

Earlier today I had the opportunity to visit Dr. Paul Ivancic PhD who is faculty at the the Yale University School of Medicine Biomechanics Research Laboratory in the Department of Orthopaedics & Rehabilitation. He obtained his PhD from Yale University in 2006, specializing in human injury biomechanics. He has over 60 publications in peer-reviewed scientific journals, most in the area of traumatic spinal injuries. He has provided expert testimony at depositions and trials. He has also consulted on numerous cases including traumatic injury associated with vehicle crashes; product liability; sport, recreation & playgrounds; slip, trip & fall; and human factors & performance. I asked Paul to write a short introduction on spinal injuries for the newsletter and he provided this to me by the time I arrived back in my office.

Traumatic Spinal Injuries

A summary by Dr. Paul Ivancic, PhD

Does a causal association exist between traumatic spinal loading and the clinically diagnosed injuries that lead to surgeries? Multiple factors are considered when determining whether or not a causal association exists. Injury tolerance is subject-specific. A motor vehicle crash that may injure an older frail occupant who has pre-existing medical conditions may not injure a younger, physically active occupant. Important occupant characteristics include age, height, weight, gender, the existence of medical conditions or pain, and the subject history including prior trauma or surgeries. Multiple pre-crash factors are considered including whether or not the occupant anticipated the crash and their position at the time of the crash. The crash-related factors include crash orientation, points of impact, vehicle dynamics, usage of safety systems, occupant motions, and whether or not blunt impact occurred. Finally, post-crash factors consider whether or not the occupant experienced immediate or delayed pain and the severity of the pain.

In our recent review papers, we have summarized the anatomical locations of the neck that can be injured due to motor vehicle crashes and traumatic loading with emphasis on the role of soft tissue injury, including injuries to the spinal discs and ligaments. The soft tissues of the neck, including the facet capsules, spinal ligaments, intervertebral discs, vertebral arteries, dorsal root ganglia, and neck muscles, are strained during a motor vehicle crash. Partial or complete rupture occurs when strain during a motor vehicle crash exceeds the tissue's tolerance. There exists significant scientific evidence in support of neck loading due to motor vehicle crashes causing lesions to the soft tissues of the neck which leads to pain and clinical sequelae. The studies have demonstrated strains beyond physiologic limits in the facet joint capsules and annular fibers of the disc; partial or complete ruptures of capsules, ligaments, and annular fibers; intra-articular contusions; intra-articular fractures; and transarticular synovial joint fractures.

I am excited that Paul has agreed to join me in a presentation series tentatively scheduled to start later this year when we will have experts from multiple disciplines present on topics that I'm sure will be of value to your practice. I expect that you will find Paul as interesting and knowledgeable as I did during our meeting. I was very pleased to see that he brings an unbiased and extremely informed perspective relative to injury biomechanics and particularly as it relates to the types of injuries we see routinely. And even better, he is right here in our back yard. Dr. Ivancic is available to consult on personal injury cases and can be reached by telephone at: 203-785-4052 and by email at: paul.ivancic@yale.edu. His CV is available at www.ShawChiropractic.com along with this newsletter.

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CURRICULUM VITAE

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Yale University School of Medicine
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Date of Birth: November 17, 1971
Citizenship: USA and Canada

FIELDS OF INTEREST

Spine Biomechanics, Human Injury and Whiplash Biomechanics, Injury Mechanisms and Tolerance, Injury Prevention, Injury Epidemiology, Accident Investigation, Orthopaedic Implant Design

EDUCATION

Ph.D.	Biomedical Engineering	Yale University, New Haven, CT	2006
M.Phil.	Biomedical Engineering	Yale University, New Haven, CT	2003
M.S.	Biomedical Engineering	Yale University, New Haven, CT	2002
M.A.	Mathematics	University of Pennsylvania, Phila, PA	2000
M.S.E.	Computer Science	University of Pennsylvania, Phila, PA	1999
M.S.E.	Bioengineering	University of Pennsylvania, Phila, PA	1997
B.Sc.	Mathematics & Applied Mechanics	Queen's University, Ontario, Canada	1995

- Formal mathematics training included probability and statistics
- As part of his doctoral program at Yale University, Dr. Ivancic received formal training in the use of statistics in the fields of epidemiology and public health

RESEARCH & PROFESSIONAL EXPERIENCE

<i>Associate Research Scientist</i>	2014-present
<i>Assistant Professor</i>	2008-2014
<i>Associate Research Scientist</i>	2006-2008

Biomechanics Research Laboratory
Department of Orthopaedics & Rehabilitation
Yale University School of Medicine, New Haven, CT

TEACHING EXPERIENCE

<i>Lecturer</i>	2008
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Departments of Biomedical Engineering and Mechanical Engineering
School of Engineering & Applied Science, Yale University, New Haven, CT
Course title: *Biomechanics*
An undergraduate/graduate engineering course offered to senior undergraduates and MS and PhD candidates. Topics included: viscoelasticity, biomaterials, functional anatomy, kinematics of human motion, analysis of joint loads, variational mechanics, and finite element methods.

