Instrum*. 42:7-12, 2006.

93. Kennedy, E.A., Bonivitch, A.R., Manoogian, S.J., Stitzel, J.D., Herring, I.P., and Duma, S.M., The Effects of Extraocular Muscles on Static Displacements of the Human Eye. *Biomed Sci Instrum.* 42:372-377, 2006.
94. Kennedy, E.A., Ng, T.P., McNally, C., Stitzel, J.D., and Duma, S.M., Risk functions for human and porcine eye rupture based on projectile characteristics of blunt objects. *Stapp Car Crash Journal.* 50:651-671, 2006.
95. Hansen, G.A., Stitzel, J.D., and Duma, S.M., The incidence of elderly eye injuries in automobile crashes: the effects of lens stiffness as a function of age. *Annals of Advances in Automotive Medicine.* 47:147-163, 2003.
96. Duma, S., Jernigan, M., Stitzel, J., Herring, I., "Eye Injury Incidence and Mechanisms in Automobile Crashes," Proceedings of the 18th International Technical Conference on the Enhanced Safety of Vehicles, Nagoya, Japan, May, 2003.
97. Stitzel, J.D., Duma, S.M., Cormier, J.M., and Herring, I.P., A Nonlinear Finite Element Model of the Eye with Experimental Validation for the Prediction of Globe Rupture. *Stapp Car Crash Journal.* 46:81-102, 2002.
98. Duma, S.M., Kress, T.A., Porta, D.J., Simmons, R.J., Alexander, C.L., Woods, C.D., Airbag-Induced Eye Injuries: Experiments with In Situ Cadaver Eyes. *Biomed Sci Instrum.* 33:106-111, 1997.
99. Duma, S.M., Kress, T.A., Porta, D.J., Simmons, R.J., Alexander, C.L., An experimental study of airbag impact to the orbit using an instrumented Hybrid III headform. *Biomed Sci Instrum.* 33:59-64, 1997.
100. Gayzik, F.S., Bostrom, O., Ortenwall, P., Duma, S.M., and Stitzel, J.D., An experimental and computational study of blunt carotid artery injury. *Annals of Advances in Automotive Medicine.* 50:13-32, 2006.
101. Manoogian, S.J., Kennedy, E.A., Wilson, K.A., Duma, S.M., Alem, N.M. Predicting Neck Injuries Due to Head-Supported Mass. *Aviation, Space, and Environmental Medicine.* 77(5):509-514, 2006.
102. Duma, S.M., Crandall, J.R., Rudd, R.W., and Kent, R.W. Small female head and neck interaction with a deploying side airbag. *Accident Analysis and Prevention.* 35(5):811-816, 2003.
103. Duma, S.M., Crandall, J.R., Seki, K., and Aoki, T., Comparison of the Q3 and Hybrid III 3 Year Old Dummy Head and Neck Response During Side Air Bag Loading. *Proceedings of the Institution of Mechanical Engineers Part D - Journal of Automobile Engineering.* 214(D7):675-684, 2000.
104. Duma, S.M., Crandall, J.R., Pilkey, W.D., Seki, K., and Aoki, T., Dynamic Response of the Hybrid III 3 Year Old Dummy Head and Neck During Side Air Bag Loading. *Proceedings of the Institution of Mechanical Engineers Part D - Journal of Automobile Engineering.* 213(D5):471-480, 1999.
105. Stitzel, J.D., Danelson, K.A., Gayzik, F.S., Yu, M.M., Martin, R.S., and Duma, S.M., Bilateral carotid artery injury response in side impact using a vessel model integrated with a human body model. *Annals of Advances in Automotive Medicine.* 53:271-278, 2009.
106. Danelson, K.A., Gayzik, F.S., Yu, M.M., Duma, S.M., Stitzel, J.D. A Regional finite element model of the neck for bilateral carotid artery injury assessment in far side crash configuration, SAE Digital Human Modeling, Gothenburg, Sweden (09DHM-0049), June 2009.
107. Duma, S.M., Kemper, A.R., and Porta, D.J., Biomechanical Response of the Human Cervical Spine. *Biomed Sci Instrum.* 44:135-140, 2008.
108. Kemper AR, McNally C, Manoogian SJ, McNeely DM, and Duma SM. Stiffness Properties of Human Lumbar Intervertebral Discs in Compression and the Influence of Strain Rate. *Proceedings of the 20<sup>th</sup> Enhanced Safety of Vehicles Conference*, Lyon, France. Paper Number: 07-0471, 2007.
109. Lambert, C.C., Gayzik, F.S., Stitzel, J.D., "Characterization of the carotid and adjacent anatomy using non-contrast CT for biomechanical model development," *Biomedical Sciences and Instrumentation* April 2007; 43: 330-5.
110. Kemper, A.R., McNally, C., and Duma, S.M., The Influence of Strain Rate on the Compressive Stiffness Properties of Human Lumbar Intervertebral Discs. *Biomed Sci Instrum.* 43:176-181, 2007.
111. Duma, S.M., Kemper, A.R., McNeely, D.E., Brolinson, P.G., and Matsuoka, F., Biomechanical Response of the Lumbar Spine in Dynamic Compression. *Biomed Sci Instrum.* 42:476-481, 2006.
112. Gayzik, F.S., Tan, J.C., Duma, S.M., and Stitzel, J.D., Mesh Development for a Finite Element Model of the Carotid Artery. *Biomed Sci Instrum.* 42:187-192, 2006.
113. Ng, T.P., Bussone, W.R., Duma, S.M., and Kress T.A., Thoracic and Lumbar Spine Accelerations in Everyday Activities. *Biomed Sci Instrum.* 42:410-415, 2006.
114. Beeman, S.M., Kemper, A.R., Madigan, M.L., and Duma, S.M., Kinetic and Kinematic Responses of Post Mortem Human Surrogates and the Hybrid III ATD in High-Speed Frontal Sled Tests. *Accident Analysis and Prevention*, 55: 34-47. 2013.
115. Beeman, S.M., Kemper, A.R., Madigan, M.L., Franck, C.T., and Loftus, S.C. Occupant Kinematics in Low-Speed Frontal Sled Tests: Human Volunteers, Hybrid III ATD, and PMHS. *Accident Analysis and Prevention.* 47: 128-139. 2012.

116. Beeman, S.M., Kemper, A.R., Madigan, M.L., and Duma, S.M. Effects of Bracing on Human Kinematics in Low-Speed Frontal Sled Tests. *Annals of Biomedical Engineering*. 39(12): 2998-3010, 2011.
117. Kemper, A.R., Kennedy, E.A., McNally, C., Manoogian, S.J., Stitzel, J.D., and Duma, S.M. Reducing Chest Injuries in Automobile Collisions: Rib Fracture Timing and Implications for Thoracic Injury Criteria. *Annals of Biomedical Engineering*. 39(8):2141-2151, 2011.
118. Duma, S.M., Kemper, A.R., Stitzel, J.D., McNally, C., Kennedy, K.A., Matsuoka, F. Rib Fracture Timing in Dynamic Belt Tests with Human Cadavers. *Clinical Anatomy*. 24(3):327-338, 2011.
119. Stitzel JD, Kilgo PD, Weaver AA, Martin RS, Loftis KL, Meredith JW. Age thresholds for increased mortality of predominant crash induced thoracic injuries. *Ann Adv Automot Med*. 2010; 54:41-50.
120. Gayzik, F.S., Martin, R.S., Gabler, H.C., Hoth, J.J., Duma, S.M., Meredith, J.W., and J.D. Stitzel. Characterization Of Crash Induced Thoracic Loading Resulting In Pulmonary Contusion. *Journal of Trauma*. 66(3):840-849, 2009.
121. Kemper AR, Stitzel JD, McNally C, Gabler HC, and Duma SM. Biomechanical Response of the Human Clavicle: The Effects of Loading Direction on Bending Properties. *Journal of Applied Biomechanics*, 25(2): 165-174, 2009.
122. Gayzik FS, Yu M, Danelson KA, Slice DE, Stitzel JD, "Quantification of age-related change of the human rib cage through geometric morphometrics," *J. Biomech*; 41(7):1545-54, 2008.
123. Bolin, D, Kemper A, and Brolinson P Current Concepts in the Evaluation and Management of Stress Fractures. *Current Sports Medicine Report*, 4(6): 295-300. 2005.
124. doi: 10.1097/01.CSMR.0000306289.98127.23
125. Stitzel, J.D., Gayzik, F.S., Hoth, J.J., Mercier, J., Gage, H.D., Morton, K.A., Duma, S.M., and Payne,R.M., Development of a finite element-based injury metric for pulmonary contusion part I: model development and validation. *Stapp Car Crash Journal*. 49:271-289, 2005.
126. Stitzel, J.D., Barretta, J.T., and S.M. Duma. Predicting fractures due to blunt impact: a sensitivity analysis of the effects of altering failure strain of human rib cortical bone. *International Journal of Crashworthiness*. 9(6):633-642, 2004.
127. Kent, R.W., Crandall, J.R., Bolton, J.R., Duma, S.M., Comparison and evaluation of contemporary restraint systems in the driver and front-passenger environments. *Proceedings of the Institution of Mechanical Engineers Part D - Journal of Automobile Engineering*. 215(D11):1147-1159, 2001.
128. Weaver AA, Armstrong EG, Moody EA, Stitzel JD. "Image Segmentation and Registration Algorithm to Collect Homologous Landmarks for Age-Related Thoracic Morphometric Analysis." 22<sup>nd</sup> Enhanced Safety of Vehicles Conference Proceedings, Washington, DC, June 2011.
129. Weaver AA, Moody EA, Armstrong EG, Stitzel JD. "Image Segmentation and Registration Algorithm to Collect Homologous Landmarks for Age-Related Thoracic Morphometric Analysis." *Biomed Sci Instrum*. 2011;47:70-5.
130. Kemper AR, Beeman SM, and Duma SM. Effects of Pre-Impact Bracing on Chest Compression of Human Occupants in Low Speed Frontal Sled Tests. *Proceedings of the 22<sup>nd</sup> Enhanced Safety of Vehicles Conference*, Washington, DC, USA. Paper Number: 11-0193, 2011.
131. Kemper, A.R., McNally, C., and Duma, S.M., Load Transfer and Deformation Characteristics of the Pelvis in Non-Destructive Side Impact Testing. In: *Proceedings of the 21<sup>st</sup> Enhanced Safety of Vehicles Conference*. Stuttgart, Germany, 2009, Paper number: 09-0508.
132. Kemper, A.R., McNally, C., and S.M. Duma. The Effect of the Periosteum and Strain Gages on the Structural Response of Human Ribs. *Biomed Sci Instrum*. 45:12-17, 2009.
133. Kemper AR, McNally C, and Duma SM. Acquiring Non-Censored Pelvic Bone Fracture Data during Dynamic Side Impact Loading. *Biomedical Sciences Instrumentation*, 45: 395-400, 2009.
134. Kemper, A.R., McNally, C., Kennedy, E.A., Manoogian, S.J., and S.M. Duma. The influence of arm position on thoracic response in side impacts. *Stapp Car Crash Journal*. 52:379-420, 2008.
135. Kemper, A.R., McNally, C., and S.M. Duma. Dynamic Tensile Material Properties of Human Pelvic Cortical Bone. *Biomed Sci Instrum*. 44:417-418, 2008.
136. Kemper, A.R., McNally, C., Manoogian, S.J., and S.M. Duma. Tensile Material Properties of Human Tibia Cortical Bone: Effects of Orientation and Loading Rate. *Biomed Sci Instrum*. 44:419-427, 2008.
137. Kemper, A.R., McNally, C., and S.M. Duma. Dynamic Compressive response of the Human Pelvis: Axial Loading of the Sacroiliac Joint. *Biomed Sci Instrum*. 44:171-176, 2008.
138. Kemper, A.R., McNally C., Pullins, C.A., Freeman, L.J., Duma, S.M. and S.M. Rouhana. The biomechanics of human ribs: material and structural properties from dynamic tension and bending tests. *Stapp Car Crash Journal*. 51:235-273, 2007.

139. Kemper AR, McNally C, Kennedy EA, Manoogian SJ, and Duma SM. The Material Properties of Human Tibia Cortical Bone in Tension and Compression: Implications for the Tibia Index. *Proceedings of the 20<sup>th</sup> Enhanced Safety of Vehicles Conference*, Lyon, France. Paper Number: 07-0470, 2007.
140. Gayzik, F.S., Loftis, K.L., Slice, D.E., Stitzel, J.D., "A finite element study of age-based size and shape variation in the human rib cage," *Biomedical Sciences and Instrumentation*. 2006; 42:19-24
141. Kemper, A.R., Ng, T.P., and S.M. Duma. The Biomechanical Response of Human Bone: The Influence of Bone Volume and Mineral Density. *Biomed Sci Instrum*. 42:284-289, 2006.
142. Kemper AR, Stitzel JD, Gabler HC, and Duma SM. Biomechanical Response of the Human Clavicle Subjected to Dynamic Bending. *Biomedical Sciences Instrumentation*, 42: 231-236, 2006.
143. Duma SM, Kemper AR, McNally C, Kennedy EA, Rath AL, Manoogian SJ, and Stitzel JD. Non-Censored Rib Fracture Data from Dynamic Belt Loading Tests on the Human Cadaver Thorax. *Proceedings of the 19<sup>th</sup> Enhanced Safety of Vehicles Conference*, Washington, DC, United States. Paper Number: 05-0360, 2005.
144. Kemper, A.R., McNally, C., Kennedy, E.A., Manoogian, S.J., Rath, A.L., Ng, T.P., Stitzel, J.D., Smith, E.P., Duma, S.M., and F. Matsuoka. Material properties of human rib cortical bone from dynamic tension coupon testing. *Stapp Car Crash Journal*. 49:199-230, 2005.
145. Cormier, J.M., Stitzel, J.D., Duma, S.M., and F. Matsuoka. Regional variation is the structural response and geometrical properties of human ribs. *Annals of Advances in Automotive Medicine*. 49:153-170, 2005.
146. Stitzel, J.D., Cormier, J.M., Barretta, J.T., Kennedy, E.A., Smith, E.P., Rath, A.L., Duma, S.M., and F. Matsuoka. Defining regional variation in the material properties of human rib cortical bone and its effect on fracture prediction. *Stapp Car Crash Journal*. 47:243-265, 2003.
147. Duma, S.M., Stitzel, J.D., Ryan, L.P., and Crandall, J.R., Determination of Bone Mineral Content in Cadaveric Test Specimens. *Journal of the Southern Orthopedic Association*. 11(3):128-134, 2002.
148. Kemper, A.R., Santago, A.C., Stitzel, J.D., Sparks, J.L., and Duma, S.M., Effect of Strain Rate on the Material Properties of Human Liver Parenchyma in Unconfined Compression. *Journal of Biomechanical Engineering*, (In press)
149. Hayes, AR, Gayzik FS, Moreno DP, Martin RS, Stitzel, JD. "Comparison of Organ Location, Morphology, and rib coverage of a midsized male in the supine and seated positions". *Comput Math Methods Med*. 2013;419821. Doi: 10.1155/2013/419821. Epub 2013 Mar 27 PMID: 23606901 (in process)
150. Becher, R., Colonna A.L., Enniss T.M., Weaver A.A., Crane D.K., Martin R.S., Mowery N.T., Miller P.R., Stitzel J.D., Hoth J.J. "An Innovative Approach to Predict the Development of Adult Respiratory Distress Syndrome in Patients with Blunt Trauma." *Journal of Trauma and Acute Care Surgery*, 2012 Nov. 73(5):1229-35.