HONORS & AWARDS

Young Scientist Post-Doctoral Award	American Society of Biomechanics	2011
Promising Young Scientist Award	International Society of Biomechanics	2007
The Margaret H. Hines Award for best oral presentation	Injury Biomechanics Symposium , Ohio State University, Columbus, OH	2007
Research Assistantship, Biomechanics Research Laboratory	Yale University, New Haven, CT	2001-2006
Raymond John Wean Foundation Fellowship	Yale University, New Haven, CT	2000-2003
Biomedical Engineering & University Fellowships	Yale University, New Haven, CT	2000-2001
Good Teaching Award, Department of Mathematics http://www.math.upenn.edu/ugrad/historical-awards.htm	University of Pennsylvania, Phila, PA	Fall 1999 Fall 1998 Spring 1998

GRANTS AWARDED & ADDITIONAL FUNDING

Centers for Disease Control and Prevention (CDC) 1R01CE001257	<i>Prevention of neck injuries in older adults during rear motor vehicle collisions</i> Role: PI	9/1/07- 8/31/11
Stryker Spine Research Grant	<i>Biomechanical comparison of uniaxial screws and monoaxial screws</i> Role: Co-investigator	8/1/09- 7/31/10
Ossur Americas, Aliso Viejo, CA, USA	<i>Research support</i>	2007-2008
Aspen Medical Products Inc., Irvine, CA, USA	<i>Research support</i>	2011-2012
SpineGuard, Inc, San Francisco, CA, USA	<i>Research support</i>	2014

MEMBERSHIP IN PROFESSIONAL SOCIETIES

International Society of Biomechanics	2006-2011
American Society of Biomechanics	2007-2011
Canadian Society of Biomechanics	2010-2012

EDITORIAL ADVISORY BOARDS

The Open Ergonomics Journal	2007-present
Clinical Medicine: Trauma and Intensive Medicine	2008-present
The Open Orthopaedics Journal	2011-present

REVIEWER FOR JOURNALS

Journal of Biomechanics	2004-present
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Medical Engineering & Physics	2005-present
Traffic Injury Prevention	2005-present
Journal of Biomechanical Engineering	2006-present
BMC Musculoskeletal Disorders	2007-present
The Open Ergonomics Journal	2007-present
Clinical Anatomy	2008-present
Recent Patents on Mechanical Engineering	2008-present
Biomechanics and Modeling in Mechanobiology	2008-present
Journal of Emergencies, Trauma and Shock	2009-present
Acta Biomaterialia	2010-present
Revista Española de Medicina Legal	2010-present
Open Access Emergency Medicine	2011-present
Annals of Biomedical Engineering	2011-present
Transactions on Mechatronics	2011-present
Journal of Multidisciplinary Healthcare	2011-present
The Open Orthopaedics Journal	2011-present
Spine	2011-present
Accident Analysis and Prevention	2012-present
Evidence-Based Complementary and Alternative Medicine	2012-present
Journal of Orthopedic Research	2012-present
British Journal of Sports Medicine	2012-present
Rehabilitation Research and Practice	2012-present
Gait & Posture	2012-present
Journal of Spine	2012-present
European Spine Journal	2012-present
Reports in Medical Imaging	2012-present
PLOS ONE	2012-present
Journal of Athletic Training	2013-present
Journal of Spine & Neurosurgery	2013-present
Clinical Medicine Insights: Trauma and Intensive Medicine	2013-present
Medical Science Monitor	2013-present
Cancer Control	2013-present
Clinical Biomechanics	2013-present
Prosthetics & Orthotics International	2014-present
Global Spine Journal	2014-present
Journal of the Mechanical Behavior of Biomedical Materials	2014-present
Journal of Orthopaedic Surgery and Research	2014-present
Journal of Injury and Violence Research	2014-present

PROFESSIONAL SERVICE

Program Committee Member, The Fifth IASTED International Conference on Biomechanics, August 20-22, 2007, Honolulu, Hawaii, USA	2007
Review panel member for the Biomedical Engineering Program, National Science Foundation, Arlington, VA	2008
Thesis reviewer, Doctor of Medicine Program, Yale University School of Medicine	2007-present
Admission committee member and interviewer, Yale Comprehensive Integrated Spine Fellowship, Department of Orthopaedics & Rehabilitation Yale University School of Medicine	2009, 2014
Chair of spine podium session, American Society of Biomechanics 33rd Annual Meeting, State College, PA, August 26-29, 2009	2009
Chair of joint mechanics podium session and Program Committee Member, American Society of Biomechanics 34th Annual Meeting, Providence, Rhode Island, August 18-21, 2010	2010
	2010

Chair of spine podium session and Reviewer, 16th Biannual Conference of the Canadian Society for Biomechanics, Queens University, Kingston, ON, June 9-12, 2010	
Program Committee Member, The 6th IASTED International Conference on Biomechanics, November 7-9, 2011, Pittsburgh, PA, USA	2011
Ad hoc Member of the Center for Scientific Review, Arthritis and Musculoskeletal and Skin Diseases Special Grants Review Committee (AMS), National Institutes of Health, June 15-16, 2011, Rockville, MD	2011
Invited contributor, The Spine Blog, a forum for discussion of articles published in Spine	2011-present
Reviewer, 17th Biannual Conference of the Canadian Society for Biomechanics, Simon Fraser University, Burnaby, BC, June 6-9, 2012	2012
Ad hoc Member of the Center for Scientific Review, Arthritis and Musculoskeletal and Skin Diseases Special Grants Review Committee (AMS), February 23-24, 2012, and AMS Conflict Panel, March 5, 2012, National Institutes of Health, Rockville, MD	2012
Member, non-advocate scientific review panel, Human Research Program, NASA, Arlington, VA	2012
Standing Review Panel, Occupant Protection Risk, Human Research Program, NASA's Johnson Space Center; review meeting: November 8-9, 2012, Houston, TX	2012
Peer Reviewer, Military Medical Research and Development, United States Army Medical Research Acquisition Activity (USAMRAA), Department of the Army, Peer review administered by The American Institute of Biological Sciences, Reston, VA, March-April, 2013.	2013
Examiner of the thesis for degree of Doctor of Philosophy at the University of Queensland, Brisbane, Australia.	2014
Technical Advisor II, Biomechanics and Spine Research Services, Division of Safety Research (DSR), Protective Technology Branch, National Institute for Occupational Safety and Health (NIOSH), Centers for Disease Control and Prevention (CDC), Morgantown, WV.	2014-2015
Mail Reviewer, Center for Scientific Review, Special Emphasis Panel, ZRG1 SBIB-V 82 S, SBIB Clinical Pediatric and Fetal Applications, October 23, 2014, National Institutes of Health.	2014

UNDERGRADUATE, GRADUATE, AND POSTDOCTORAL SCHOLAR SUPERVISION AND DISSERTATION COMMITTEES

2007-08	Research Scientist	Daohang Sha	Biomechanics of neck injury prevention
2008	MD	Erik Carlson	Effect of rotated head posture on dynamic vertebral artery elongation during simulated rear impact
2008	BS	Lindsay Hong	Biofidelic human model of the neck for evaluation of head restraint systems
2008	BS	Thomas Heish	Development of system to apply preload to a human model of the neck
2008	Residents	Fred Mo Brandon Lawrence	Biomechanics of halo-vest and dens screw fixation for Type II odontoid fracture
2008-09	Resident	Connor Telles	Neck motions due to the halo-vest in prone and supine positions
2009	MD	Naseem Beauchman	Effect of halo-vest components on stabilizing the injured cervical spine

2009-10	Post-doc	Ming Xiao	Whiplash injury prevention with energy absorbing seat
2009-2014	PhD	Kamran Shamaei	PhD dissertation committee member
2012-2013	MD	Ameya Save	Effects of screw fixation on scaphoid fracture
2012-2014	MD	Rafael Buerba Siller	MD thesis committee member: Outcomes following lumbar and cervical spinal fusion in the obese

ORIGINAL ARTICLES (Published in peer review journals)

1. **Ivancic PC**, Cholewicki J, Radebold A. Effects of the abdominal belt on muscle-generated spinal stability and L4/L5 joint compression force. *Ergonomics*. 45:501-513, 2002.
2. Cholewicki J, **Ivancic PC**, Radebold A. Can increased intra-abdominal pressure in humans be decoupled from trunk muscle co-contraction during steady state isometric exertions? *Eur J Appl Physiol*. 87:127-133, 2002.
3. Panjabi MM, Pearson AM, Ito S, **Ivancic PC**, Wang JL. Cervical spine curvature during simulated whiplash. *Clin Biomech*. 19:1-9, 2004.
4. **Ivancic PC**, Pearson AM, Panjabi MM, Ito S. Injury of the anterior longitudinal ligament during whiplash simulation. *Eur Spine J*. 13:61-68, 2004.
5. Pearson AM, **Ivancic PC**, Ito S, Panjabi MM. Facet joint kinematics and injury mechanisms during simulated whiplash. *Spine*. 29:390-397, 2004.
6. Ito S, **Ivancic PC**, Panjabi MM, Cunningham, BW. Soft tissue injury threshold during simulated whiplash: A biomechanical investigation. *Spine*. 29:979-987, 2004.
7. Panjabi MM, Ito S, Pearson AM, **Ivancic PC**. Injury mechanisms of the cervical intervertebral disc during simulated whiplash. *Spine*. 29:1217-1225, 2004.
8. Ito S, Panjabi MM, **Ivancic PC**, Pearson AM. Spinal canal narrowing during simulated whiplash. *Spine*. 29:1330-1339, 2004.
9. Ghole SA, **Ivancic PC**, Tominaga Y, Gimenez SE, Panjabi MM. Incremental and single trauma produce equivalent subfailure soft tissue injury of the cervical spine. *Clin Biomech*. 19:784-789, 2004.
10. Panjabi MM, Pearson AM, Ito S, **Ivancic PC**, Gimenez SE, Tominaga Y. Cervical spine ligament injury during simulated frontal impact. *Spine*. 29:2395-2403, 2004.
11. **Ivancic PC**, Ito S, Panjabi MM, Pearson AM, Tominaga Y, Wang JL, Gimenez SE. Intervertebral Neck Injury Criterion for simulated frontal impacts. *Traffic Inj Prev*. 6:175-184, 2005.
12. **Ivancic PC**, Panjabi MM, Ito S, Cripton PA, Wang JL. Biofidelic whole cervical spine model with muscle force replication for whiplash simulation. *Eur Spine J*. 14:346-355, 2005.
13. Ito S, **Ivancic PC**, Pearson AM, Tominaga Y, Gimenez SE, Rubin W, Panjabi MM. Cervical intervertebral disc injury during simulated frontal impact. *Eur Spine J*. 14:356-365, 2005.