151. Weaver, A.A., Danelson, K.A., Armstrong, E.G., Hoth, J.J., Stitzel, J.D. "Investigation of pulmonary contusion extent and its correlation to crash, occupant, and injury characteristics in motor vehicle crashes." *Accident Analysis & Prevention*, April 2012, doi: 10.1016/j.aap.2012.04.013.
152. Danelson, K.A., Chiles, C., Thompson, A.B., Donadino, K., Weaver, A.A., Stitzel, J.D., "Correlating the extent of pulmonary contusion to vehicle crash parameters in near-side crashes," *Ann Adv Automot Med*. 2011;55:217-230.
153. Danelson, K.A., Gayzik, F.S., Stern, A.R., Hoth, J.J., Stitzel, J.D., Design, development and analysis of a pulmonary surrogate for pulmonary injury prediction. *Annals of Biomedical Engineering*, 2011; 39(10): 2560-2567.
154. Gayzik, F.S, Hoth, J.J, Stitzel, J.D. Finite element-based injury metrics for pulmonary contusion via concurrent model optimization. *Biomech Model Mechanobiol*. 2011; 10(4): 505-20. Epub 2010 Aug 25.
155. Kemper, A.R., Santago, A.C., Stitzel, J.D., Sparks, J.L., and Duma, S.M., Biomechanical Response of Human Spleen in Tensile Loading. *Journal of Biomechanics*. 45(2): 348-355, 2011. DOI: 10.1016/j.jbiomech.2011.10.022.
156. Kemper, A.R., Santago, A.C., Stitzel, J.D., Sparks, J.L., Duma, S.M., Biomechanical response of human liver in tensile loading. *Annals of Advancement of Automotive Medicine*. 54:15-26, 2010.
157. Daly M, Miller PR, Carr J, Gayzik FS, Hoth J, Meredith JW, Stitzel JD, "Traumatic Pulmonary Pathology Measured with Computed Tomography and a Semi-Automated Analytic Method," *Clinical Imaging* 2008; 32(5): 346-54.
158. Hoth, J.J., Stitzel, J.D., Gayzik, F.S., Brownlee, N.A., Miller, P.R., Yoza, B.K., McCall, C.E., Meredith, J.W., Payne, R.M., "The pathogenesis of pulmonary contusion: an open chest model in the rat," *J Trauma*. 2006 Jul; 61(1):32-44; discussion 44-5.

159. Anderson, SA; Danelson, KA; Mammarrappallil, JG; Chiles, C; Stitzel, JD. "Semiautomatic Method of Quantifying Pleural Effusions Using Computed Tomography Scans." *Biomed Sci Instrum.* 2013 Apr 5; 49:13-19.
160. Rhyne, AC; Gayzik, FS; Moreno, DP; Stitzel, JD. "Methods for Comparison of Abdominal Organ Location and Shape in the Supine and Upright Positions." *Biomedical Sciences and Instrumentation*, 2012;48:351-8.
161. Kemper, A.R., Santago, A.C., Stitzel, J.D., Sparks, J.L., and Duma, S.M., (2011) Multi-Scale Biomechanical Characterization of Human Liver and Spleen. *Proceedings of the 22<sup>nd</sup> Enhanced Safety of Vehicles Conference*, Washington, DC, USA. Paper Number: 11-0195.
162. Brown PJ, Huan T, Stitzel JD. "Displacement Control Device for Dynamic Tissue Deformation in MRI." *Biomed Sci Instrum*, 2010; 46:99-104.
163. Santago, A.C., Kemper, A.R., McNally, C., Sparks, J.L., and Duma, S.M., The effect of temperature on the mechanical properties of bovine liver. *Biomed Sci Instrum.* 45:24-29, 2009.
164. Weaver AA, Gayzik FS, Stitzel JD. Biomechanical analysis of pulmonary contusion in motor vehicle crash victims: a crash injury research and engineering network (CIREN) study - biomed 2009. *Biomed Sci Instrum.* 2009;45:364-9.
165. Santago A.C., Kemper A.R., McNally C., Sparks J.L., and Duma, S.M., Freezing Affects the Mechanical Properties of Bovine Liver. *Biomed Sci Instrum.* 45:376-381, 2009.
166. Bisplinghoff, J.A., and Duma, S.M., The effect of stress and strain formulations on the representation of biological tissue mechanical properties. *Biomed Sci Instrum.* 45:389-394, 2009.
167. Gayzik, F.S., Hoth, J.J., Stitzel, J.D., "Quantitative histology of contused lung tissue with comparison to computed tomography." *Biomed Sci Instrum.* 2008; 44:225-30.
168. Danelson, K.A., Stitzel, J.D. "Volumetric Splenic Injury Measurement in CT Scans for Comparison with Injury Score," *Biomedical Sciences and Instrumentation*, 2008; 44.
169. Gayzik, F.S., Hoth, J.J., Stitzel, J.D., "A comparative study of optimization techniques for tuning a finite element model of the lung to biomechanical data," *Biomedical Sciences and Instrumentation*; April 2007; 43: 212-7.
170. Danelson, K.A., Hoth, J.J., Miller, P.R., Stitzel, J.D. "A Semi-automated Approach for Measuring Splenic Injury Using Computed Tomography." *Biomedical Sciences and Instrumentation*, 2007; 43, 13-17.
171. Kemper, A.R., McNally, C., Smith, B., and Duma, S.M., Quasi-Linear Viscoelastic Characterization of Human Hip Ligaments. *Biomed Sci Instrum.* 43:324-329, 2007.
172. Gayzik, F.S., Hoth, J.J., Daly, M.D., Meredith, J.W., Stitzel, J.D., "A Finite Element-Based Injury Metric for Pulmonary Contusion: investigation of candidate metrics through correlation with computed tomography," *Stapp Car Crash Journal*; 51: 189-209, 2007.
173. Kennedy, E.A., Tordonado, D.S., and Duma, S.M., Effects of Freezing on the Mechanical Properties of Articular Cartilage. *Biomed Sci Instrum.* 43:342-347, 2007.
174. Duma, S.M., Stitzel, J.D., Kemper, A.R., McNally, C., Kennedy, E.A., and Brolinson, P.G., Acquiring Non-Censored Rib Fracture Data During Dynamic Belt Loading. *Biomed Sci Instrum.* 42:148-153, 2006.
175. Lu Y-C, Kemper A.R., Untaroiu, C.D. (2013) Effect of Storage on Tensile Material Properties of Bovine Liver, *Journal of the Mechanical Behavior of Biomedical Materials*.
176. Untaroiu, C.D. (2013) The influence of the specimen shape and loading conditions on the parameter identification of a viscoelastic brain model, *Computational and Mathematical Methods in Medicine*, vol. 2013, Article ID 460413, 7 pages.
177. Untaroiu, C.D., Lu Y-C, Kemper R.A. (2013) Modeling the Biomechanical and Injury Response of Human Liver Parenchyma under Tensile Loading, *Proceeding of the IRCOBI Conference*, Goteborg, Sweden.
178. Lu, Y-C, Untaroiu C.D. (2013) Statistical shape analysis of clavicular cortical bone with applications in development of percentile models, *Computer Methods and Programs in Biomedicine*, 111(3): 613-628.