14. Panjabi MM, Ito S, **Ivancic PC**, Rubin W. Evaluation of the Intervertebral Neck Injury Criterion using simulated rear impacts. *J Biomech.* 38:1694-1701, 2005.
15. Pearson AM, Panjabi MM, **Ivancic PC**, Ito S, Cunningham BW, Rubin W, Gimenez SE. Frontal impact causes ligamentous cervical spine injury. *Spine.* 30:1852-8, 2005.
16. Panjabi MM, **Ivancic PC**, Tominaga Y, Wang JL. Intervertebral neck injury criterion for prediction of multiplanar cervical spine injury due to side impacts. *Traffic Inj Prev.* 6:387-97, 2005.
17. **Ivancic PC**, Panjabi MM, Tominaga Y, Pearson AM, Gimenez SE, Maak TG. Spinal canal narrowing during simulated frontal impact. *Euro Spine J.* 15:891-901, 2006.
18. **Ivancic PC**, Ito S, Tominaga Y, Carlson EJ, Rubin W, Panjabi MM. Effect of rotated head posture on dynamic vertebral artery elongation during simulated rear impact. *Clin Biomech.* 21:213-220, 2006.
19. **Ivancic PC**, Wang JL, Panjabi MM. Calculation of dynamic spinal ligament strain. *Traffic Inj Prev.* 7:81-87, 2006.
20. Panjabi MM, **Ivancic PC**, Maak TG, Tominaga Y, Rubin W. Multiplanar cervical spine injury due to head-turned rear impact. *Spine.* 31:420-429, 2006.
21. Panjabi MM, Maak TG, **Ivancic PC**, Ito S. Dynamic intervertebral foramen narrowing during simulated rear impact. *Spine.* 31:E128-E134, 2006.
22. Maak TG, Tominaga Y, Panjabi MM, **Ivancic PC**. Alar, transverse, and apical ligament strain due to head-turned rear impact. *Spine.* 31:632-638, 2006.
23. Tominaga Y, Maak TG, **Ivancic PC**, Panjabi MM, Cunningham BW. Head-turned rear impact causing dynamic cervical intervertebral foramen narrowing: implications for ganglion and nerve root injury. *J Neurosurg Spine.* 4:380-387, 2006.
24. **Ivancic PC**, Panjabi MM, Tominaga Y, Malcolmson GF. Predicting multiplanar cervical spine injury due to head-turned rear impacts using IV-NIC. *Traffic Inj Prev.* 7:264-75, 2006.
25. **Ivancic PC**, Panjabi MM, Ito S. Cervical spine loads and intervertebral motions during whiplash. *Traffic Inj Prev.* 7:389-399, 2006.
26. Carlson EJ, Tominaga Y, **Ivancic PC**, Panjabi MM. Dynamic vertebral artery elongation during frontal and side impacts. *The Spine Journal.* 7:222-8, 2007.
27. **Ivancic PC**, Ito S, Panjabi MM. Dynamic sagittal flexibility coefficients of the human cervical spine. *Accident Analysis & Prevention,* 39:688-695, 2007.
28. Tominaga Y, Ndu AB, Coe MP, Valenson AJ, **Ivancic PC**, Ito S, Rubin W, Panjabi MM. Neck ligament strength is decreased following whiplash trauma. *BMC Musculoskeletal Disorders,* 7:103, 2006.
29. **Ivancic PC**, Coe MP, Ndu AB, Tominaga Y, Carlson EJ, Rubin W, Panjabi MM. Dynamic mechanical properties of intact human cervical spine ligaments. *The Spine Journal,* 7:659-65, 2007.

30. Panjabi MM, Simpson AK, **Ivancic PC**, Pearson AM, Tominaga T, Yue JJ. Cervical facet joint kinematics during bilateral facet dislocation. *Euro Spine J*, 16:1680-8, 2007.
31. **Ivancic PC**, Pearson AM, Tominaga Y, Simpson AK, Yue JJ, Panjabi MM. Mechanism of cervical spinal cord injury during bilateral facet dislocation. *Spine*, 32: 2467-73, 2007.
32. Maak TG, **Ivancic PC**, Tominaga Y, Panjabi MM. Side impact causes multiplanar cervical spine injuries. *The Journal of Trauma, Injury, Infection and Critical Care*, 63:1296-1307, 2007.
33. **Ivancic PC**, Ito S, Tominaga Y, Rubin W, Coe MP, Ndu AB, Carlson AJ, Panjabi MM. Whiplash causes increased laxity of cervical capsular ligament. *Clin Biomech*, 23:159-165, 2008.
34. **Ivancic PC**, Pearson AM, Tominaga Y, Simpson AK, Yue JJ, Panjabi MM. Biomechanics of cervical facet dislocation. *Traffic Injury Prevention*, 9:606-611, 2008.
35. Siegmund GP, Winkelstein BA, **Ivancic PC**, Svensson MY, Vasavada A. The anatomy and biomechanics of acute and chronic whiplash injury. *Traffic Injury Prevention*, 10:101-112, 2009.
36. **Ivancic PC**, Beauchman NN, Tweardy L. Effect of halo-vest components on stabilizing the injured cervical spine. *Spine*, 34:167-75, 2009.
37. **Ivancic PC**, Beauchman NN, Mo F, Lawrence BD. Biomechanics of halo-vest and dens screw fixation for type II odontoid fracture. *Spine*, 34:484-90, 2009.
38. **Ivancic PC**, Sha D, Panjabi MM. Whiplash injury prevention with active head restraint, *Clinical Biomechanics*, 24:699-707, 2009.
39. **Ivancic PC**, Sha D. Comparison of the whiplash injury criteria. *Accident Analysis & Prevention*, 42:56-63, 2010.
40. **Ivancic PC**, Telles CJ. Neck motion due to the halo-vest in prone and supine positions. *Spine*, 40:E400-E406, 2010.
41. Xiao M, **Ivancic PC**. WHIPS seat and occupant motions during simulated rear crashes. *Traffic Injury Prevention*, 11:514-521, 2010.
42. **Ivancic PC**, Sha D, Lawrence BD, Mo F. Effect of active head restraint on residual neck instability due to rear impact. *Spine*, 35:2071-8, 2010.
43. **Ivancic PC**, Xiao M. Cervical spine curvature during simulated rear crashes with energy-absorbing seat. *Spine J*, 11:224-233, 2011.
44. **Ivancic PC**. Facet joint and disc kinematics during simulated rear crashes with active injury prevention systems. *Spine*, 36:E1215-E1224, 2011.
45. **Ivancic PC**, Xiao M. Understanding whiplash injury and prevention mechanisms using a human model of the neck. *Accident Analysis & Prevention*, 43:1392-1399, 2011.
46. Curatolo M, Bogduk N, **Ivancic PC**, McLean SA, Siegmund GP, Winkelstein BA. The role of tissue damage in whiplash associated disorders. Discussion paper 1. *Spine*, 36(25S): S309-S315, 2011.

47. **Ivancic PC.** Does knowledge of whiplash injury mechanisms and seat design translate to understanding outcomes? *Spine*, 36(25S): S187-S193, 2011.
48. **Ivancic PC.** Atlas injury mechanisms during head-first impact. *Spine*, 37(12):1022-9, 2012.
49. **Ivancic PC.** Cervical neural space narrowing during simulated rear crashes with anti-whiplash systems. *Euro Spine J*, 21(5):879-86, 2012.
50. **Ivancic PC.** Head-first impact with head protrusion causes noncontiguous injuries of the cadaveric cervical spine. *Clin J Sport Med*, 22(5):390-6, 2012.
51. **Ivancic PC.** Biomechanics of sports-induced axial compression injuries of the neck. *Journal of Athletic Training*, 47(5): 489-497, 2012.
52. Essig D, Miller CP, Xiao M, **Ivancic PC**, Badrinath R, Smith BG, Grauer JN. Comparison of endplate forces generated by uniaxial screws and monoaxial pedicle screws. *Orthopedics*, 35(10):e1528-32, 2012.
53. **Ivancic PC.** Neck injury response to direct head impact. *Accident Analysis & Prevention*, 50:323-329, 2013.
54. **Ivancic PC.** Effects of orthoses on three-dimensional load-displacement properties of the cervical spine. *European Spine Journal*, 22(1):169-77, 2013.
55. **Ivancic PC.** Effects of cervical orthoses on neck biomechanical responses during transitioning from supine to upright. *Clinical Biomechanics*, 28(3):239-245, 2013.
56. **Ivancic PC.** Do cervical collars and cervicothoracic orthoses effectively stabilize the injured cervical spine? A biomechanical investigation. *Spine*, 38(13):E767-74, 2013.
57. **Ivancic PC.** Hybrid cadaveric/surrogate model of thoracolumbar spine injury due to simulated fall from height. *Accident Analysis & Prevention*, 59:185-191, 2013.
58. **Ivancic PC**, Save AV, Carlson EJ, Dodds SD. Scaphoid interfragmentary motions due to simulated transverse fracture and volar wedge osteotomy. *Clinical Biomechanics*, 29:189-195, 2014.
59. **Ivancic PC.** Cervical spine instability following axial compression injury: A biomechanical study. *Orthopaedics & Traumatology: Surgery & Research*, 100: 127-133, 2014.
60. **Ivancic PC.** Biomechanics of thoracolumbar burst and chance-type fractures during fall from height. *Global Spine Journal*, 4(3):161-8, 2014.
61. **Ivancic PC.** Plough fracture of the anterior arch of the atlas: a biomechanical investigation. *Euro Spine J*, DOI: 10.1007/s00586-014-3449-x, 2014.
62. **Ivancic PC.** Axis Ring Fractures due to Simulated Head Impacts. *Clinical Biomechanics*, DOI: 10.1016/j.clinbiomech.2014.06.017, 2014.
63. **Ivancic PC.** Odontoid fracture biomechanics. *Spine*, doi:10.1097/BRS.0000000000000609, 2014.