179. Untaroiu, C.D. Lu Y-C, (2013) Material characterization of liver parenchyma using specimen-specific finite element models and optimization techniques, *Journal of the Mechanical Behavior of Biomedical Materials*, 26(10) 11-22.
180. Lu, Y-C, Untaroiu C.D. (2013) Effect of Storage Methods on Indentation-based Material Properties of Abdominal Organs due to Tissue Storage Methods, *Journal of Engineering in Medicine*, Proc IMechE- Part H, 227(3):293-301.
181. Lu Y-C, Untaroiu, C.D. (2012), Freezing and Decay effects on Material Properties of Porcine Kidney and Liver, *Biomedical Sciences Instrumentation*, 48: 275-281.

182. Untaroiu, C.D., Bose, D., Lu, Y-C, Riley P., Lessley D., Sochor M. (2012) Effect of seat belt pretensioners on human abdomen and thorax: biomechanical response and risk of injuries, *Journal of Trauma and Acute Care Surgery*, 72(5):1304-1315.
183. Lu, Y.C., Untaroiu, C.D.\* (2012) A Bootstrap Approach for Lower Injury Levels of the Risk Curves. *Computer Methods and Programs in Biomedicine*, 106(3): 274-286.
184. Manoogian SJ, Bisplinghoff JA, Kemper AR, and Duma SM (2012) Dynamic Material Properties of Human Uterus. *Journal of Biomechanics*, doi:10.1016/j.jbiomech.2012.04.001.
185. Manoogian, S.J., Bisplinghoff, J.A., McNally, C., Kemper, A.R., Santago, A.C. and Duma, S.M., Effect of strain rate on the tensile material properties of human placenta. *Journal of Biomechanical Engineering*, 131(9):091008, 2009.
186. Manoogian, S.J., Bisplinghoff, J.A., McNally, C., Kemper, A.R., Santago, A.C., and Duma, S.M., Dynamic tensile properties of human placenta. *Journal of Biomechanics*. 41(16):3436-3440, 2008.
187. Moorcroft, D.M., Stitzel, J.D., Duma, G.G. and S.M. Duma, S.M. Computational model of the pregnant occupant: predicting the risk of injury in automobile crashes. *American Journal of Obstetrics and Gynecology*, 189(2):540-544, 2003.
188. Moorcroft, D.M., Stitzel, J.D., Duma, S., and Duma, G.G., The effects of uterine ligaments on the fetal injury risk in frontal automobile crashes. *Proceedings of the Institution of Mechanical Engineers Part D - Journal of Automobile Engineering*. 217(D):1049-1055, 2003.
189. Duma, S.M., Pregnant Occupant Biomechanics: Advances in Automobile Safety Research (2010) Published by the Society of Automotive Engineers, Warrendale PA.
190. Yu, M.M., Manoogian, S.J., Duma, S.M. and Stitzel, J.D., Finite element modeling of human placental tissue. *Annals of Advances in Automotive Medicine*. 53:257-270, 2009.
191. Manoogian, S.J., McNally, C., Stitzel, J.D., and Duma, S.M., Dynamic biaxial tissue properties of pregnant porcine uterine tissue. *Stapp Car Crash Journal*. 52:167-185, 2008.
192. Duma, S.M., Gabler, H.C., Moorcroft, D.M., Manoogian, S.J., Stitzel, J.D., and Duma, G.G., Analysis of pregnant occupant exposure and the potential effectiveness of four-point seatbelts in far side crashes. *Annals of Advances in Automotive Medicine*. 50:187-198, 2006.
193. Duma, S.M., Moorcroft, D.M., Stitzel, J.D., Duma, G.G., Biomechanical modeling of pregnant occupants in far-side vehicle crashes. *Biomed Sci Instrum*. 4:154-159, 2006.
194. Manoogian, S.J., Moorcroft, D.M., and Duma, S.M., Evaluation of Pregnant Female Injury Risk During Everyday Activities. *Biomed Sci Instrum*. 44:183-188, 2008.
195. Manoogian, S.J., Duma, S.M., and Moorcroft, D.M., Pregnant Occupant Injury Risk in Severe Frontal Crashes Using Computer Simulations. *Biomed Sci Instrum*. 44:249-255, 2008.
196. Loftis, K.L., Halsey, M.G., Anthony, E.Y. Duma, S.M., and Stitzel, J.D., Pregnant Female Anthropometry from CT Scans for Finite Element Model Development. *Biomed Sci Instrum*. 44:355-360, 2008.
197. Manoogian, S.J., McNally, C., Calloway, B., and Duma, S.M., Methodology for Dynamic Biaxial Tension Testing of Pregnant Uterine Tissue. *Biomed Sci Instrum*. 43:230-235, 2007.
198. Manoogian, S.J., McNally, C., Calloway, B., Duma, S.M., and Mertz, H., Utilizing Cryogenic Grips for Dynamic Tension Testing of Human Placenta Tissue. *Biomed Sci Instrum*. 43:354-359, 2007.
199. S. Duma, D. Moorcroft, J. Stitzel, G. Duma, "A Computational Model of the Pregnant Occupant: Effects of Restraint Usage and Occupant Position on Fetal Injury Risk," Proceedings of the International Technical Conference on the Enhanced Safety of Vehicles, 2005.
200. Moorcroft, D., Stitzel, J., Duma, S., Duma, G., "The Effect of Pregnant Occupant Position and Belt Placement on the Risk of Fetal Injury," Paper Number 2004-01-0324, Society of Automotive Engineers International Congress and Exposition, Detroit, Michigan, March, 2004.
201. Duma, S.M., Moorcroft, D.M., Stitzel, J.D., and Duma, G.G., Evaluating pregnant occupant restraint effectiveness: the effect of local uterine compression on the risk of fetal injury. *Ann P Ass Adv Automo*. 48:103-114, 2004.
202. Moorcroft, D., Duma, S., Stitzel, J., Duma, G., "A Finite Element and Multi-body Model of the Pregnant Female Occupant for the Analysis of Restraint Effectiveness," Society of Automotive Engineers International Congress and Exposition, Detroit, Michigan, March, 2003.
203. Plate, JF; Brown, PH; Walters, J; Clark, J; Smith, TL; Freehill, MT; Tuohy, CJ; Stitzel, JD; Mannava, S. "Advanced Age Diminishes Tendon-To-Bone Healing in a Rat Model of Rotator Cuff Repair." *Journal of Bone and Joint Surgery*, 2013 February. Submitted
204. Kemper, A.R., Response Corridors for the Medial-Lateral Compressive Stiffness of the Human Arm: Implications for Side Impact Protection. *Accident Analysis and Prevention*, 50: 204-222, 2013.

205. DOI: 10.1016/j.aap.2012.04.014.
206. Kemper, A.R., Stitzel, J.D., McNally, C., Gabler, H.C., and S.M. Duma. Biomechanical Response of the Human Clavicle: The Effects of Loading Direction on Bending Properties. *Journal of Applied Biomechanics*. 25(2):165-174, 2009.
207. Kemper, A.R., McNally, C., Kennedy, E.A., Manoogian, S.J., and Duma, S.M., The Influence of Arm Position on Thoracic Response in Side Impacts. *Stapp Car Crash Journal*, 52: 379-420, 2008.
208. McGwin, G., Modjarrad, K., Duma, S., Rue, L., Association between upper extremity injuries and side airbag availability. *Journal of Trauma-Injury Infection and Critical Care*. 64(5):1297-1301, 2008.
209. DOI: 10.1097/TA.0b013e3181271b21
210. Rath, A.L., Jernigan, M.V., Stitzel, J.D., and Duma, S.M., The effects of depowered airbags on skin injuries in frontal automobile crashes. *Plastic and Reconstructive Surgery*. 115(2):428-435, 2005.
211. Duma, S.M., Cormier, J.C., Hurst, W.J., Stitzel, J.D., Herring, I.P., Experimental Analysis of Airbag Seam Design: High-Rate Shear Testing for Skin Abrasions, *Journal of Automobile Engineering*
212. DOI: 10.1177/0954407011421421
213. Hurst, W.J., Cormier, J.M., Stitzel, J.D., Jernigan, M.V., Moorcroft, D.M., Herring, I.P., Duma, S.M., "A New Methodology for Investigating Airbag-induced Skin Abrasions," *Proceedings of the Institution of Mechanical Engineers Part D - Journal of Automobile Engineering* Vol. 219 (D5):599-605, 2005.
214. 10.1243/095440705X11158
215. Jernigan, M.V., and Duma, S.M., Analysis of burn injuries in frontal automobile crashes. *Journal of Burn Care and Rehabilitation*. 25(4):357-362, 2004.
216. Jernigan, M.V., Rath, A.L., and Duma, S.M., Severe upper extremity injuries in frontal automobile crashes: the effects of depowered airbags. *American Journal of Emergency Medicine*. 23(2):99-105, 2005.
217. Jernigan, M.V., and Duma, S.M., The effects of airbag deployment on severe upper extremity injuries in frontal automobile accidents. *American Journal of Emergency Medicine*. 21(2):100-105, 2003.
218. Duma, S.M., Boggess, B.M., Crandall, J.R., and MacMahon, C.B., Injury risk function for the small female wrist in axial loading. *Accident Analysis and Prevention*. 35(6):869-875, 2003.
219. Duma, S.M., Boggess, B.M., Crandall, J.R., Hurwitz, S.R., Seki, K. and Aoki, T., Upper extremity interaction with a deploying side airbag: a characterization of elbow joint loading. *Accident Analysis and Prevention*. 35(3):417-425, 2003.
220. Bass, C.R., Duma, S.M., Crandall, J.R., George, S., Kuppa, S., Khaewpong, N., Sun, E., and Eppinger, R., The interaction of air bags with upper extremity test devices. *Proceedings of the Institution of Mechanical Engineers Part D - Journal of Automobile Engineering*. 216(D10):795-803, 2002.
221. Duma, S.M., Schreiber, P., McMaster, J.D., Crandall, J.R., and Bass, C.R., Fracture Tolerance of the Male Forearm: the Effect of Pronation Versus Supination. *Proceedings of the Institution of Mechanical Engineers Part D - Journal of Automobile Engineering*. 216(D8):649-654, 2002.
222. Duma, S.M., Crandall, J.R., Pilkey, W.D., Seki, K., and Aoki, T., Fifth percentile dummy upper extremity interaction with a deploying side air bag. *Proceedings of the Institution of Mechanical Engineers Part D - Journal of Automobile Engineering*. 217(D2):79-86, 2003.
223. Stitzel, J. Duma, S., Crandall, C., Bass, C., "Filter Class Selection for the Small Female Upper Extremity," SAE Transactions: Journal of Passenger Cars, Vol. 111, Section 6, pp. 1202-1216, 2003.
224. Duma, S.M., Schreiber, P.H., McMaster, J.D., Crandall, J.R., Bass, C.R., and Pilkey, W.D., Dynamic Injury Tolerance for Long Bones in the Female Upper Extremity. *Journal of Anatomy*. 194(3):463-471, 1999.
225. Kemper AR, McNally C, and Duma SM. Development of Stiffness Corridors for the Male and Female Arm. *Proceedings of the 21<sup>st</sup> Enhanced Safety of Vehicles Conference*, Stuttgart, Germany. Paper Number: 09-0506, 2009.
226. Kemper AR, McNally C, and Duma SM. Biofidelity of an Original and Modified SID-II's Upper Extremity: Matched Cadaver and Dummy Compression Tests. *Biomedical Sciences Instrumentation*, 44: 111-116, 2008.
227. Santago, A.C., Cormier, J.M., Duma, S.M., Yoganandan, N., and Pintar, F.A., Forearm Fracture Bending Risk Function for the 50<sup>th</sup> Percentile Male. *Biomed Sci Instrum*. 44:201-206, 2008.
228. Santago, A.C., Cormier, J.M., and Duma, S.M., Humerus Fracture Bending Risk Function for the 50<sup>th</sup> Percentile Male. *Biomed Sci Instrum*. 44:231-236, 2008.
229. Kemper AR, Stitzel JD, Gabler HC, and Duma SM. Biomechanical Response of the Human Clavicle Subjected to Dynamic Bending. *Biomedical Sciences Instrumentation*, 42: 231-236, 2006.
230. Kemper AR, Stitzel JD, Duma SM, Matsuoka F, and Mitsutoshi M. Biofidelity of the SID-II's and a Modified SID-II's Upper Extremity: Biomechanical Properties of the Human Humerus. *Proceedings of the 19<sup>th</sup> Enhanced Safety of Vehicles Conference*, Washington, DC, United States. Paper Number: 05-0123, 2005.

231. Duma, S.M., Hansen, G.A., Kennedy, E.A., Rath, A.L., McNally C., Kemper, A.R., Smith, E.P., Brolinson, P.G., Stitzel, J.D., Davis, M.B., Bass, C.R., Brozoski, F.T., McEntire, B.J., Alem, N.M. and Crowley, J.S., Upper extremity interaction with a helicopter side airbag: injury criteria for dynamic hyperextension of the female elbow joint. *Stapp Car Crash Journal*. 48:155-176, 2004.
232. Duma, S.M., Boggess, B.M., Crandall, J.R., and MacMahon, C.B., Fracture Tolerance of the Small Female Elbow Joint in Compression: The Effect of Load Angle Relative to the Long Axis of the Forearm. *Stapp Car Crash Journal*. 46:195-210, 2002.
233. Duma, S.M., Crandall, J.R., Hurwitz, S.R., and Pilkey, W.D., Small Female Upper Extremity Interaction with a Deploying Side Air Bag. Proceedings 42<sup>nd</sup> Stapp Car Crash Conference, Tempe, Arizona, November, 1998, Paper no.:983148.
234. Duma, S.M., Bass, C.R., Klopp, G.S., Grillo, N.R., Micek, T.J., Crandall, J.R., Pilkey, W.D., A Technique for Using Strain Gauges to Evaluate Airbag Interaction with Cadaveric Upper Extremities. *Biomedical Sciences Instrumentation*. 33:47-52, 1997.
235. Weaver AA, Loftis KL, Stitzel JD. "Investigation of the Safety Effects of Knee Bolster Airbag Deployment in Similar Real-World Crash Comparisons." *Traffic Injury Prevention*, 2013; 14(2): 168-80, doi: 10.1080/15389588.2012.697643.
236. Pilson H.; Brown P.J.; Stitzel, J.D.; Scott, A.T. "Single-Row Versus Double-Row Repair of the Distal Achilles Tendon: A Biomechanical Comparison." *The Journal of Foot and Ankle Surgery, Accepted*, July 2012.
237. Stubbs, A.J., Anz, A.W., Frino, J., Lang, J.E., Weaver, A.A., Stitzel, J.D. "Classic measures of hip dysplasia do not correlate with three-dimensional computer tomographic measures and indices." *Hip International*, 2011 Sept; 21(5):549-58.
238. Urban JE, Weaver AA, Theivendran K, Stitzel JD. "Acetabular Rim Profile Measurement in Femoroacetabular Impingement Patients." *Biomed Sci Instrum*. 2011;47:118-23.