SUBMITTED

1. Yue JJ, **Ivancic PC**, Scott DL. Teardrop fracture following head-first impact in an ice hockey player: Case report and analysis of injury mechanisms. Submitted to *Global Spine Journal*, 2014.

DOCTORAL THESIS

1. **Ivancic PC**. Cervical spine injury during simulated automobile collisions. Ph.D. Dissertation in Biomedical Engineering, Yale University, New Haven, CT, 2006.

BOOK CHAPTERS

1. **Ivancic PC**, Tominaga Y, Ndu AB, Coe MP, Ito S, Rubin W, Valenson AJ, Panjabi MM. Neck ligament injuries due to whiplash. In *Schleudertrauma (German) Whiplash*, Eds. Wedig HD, Graf M, Grill C, Steinkopff-Verlag (Springer-Group), 2008, pp 39-47.
2. **Ivancic PC**, Dvorak J, Goel VK, Fairchild TA, White AA, DiAngelo DJ. Cervical Spine Kinematics and Clinical Instability. In *The Cervical Spine*, 5th Edition, Lippincott, 2012.
3. **Ivancic PC**. Basic Principles in Biomechanics: Force and Effects. In *Dynamic Reconstruction of the Spine*, 2nd Edition, Thieme, In press, 2014.

ABSTRACTS

1. Cholewicki J, **Ivancic PC**, Radebold A. Increased intra-abdominal pressure is coupled with trunk muscle co-contractions during steady state exertions. Presented at 4th World Congress of Biomechanics meeting, Calgary, Alberta, August 4-9, 2002.
2. **Ivancic PC**, Panjabi MM, Ito S, Cripton PA, Wang JL. A biofidelic osteoligamentous cervical spine model with muscle force replication for whiplash trauma simulation. Presented at the Cervical Spine Research Society 30th annual meeting, Miami Beach, Florida, December 5-7, 2002.
3. Ito S, **Ivancic PC**, Panjabi MM, Cunningham BW. Biomechanical testing of the cervical spine before and after simulated whiplash trauma to identify soft tissue injury sites and severities. Presented at the Cervical Spine Research Society 30th annual meeting, Miami Beach, Florida, December 5-7, 2002.
4. Ito S, **Ivancic PC**, Panjabi MM, Cunningham, BW. Identification of soft tissue whiplash injuries through biomechanical testing of the cervical spine before and after simulated trauma. Presented at the Orthopaedic Research Society 49th annual meeting, New Orleans, Louisiana, February 2-5, 2003.
5. Panjabi MM, Ito S, Pearson AM, **Ivancic PC**. Cervical intervertebral disc injury mechanisms during simulated whiplash. Presented at American Society of Biomechanics 27th annual meeting, Toledo, Ohio, September 25-27, 2003.
6. **Ivancic PC**, Panjabi MM, Ito S, Cripton PA, Wang JL. Whole cervical spine model with muscle force replication for whiplash simulation: development and evaluation. Presented at American Society of Biomechanics 27th annual meeting, Toledo, Ohio, September 25-27, 2003.

7. **Ivancic PC**, Ito S, Pearson AM, Panjabi MM, Rubin W. Calculation of dynamic spinal soft tissue deformation. Presented at American Society of Biomechanics 27th annual meeting, Toledo, Ohio, September 25-27, 2003.
8. Pearson AM, **Ivancic PC**, Ito S, Panjabi MM. Facet joint kinematics and injury mechanisms during simulated whiplash. Presented at the Cervical Spine Research Society 31st annual meeting, Scottsdale, AZ, December 11-13, 2003.
9. Ito S, Panjabi MM, **Ivancic PC**, Pearson AM. Spinal canal narrowing during simulated whiplash. Presented at the Cervical Spine Research Society 31st annual meeting, Scottsdale, AZ, December 11-13, 2003.
10. **Ivancic PC**, Ito S, Panjabi MM, Pearson AM, Tominaga Y, Wang JL, Gimenez SE. Intervertebral Neck Injury Criterion for simulated frontal impacts. Presented at the American Society of Biomechanics 28th annual meeting, Portland, Oregon, September 8-11, 2004.
11. Panjabi MM, Pearson AM, Ito S, **Ivancic PC**, Gimenez SE, Tominaga Y. Ligamentous injury during simulated frontal impact. Presented at the American Society of Biomechanics 28th annual meeting, Portland, Oregon, September 8-11, 2004.
12. Pearson AM, Panjabi MM, **Ivancic PC**, Ito S, Cunningham BW, Rubin W, Gimenez SE. Spinal instability due to simulated frontal impacts. Presented at the American Society of Biomechanics 28th annual meeting, Portland, Oregon, September 8-11, 2004.
13. Ito S, **Ivancic PC**, Pearson AM, Tominaga Y, Gimenez SE, Rubin W, Panjabi MM. Disc injury during simulated automotive collisions. Presented at the Cervical Spine Research Society 32nd annual meeting, Boston, MA, December 9-11, 2004.
14. Pearson AM, Panjabi MM, **Ivancic PC**, Ito S, Cunningham BW, Rubin W, Gimenez SE. Spinal instability due to simulated frontal impacts. Presented at the Cervical Spine Research Society 32nd annual meeting, Boston, MA, December 9-11, 2004.
15. Panjabi MM, Pearson AM, Ito S, **Ivancic PC**, Gimenez SE, Tominaga Y. Ligamentous injury during simulated frontal impact. Presented at the Cervical Spine Research Society 32nd annual meeting, Boston, MA, December 9-11, 2004.
16. Ito S, **Ivancic PC**, Pearson AM, Tominaga Y, Gimenez SE, Rubin W, Panjabi MM. Disc injury during simulated automotive collisions. Presented at the Orthopaedic Research Society 51st annual meeting, Washington, DC, February 20-23, 2005.
17. Panjabi MM, Pearson AM, Ito S, **Ivancic PC**, Gimenez SE, Tominaga Y. Ligamentous injury during simulated frontal impact. Presented at the Orthopaedic Research Society 51st annual meeting, Washington, DC, February 20-23, 2005.
18. **Ivancic PC**, Pearson AM, Tominaga Y, Simpson AM, Yue JJ, Panjabi MM. Mechanism of cervical spine injury during bilateral facet dislocation, Presented at the Injury Biomechanics Symposium, The Ohio State University, Columbus, OH, May 21-22, 2007.
19. **Ivancic PC**, Ito S, Tominaga Y, Rubin W, Coe MP, Ndu AB, Carlson EJ, Panjabi MM. Whiplash causes increased laxity of cervical capsular ligament, Presented at the American Society of Biomechanics 31st Annual Meeting, Stanford, CA, August 22-25, 2007.

20. Siegmund GP, Winkelstein BA, **Ivancic PC**, Svensson MY, Vasavada A, Jakobsson L. Theories of Neck Injury Mechanisms Related to Motor Vehicle Crashes. World Congress on Neck Pain, Los Angeles, CA, January 20-22, 2008.
21. **Ivancic PC**, Pearson AM, Tominaga Y, Simpson AK, Yue JJ, Panjabi MM. Biomechanics of cervical facet dislocation. World Congress on Neck Pain, Los Angeles, CA, January 20-22, 2008.
22. **Ivancic PC**, Ito S, Tominaga Y, Rubin W, Coe MP, Ndu AB, Carlson AJ, Panjabi MM. Increased laxity of cervical capsular ligament due to whiplash. World Congress on Neck Pain, Los Angeles, CA, January 20-22, 2008.
23. **Ivancic PC**, Sha D, Lawrence BD, Mo F. Effect of active head restraint on residual neck instability due to rear impact. Presented at the American Society of Biomechanics 33rd Annual Meeting, State College, PA, August 26-29, 2009.
24. **Ivancic PC**, Sha D, Panjabi MM. Whiplash injury prevention with active head restraint. Presented at the American Society of Biomechanics 33rd Annual Meeting, State College, PA, August 26-29, 2009.
25. **Ivancic PC**, Sha D, Lawrence BD, Mo F. Effect of active head restraint on residual neck instability due to rear impact. Presented at the 53rd Annual Conference of the Associate for the Advancement of Automotive Medicine, Baltimore, MD, October 4-7, 2009.
26. **Ivancic PC**, Sha D, Panjabi MM. Whiplash injury prevention with active head restraint. Presented at the XXII Congress of the International Society of Biomechanics, Cape Town, South Africa, July 5-9, 2009.
27. **Ivancic PC**, Sha D, Panjabi MM. Relation between active head restraint position and whiplash injury. Presented at the Cervical Spine Research Society 37th annual meeting, Salt Lake City, Utah, December 3-5, 2009.
28. Xiao M, **Ivancic PC**. Mechanisms of whiplash injury prevention attributable to energy-absorbing seat. Presented at the 2010 Injury Biomechanics Symposium, The Ohio State University, Columbus, OH, May 17-18, 2010.
29. **Ivancic PC**, Telles CJ. Mechanisms of whiplash injury prevention attributable to energy-absorbing seat. Presented at the 16th Biannual Conference of the Canadian Society for Biomechanics, Queens University, Kingston, ON, June 9-12, 2010.
30. **Ivancic PC**, Xiao M. Neck motion due to the halo-vest in prone and supine positions. Presented at the 16th Biannual Conference of the Canadian Society for Biomechanics, Queens University, Kingston, ON, June 9-12, 2010.
31. **Ivancic PC**, Telles CJ. Mechanisms of whiplash injury prevention attributable to energy-absorbing seat. Presented at the 6th World Congress on Biomechanics, Singapore, August 1-6, 2010.
32. **Ivancic PC**, Xiao M. Neck motion due to the halo-vest in prone and supine positions. Presented at the 6th World Congress on Biomechanics, Singapore, August 1-6, 2010.
33. **Ivancic PC**, Telles CJ. Mechanisms of whiplash injury prevention attributable to energy-absorbing seat. Presented at the American Society of Biomechanics 34th Annual Meeting, Providence, RI, August 18-21, 2010.