239. Urban JE, Loftis KL, Stitzel JD. "Investigating injury mechanism and occupant bmi for malleolar fractures in frontal motor vehicle collisions - biomed 2010." *Biomed Sci Instrum*. 2010;46:320-5.
240. Weaver, A.A., Gilmartin, T.D., Anz, A.W., Stubbs, A.J., Stitzel, J.D. "A method to measure acetabular metrics from three dimensional computed tomography pelvis reconstructions." *Biomed Sci Instrum*;45: 155-60, 2009.
241. Kemper AR, McNally C, and Duma SM. Load Transfer and Deformation Characteristics of the Pelvis in Non-Destructive Side Impact Testing. *Proceedings of the 21<sup>st</sup> Enhanced Safety of Vehicles Conference*, Stuttgart, Germany. Paper Number: 09-0508, 2009.
242. Kemper AR, McNally C, and Duma SM. Acquiring Non-Censored Pelvic Bone Fracture Data during Dynamic Side Impact Loading. *Biomedical Sciences Instrumentation*, 45: 395-400, 2009.
243. Kemper AR, McNally C, and Duma SM Dynamic Tensile Material Properties of Human Pelvic Cortical Bone. *Biomedical Sciences Instrumentation*, 44: 417-422, 2008.
244. Kemper AR, McNally C, Manoogian SJ, and Duma SM. Tensile Material Properties of Human Tibia Cortical Bone: Effects of Orientation and Loading Rate. *Biomedical Sciences Instrumentation*, 44: 419-427, 2008.
245. Kemper AR, McNally C, and Duma SM. Dynamic Compressive Response of the Human Pelvis: Axial Loading of the Sacroiliac Joint. *Biomedical Sciences Instrumentation*, 44: 171-176, 2008.
246. Kemper AR, McNally C, Smith B, and Duma SM. Quasi-Linear Viscoelastic Characterization of Human Hip Ligaments. *Biomedical Sciences Instrumentation*, 43: 324-330, 2007.
247. Kemper AR, McNally C, Kennedy EA, Manoogian SJ, and Duma SM. The Material Properties of Human Tibia Cortical Bone in Tension and Compression: Implications for the Tibia Index. *Proceedings of the 20<sup>th</sup> Enhanced Safety of Vehicles Conference*, Lyon, France. Paper Number: 07-0470, 2007.
248. Daly, M., Duma, S.M., and Stitzel, J.D., Retrospective Identification of Subject Anthropometry Using Computed Tomography of the Leg. *Biomed Sci Instrum*. 42:114-119, 2006.
249. Kennedy, E.A., Hurst, W.J., Stitzel, J.D., Cormier, J.M., Hansen, G.A., Smith, E.P., and Duma, S.M., Lateral and Posterior Dynamic Bending of the Mid-Shaft Femur: Fracture Risk Curves for the Adult Population. *Stapp Car Crash Journal*. 48:27-51, 2004.
250. Untaroiu, C.D. Yue, N., Shin, J. (2013) A Finite Element Model of the Lower Limb for Simulating Automotive Impacts, *Annals of Biomedical Engineering*, 41(3): 513-526.
251. Shin, J., Yue, N., Untaroiu, C.D. (2012) A Finite Element Model of the Foot and Ankle for Automotive Impact Applications, *Annals of Biomedical Engineering*, 40(12): 2519-2531.
252. Beeman, S.M., Kemper, A.R., Madigan, M.L., and Duma, S.M., Kinetic and Kinematic Responses of Post Mortem Human Surrogates and the Hybrid III ATD in High-Speed Frontal Sled Tests. *Accident Analysis and Prevention*, 55: 34-47. 2013.

253. Vavalle, NA; Moreno, DP; Rhyne, AC; Stitzel, JD. "Lateral Impact Validation of a Geometrically Accurate Full Body Finite Element Model for Blunt Injury Prediction." *Annals of Biomedical Engineering*, 2013 Mar; 41 (3): 497-512. Doi: 10.1007/s10439-012-0684-3. Epub 2012 Nov. 8 PMID 23135331. (*in process*)
254. Gayzik, F.S., Moreno, D.P., Danelson, K.A., McNally, C., Klinich, K.D., Duma, S.M., Stitzel, J.D., External landmark, body surface and volume data of a mid-sized male in seated and standing postures. *Annals of Biomedical Engineering*, 2012 September; 40(9): 2019-2032, doi: 10.1007/s10439-012-0546-z.
255. Beeman, S.M., Kemper, A.R., Madigan, M.L., Franck, C.T., and Loftus, S.C. Occupant Kinematics in Low-Speed Frontal Sled Tests: Human Volunteers, Hybrid III ATD, and PMHS. *Accident Analysis and Prevention*. 47: 128-139. 2012.
256. Gayzik, F.S., Moreno, D.P., Geer, C.P., Wuertzer, D.S., Martin, R.S., Stitzel, J.D., Development of a full body CAD dataset for computational modeling: A multi-modality approach. *Annals of Biomedical Eng.* 2011; 39(10): 2568-2583.
257. Danelson KA, Bolte JH, Stitzel JD. Assessing astronaut injury potential from suit connectors using a human body finite element model. *Aviat Space Environ Med.* 2011 Feb;82(2):79-86.
258. Beeman, S.M., Kemper, A.R., Madigan, M.L., and Duma, S.M. Effects of Bracing on Human Kinematics in Low-Speed Frontal Sled Tests. *Annals of Biomedical Engineering*. 39(12): 2998-3010, 2011.
259. Kemper, A.R., Kennedy, E.A., McNally, C., Manoogian, S.J., Stitzel, J.D., and Duma, S.M. Reducing Chest Injuries in Automobile Collisions: Rib Fracture Timing and Implications for Thoracic Injury Criteria. *Annals of Biomedical Engineering*. 39(8):2141-2151, 2011.
260. Duma, S.M., Kemper, A.R., Stitzel, J.D., McNally, C., Kennedy, K.A., Matsuoka, F. Rib Fracture Timing in Dynamic Belt Tests with Human Cadavers. *Clinical Anatomy*. 24(3):327-338, 2011.
261. Tamura, A., Duma, S.M., A study on the potential risk of traumatic brain injury due to ground impact in a vehicle-pedestrian collision using full-scale finite element models, *International Journal of Vehicle Safety*, vol 5(2) pp 117-136, 2011. DOI: 10.1504/IJVS.2011.040131
262. Gayzik, FS, Moreno, DP, Vavalle, NA, Rhyne, AC, Stitzel, JD. "Development and Validation of a Novel Full Body Finite Element Model Utilizing a Multi-Modality Medical Imaging Protocol." *Icrash International Crashworthiness Conference*, Milano, Italy, July 2012.
263. Golman, AJ, Danelson, KA, Bolte, JH, Stitzel, JD. "Biomechanical Assessment of Astronaut Injury Potential from Suit Ring Elements Using a Full Human Body Finite Element Model." *Icrash International Crashworthiness Conference*, Milano, Italy, July 2012. (submitted for publication)
264. Thompson, AB; Gayzik, FS; Moreno, DP; Rhyne, AC; Vavalle, NA; Stitzel, JD. "A Paradigm for Human Body Finite Element Model Integration from a Set of Regional Models." *Biomedical Sciences and Instrumentation*, 2012;48:423-30.
265. Vavalle, NA; Moreno, DP; Stitzel, JD; Gayzik, FS. "The Effect of Impactor Location and Velocity Variation on Validation of an Advanced Human Body Finite Element Model." *Biomedical Sciences and Instrumentation*, 2012;48:454-61
266. Thompson, A. B., Rhyne, A. C., Moreno, D. P., Gayzik, F. S., Stitzel, J. D. Methods for validation of the mass distribution of a full body finite element model. *Biomed Sci Instrum.* 2011;47: 100-5.
267. Loftis, K.L., Prantikoff, T., Anthony, E.Y., Meredith, J. W., Martin, R.S., Stitzel, J.D. "Pediatric Occupants, Restraint Use, and Injuries in Motor Vehicle Crashes." *Biomedical Sciences and Instrumentation*, 2011; 48.
268. Kemper AR, Beeman SM, and Duma SM. Effects of Pre-Impact Bracing on Chest Compression of Human Occupants in Low Speed Frontal Sled Tests. *Proceedings of the 22<sup>nd</sup> Enhanced Safety of Vehicles Conference*, Washington, DC, USA. Paper Number: 11-0193, 2011.
269. Gayzik, F.S., Moreno, D.P., Hamilton, C.A., Tan, J.C., McNally, C., Duma, S.M., Klinich, K.D., Stitzel, J.D., A multi-modality image data collection protocol for full body finite element analysis model development, *SAE Technical Paper 2009-01-2261*, doi:10.4271/2009-01-2261.
270. Kemper AR, McNally C, and Duma SM. Acquiring Non-Censored Pelvic Bone Fracture Data during Dynamic Side Impact Loading. *Biomedical Sciences Instrumentation*, 45: 395-400, 2009.
271. Kemper AR, McNally C, and Duma SM. Load Transfer and Deformation Characteristics of the Pelvis in Non-Destructive Side Impact Testing. *Proceedings of the 21<sup>st</sup> Enhanced Safety of Vehicles Conference*, Stuttgart, Germany. Paper Number: 09-0508, 2009.
272. Kemper, A.R., McNally, C., Kennedy, E.A., Manoogian, S.J., and Duma, S.M., The Influence of Arm Position on Thoracic Response in Side Impacts. *Stapp Car Crash Journal*, 52: 379-420, 2008.
273. Duma SM, Kemper AR, McNally C, Kennedy EA, Rath AL, Manoogian SJ, and Stitzel JD. Non-Censored Rib Fracture Data from Dynamic Belt Loading Tests on the Human Cadaver Thorax. *Proceedings of the 19<sup>th</sup> Enhanced Safety of Vehicles Conference*, Washington, DC, United States. Paper Number: 05-0360, 2005,

274. B. Fildes, A. Linder, M. Janic, K. Digges, P. Bedewi, R. Morgan, F. Pintar, N. Yoganandan, C. Gabler, S. Duma, J. Stitzel, O. Bostom, L. Sparke, C. Newland, "Occupant Protection in Far Side Crashes," Proceedings of the International Technical Conference on the Enhanced Safety of Vehicles, 2005.
275. Untaroiu C.D., Shin, J., Lu, Y-C, (2013) Assessment of a Dummy Model in Crash Simulations using Rating Methods, *International Journal of Automotive Technology*, 14(3): 395-405.
276. Untaroiu, C.D. Adam, T, (2013) Performance- based Classification of Occupant Posture to Reduce the Risk of Injury in a Collision, *IEEE Transactions on Intelligent Transportation Systems*, 14(2): 565-573.
277. Kilgo PD, Weaver AA, Barnard RT, Love TP, Stitzel JD. "Comparison of Injury Mortality Risk in Motor Vehicle Crash Versus Other Etiologies." *Journal of Emergency Medicine*, 2013 (*In Review*).
278. Barnard RT, Loftis KL, Martin RS, Stitzel JD. "Development of a robust mapping between AIS 2+ and ICD-9 injury codes." *Accident Analysis and Prevention*, 2013 Jan 15;52C: 133-143, doi: 10.1016/j.aap.2012.11.030.
279. Loftis, K.L., Martin, R.S., Meredith, J.W., Stitzel, J.D. "A similarity scoring technique for the comparison of real-world crashes to crash tests: Initial results from a 12-point system." *International Journal of Vehicle Safety*, *Accepted*, August 2012.
280. Loftis, K.L., Weaver, A.A., Stitzel, J.D., "Investigating the Effects of Side Airbag Deployment in Real-World Crashes Using Crash Comparison Techniques," *Ann Adv Automot Med*. 2011;55:81-90.
281. Schneider, L., Rupp, J., Scarboro, M., Pintar, F., Arbogast, K., Rudd, R., Sochor, M., Stitzel, J.D., Sherwood, C., MacWilliams, J., Holloway, D., Ridella, S., Eppinger, R. "BioTab—A New Method for Analyzing and Documenting Injury Causation in Motor-Vehicle Crashes." *Traffic Injury Prevention*, 2011, Vol 12, Number 3, 256-265(10).
282. Stitzel JD, Weaver AA, Barnard RT, Kilgo PD. "Mortality-based quantification of injury severity for frequently occurring motor vehicle crash injuries." *Ann Adv Automot Med*, January 2013 (*In Review*).
283. Schoell SL, Weaver AA, Stitzel JD. "Development of an occult metric for common motor vehicle crash injuries." *Biomed Sci Instrum*. 2013 Apr 5; 49:274-280.
284. Loftis, K.L., Martin, R. S., Gabler, H.C., Meredith, J. W., Stitzel, J.D. "Development of a Method to Compare Real-World Crashes to Vehicle Crash Tests." *Society for Automotive Engineering*, 2010, Paper No. 2010-01-0147.
285. Loftis, K.L., Martin, R. S., Meredith, J. W., Stitzel, J.D. "Investigating Methods for Determining Mismatch in Near Side Vehicle Impacts." *Biomedical Sciences and Instrumentation*, 2009; 46.
286. Yu, M.M., Danelson, K.A., Stitzel, J.D. "Categorical Similarity Comparison of CIREN and NASS" *Biomedical Sciences and Instrumentation*, 2008; 44.
287. J. Stitzel, P. Kilgo, B. Schmotzer, C. Gabler, J.W. Meredith, "Comparing CIREN and NASS Cases: A Multivariate Similarity Approach," *Association for the Advancement of Automotive Medicine Conference*, Australia, 2007.
288. Gabler HC, Digges K, Fildes BN, and Sparke L, "Side Impact Injury Risk for Belted Far Side Passenger Vehicle Occupants", *SAE Transactions, Journal of Passenger Car - Mechanical Systems*, v.114, Section 6, Paper No. 2005-01-0287 (2005).
289. Bostrom O, Gabler HC, Digges K, Fildes B, and Sunnevang S, "Injury Reduction Opportunities of Far Side Impact Countermeasures", *Annals of Advances in Automotive Medicine*, v.52, pp. 289-300 (2008).
290. Newland C, Belcher T, Bostrom O, Gabler HC, Cha JG, Wong HL, Tylko S, and Nevo RD "Occupant-to-Occupant Interaction and Impact Injury Risk in Side Impact Crashes", *Stapp Car Crash Journal* (2008).
291. Johnson NS and Gabler HC, "Injury Risk due to Side Impact of Non-Tracking Vehicles into Guardrail", *Transportation Research Record: Journal of the Transportation Research Board*, *Transportation Research Board of the National Academies* (accepted).
292. Daniello A and Gabler HC, "The Characteristics of Injuries in Motorcycle to Barrier Collisions in Maryland", *Transportation Research Record: Journal of the Transportation Research Board*, *Transportation Research Board of the National Academies*, pp. 92-98, doi 10.3141/2281-12 (2012).
293. Daniello A and Gabler HC, "The Effect of Barrier Type on Injury Severity in Motorcycle to Barrier Collisions in North Carolina, Texas, and New Jersey", *Transportation Research Record: Journal of the Transportation Research Board*, No. 2262, *Transportation Research Board of the National Academies*, pp. 144–151 (2011).