34. **Ivancic PC**, Xiao M. Neck motion due to the halo-vest in prone and supine positions. Presented at the American Society of Biomechanics 34th Annual Meeting, Providence, RI, August 18-21, 2010.
35. Essig D, Grauer JN, Smith B, **Ivancic PC**, Xiao M, Jegede K, Miller C. Biomechanical Comparison of Uniaxial Screws and Monoaxial Screws. Presented at the 17th International Meeting on Advanced Spine Techniques, Toronto, ON, July 21-24, 2010.
36. Essig D, Grauer JN, Smith B, **Ivancic PC**, Xiao M, Jegede K, Miller C. Biomechanical Comparison of Uniaxial Screws and Monoaxial Screws. Presented at 2010 American Academy of Pediatrics National Conference & Exhibition, San Francisco, CA, October 2-5, 2010.
37. Ma Y, Datar A, Guess MK, Hennessey A, **Ivancic PC**, Connell KA. Short Hairpin Mediated Knockdown of Hoxa11 Leads to Increased Activation of Matrix Metalloproteinases, Decreased Expression of Collagen Subtypes & Altered Biomechanical Properties of the Uterosacral Ligament in Mice. *Reproductive Sciences* 18(3) Supplement: 153A-153A, Meeting Abstract: T293, March 2011.
38. **Ivancic PC**. Effects of anti-whiplash seats on cervical facet and disc kinematics during simulated rear crashes. Presented at the American Society of Biomechanics 35th Annual Meeting, Long Beach, CA, August 10-13, 2011.
39. Svensson MY, **Ivancic PC**, Siegmund GP, Winkelstein BA, Vasavada A, Jakobsson L. Reducing the risk of neck injury sequelae; injury mechanisms and prevention. Presented at the 5th International Whiplash Trauma Congress, Lund, Sweden, August 24-28, 2011. Abstract published in *J Rehabil Med.* 43(50):8-9, 2013.
40. Save AV, Carlson EJ, **Ivancic PC**, Dodds SD. A comparison of partially-threaded versus fully-threaded compression screws under physiologic load bearing in cadaveric scaphoids with simulated fractures. Presented at the New England Hand Society 40th Annual Meeting, Sturbridge, MA, December 7, 2012.
41. Save AV, Carlson EJ, **Ivancic PC**, Dodds SD. Biomechanical Comparison of Partially Threaded and Fully Threaded Compression Screws For Scaphoid Fracture Internal Fixation. Presented at the Connecticut Orthopaedic Society Annual Meeting, Farmington, CT, May 10, 2013.

INVITED LECTURES

Neck injury mechanisms during simulated automobile collisions, CRASH 2005, Spine Research Institute of San Diego, San Diego, CA, August 25-28, 2005.

Plenary session panel discussion: *Theories of neck injury mechanisms in motor vehicle crashes*, World Congress on Neck Pain, Los Angeles, CA, January 20-22, 2008

Effects of halo-vest on cervical spine biomechanics, Orthopaedic Unit Meeting, Ossur Americas, Dana Point, CA, January 8-10, 2009.

Cervical spine trauma and fixation, Plenary presentation, Promising Young Scientist Award, Presented at the XXII Congress of the International Society of Biomechanics, Cape Town, South Africa, July 5-9, 2009.

Does knowledge of whiplash injury mechanisms and seat design translate to understanding outcomes?, Presented at the 2011 Whiplash International Symposium Panel Discussion: Whiplash: How to lessen the transition to chronicity, Sunshine Coast, Queensland, Australia, February 15-17, 2011.

Does knowledge of whiplash injury mechanisms and seat design translate to understanding outcomes?, Presented at the 2011 Whiplash International Symposium: Whiplash: How to lessen the transition to chronicity, University of Queensland, St Lucia Campus, Brisbane, Australia, February 19-20, 2011.

Effects of anti-whiplash seats on cervical facet and disc kinematics during simulated rear crashes. Plenary presentation, 2011 Young Scientist Post-Doctoral Award. Presented at the American Society of Biomechanics 35th Annual Meeting, Long Beach, CA, August 10-13, 2011.

Spine Biomechanics. Research Seminar, Department of Orthopaedics & Rehabilitation, Yale University School of Medicine, New Haven, CT, November 29, 2012.

Spine Biomechanics Research. Spine Conference, Department of Orthopaedics & Rehabilitation, Yale University School of Medicine, New Haven, CT, February 21, 2013.

Current Research in Human Injury Biomechanics. Where Science Meets Service - Chiropractic Application of Current Research, Denver, CO, September 7, 2013.

Human Injury Biomechanics. Interuniversity Centre of Bioengineering of the Human Neuromusculoskeletal System, Department of Movement, Human and Health Sciences University of Rome "Foro Italico", Rome, Italy, September 12, 2013.

Injury Models for Development & Evaluation of Spinal Fixation Systems, Spine Biomechanics Symposium, Globus Medical Inc., Audubon, PA, July 25, 2014.

Whiplash injury prevention. Keynote speaker, 19th Annual Scientific Conference, Spine Research Institute of San Diego, Coronado Island, San Diego, CA, To be presented: November 22-23, 2014.

PUBLISHED PHOTOGRAPHS

Ivancic PC, Sun CY, Hippopotamuses at Dawn in Lake Panic, Kruger National Park, South Africa, *Spine*, 34(21), October 1, 2009.