294. Daniello AL and Gabler HC, "Fatality Risk in Motorcycle Collisions with Roadside Objects in the United States", *Accident Analysis and Prevention*, v.43, pp. 1167–1170 (2011).

295. Daniello A, Swanseen K, Mehta Y, and Gabler HC, "Rating Roads for Motorcyclist Safety: Development of a Motorcycle Road Assessment Program", *Transportation Research Record: Journal of the Transportation Research Board*, No. 2194, Transportation Research Board of the National Academies, pp. 67-74 (2010).
296. Daniello A, Gabler HC, and Mehta Y, "The Effectiveness of Motorcycle Training and Licensing", *Transportation Research Record: Journal of the Transportation Research Board*, No. 2140, Transportation Research Board of the National Academies, pp. 206–213, Washington, DC (2009).
297. Daniello A, Cristino D, and Gabler HC, "Relationship Between Rider Trajectory and Injury Outcome in Motorcycle-Barrier Crashes", *Transportation Research Record: Journal of the Transportation Research Board*, Transportation Research Board of the National Academies (accepted).
298. Kusano KD, Sherony R, and Gabler HC, "Advanced Event Data Recorders to Reconstruct Vehicle Trajectories for use in Safety Impact Methodologies (SIM)", *Traffic Injury Prevention* (in press, available online, June 2013), DOI: 10.1080/15389588.2013.796374.
299. Kusano KD and Gabler HC, "Safety Benefits of Forward Collision Warning, Brake Assist, and Autonomous Braking Systems in Rear-end Collisions", *IEEE Transactions – Intelligent Transportation Systems*, 13(4), pp. 1546 – 1555, doi 10.1109/TITS.2012.2191542 (2012).
300. Kusano KD and Gabler HC, "Field Relevance of the New Car Assessment Program Lane Departure Warning Confirmation Test," *SAE International Journal Passenger Cars - Mechanical Systems*, 5(1), doi:10.4271/2012-01-0284 (2012).
301. Kusano KD, Kusano SM, and Gabler HC, "Automated Crash Notification Algorithms: Evaluation of In-Vehicle Principal Direction of Force (PDOF) Estimations", *Transportation Research Part C*, DOI 10.1016/j.trc.2012.09.005 Volume 32, July 2013, Pages 116–128.
302. Kusano K and Gabler HC, "Method for Estimating Time to Collision at Braking in Real-world, Lead Vehicle Stopped Rear-end Crashes for Use in Pre-crash System Design", *SAE Transactions, Journal of Passenger Car - Mechanical Systems*, SAE Paper No. 2011-01-0576, v. 4 no. 1, pp. 435-443 (2011).
303. Kusano KD and Gabler HC, "Potential Occupant Injury Reduction in Pre-Crash System Equipped Vehicles in the Striking Vehicle of Rear-end Crashes", *Annals of Advances in Automotive Medicine*, v.54, pp. 203-214 (2010).
304. Kusano, K. and Gabler, H., "Characterization of Lane Departure Crashes Using Event Data Recorders Extracted from Real-World Collisions," *SAE International Journal Passenger. Cars - Mechanical Systems* 6(2):2013, doi: 10.4271/2013-01-0730.
305. Tsoi, A., Hinch, J., Ruth, R. and Gabler, H., "Validation of Event Data Recorders in High Severity Full-Frontal Crash Tests," *SAE International Journal of Transportation Safety* 1(1):2013, doi: 10.4271/2013-01-1265.
306. Hampton CE and Gabler HC, "Evaluation of the Accuracy of NASS/CDS Delta-V Estimates from the Enhanced WinSmash Algorithm", *Annals of Advances in Automotive Medicine*, v.54, pp. 241-252 (2010).
307. Hampton CE and Gabler HC, "NASS/CDS Delta-V Estimates: The Influence of Enhancements to the WinSmash Crash Reconstruction Code", *Annals of Advances in Automotive Medicine*, v.53, pp. 91-102 (2009).
308. Johnson NS and Gabler HC, "Accuracy of a Damage-Based Reconstruction Method in NHTSA Side Crash Tests", *Traffic Injury Prevention*, v.13, no. 1, pp. 72-80 (2012).
309. Gabauer DJ and Gabler HC, "Comparison of Roadside Crash Injury Metrics Using Event Data Recorders", *Accident Analysis and Prevention*, Vol. 40/2 pp 548-558 (2008).
310. Gabauer DJ and Gabler HC, "Can Delta-V be Adjusted with Structural and Occupant Restraint Performance to Improve Prediction of Chest Acceleration?", *Annals of Advances in Automotive Medicine*, v.52, pp. 165-174 (2008).
311. Funk JR, Cormier JM and Gabler HC, "Effect of Delta-V Errors in NASS on Frontal Crash Risk Calculation", *Annals of Advances in Automotive Medicine*, v.52, pp. 155-164 (2008).
312. Gabauer DJ, and Gabler HC, "Comparison of Roadside and Vehicle Crash Test Injury Criteria in Frontal Crash Tests", *Int. J. Vehicle Safety*, Vol. 3, No. 2, pp.135–148 (2008).

313. Hampton CE and Gabler HC, "Development of a Missing Post Guideline for Longitudinal Barrier Crash Safety", *Journal of Transportation Engineering*, v. 139, no.6, pp. 549-555 (2013).
314. Kusano KD and Gabler HC, "Characterization of Opposite-Direction Lane Departure Crashes in the United States", *Transportation Research Record: Journal of the Transportation Research Board*, Transportation Research Board of the National Academies (accepted).
315. Hampton CE and Gabler HC, "Crash Performance of Strong-Post W-Beam Guardrail with Missing Blockouts", *International Journal of Crashworthiness*, v. 17, no.1, pp. 93-103 (2012).
316. Hampton CE, Gabauer DJ, and Gabler HC, "Limits of Acceptable Rail and Post Deflection in Crash-Damaged Strong-Post W-Beam Guardrail", *Transportation Research Record: Journal of the Transportation Research Board*, No. 2195, Transportation Research Board of the National Academies, pp. 95-105 (2010).
317. Gabauer DJ, Kusano KD, Marzougui D, Opiela K, Hargrave M, Gabler HC, "Pendulum Testing as a Means of Assessing the Crash Performance of Longitudinal Barrier with Minor Damage", *International Journal of Impact Engineering*, v.37, p. 1121-1137 (2010).
318. Gabauer DJ and Gabler HC, "The Effects of Airbags and Seatbelts on Occupant Injury in Longitudinal Barrier Crashes", *Journal of Safety Research*, v.41, pp. 9-15, (2010).
319. Gabauer DJ and Gabler HC, "Differential Rollover Risk in Vehicle-to-Traffic Barrier Collisions", *Annals of Advances in Automotive Medicine*, v.53, pp. 131-140 (2009).
320. Gabauer DJ and Gabler HC, "Evaluation of Current Repair Criteria for Longitudinal Barrier with Crash Damage", *Journal of Transportation Engineering*, Vol. 135, No. 4, pp. 255-234 (2009).
321. Gabler HC and Hinch J, "Evaluation of Advanced Air Bag Deployment Algorithm Performance using Event Data Recorders", *Annals of Advances in Automotive Medicine*, v.52, pp. 175-184 (2008).
322. Donoughe K, Whitestone J and Gabler HC, "Analysis of Firetruck Crashes and Associated Firefighter Injuries in the United States", *Annals of Advances in Automotive Medicine*, v.56, pp. 69-76 (2012).
323. Thor CP and Gabler HC, "Assessing the Residual Teen Crash Risk Factors after Graduated Driver's License Implementation", *Annals of Advances in Automotive Medicine*, v.54, pp. 295-308 (2010).