

The Mercedes-Benz CIREN Center at the University of Alabama at Birmingham

2002 Progress Report

The Mercedes-Benz CIREN Center is located at the University of Alabama at Birmingham. The University of Alabama at Birmingham (UAB) Health System is one of the largest and most diverse providers of health care, research, and education in the Southeast. With 908 beds, the UAB Hospital is the largest tertiary care institution in Alabama. UAB trains most of Alabama's physicians, nurses, dentists, optometrists, and allied health professionals. The Center is directed by Loring W. Rue, M.D. The Team is comprised of other trauma care clinicians and researchers, emergency care providers, epidemiologists, crash investigators, and engineers. Key participants of the Mercedes-Benz CIREN Center include Drs. Jorge Alonso, Stephan Moran, Donald Reiff, Gerald McGwin, Alan Eberhardt, Gregory Davis, Jim Davidson, Mr. Daniel Selke, Ms. Marilyn Doss, Ms. Holly Waller, and Ms. Kassi Webster.



Progress and Accomplishments

As of September 2002, the Mercedes-Benz CIREN Center team has screened 1564 patients for enrollment since investigating its first case in November 1999. So far, 127 cases have been enrolled. Between January and September 2002, the Center screened 515 patients and accepted 33 cases. Case review meetings involving trauma specialists, orthopaedic specialists, EMS providers, biomedical engineers, automotive safety engineers, etc. were held each month and the Team entered approximately 50 cases into the CIREN database.

The team has presented their work at many conferences and meetings. Past year conference and outreach presentations include:

- "The Other CIREN — The Crash Injury Research and Engineering Network," presented by Holly Waller, RN, BSN at Emergency Nurses' Association Leadership Challenge, March 2, 2002—Charlotte, NC.
- "CIREN: Improving Motor Vehicle Safety" presented by Holly Waller, RN, BSN, May 16, 2002, UAB Trauma Burn Clinical Update, Birmingham, AL.
- "CIREN – Closing the Crashworthiness Loop" by Moran SG., presented at the Department of Surgery Grand Rounds, University of Alabama at Birmingham School of Medicine. Birmingham, AL. June 27, 2002.
- "CIREN – Closing the Crashworthiness Loop" Moran SG., Presented to the Western Automotive Journalists. San Francisco, CA. November 17, 2002.
- "The relationship between age and lower extremity fractures in motor vehicle collisions." Moran SG, Metzger J, McGwin G, Alonso JE, Rue LW. Poster presentation at 62nd Annual Meeting of the Association for the Surgery of Trauma.

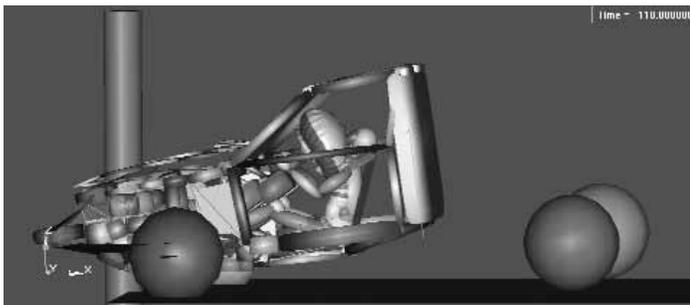


CIREN was also highlighted at the Annual Southeast Trauma Conference for Orthopedic and Trauma Surgeons, held in Destin, FL, April 4-7, 2002. CIREN-focused presentations included "CIREN and Skeletal Trauma" by Dr. Andrew Burgess of the University of Maryland and the Johns Hopkins University and "Restraint use and Lower Extremity Fracture in Frontal Motor Vehicle Collisions" by Dr. Lance Estrada, orthopedic resident at UAB.

Researchers associated with the Mercedes-Benz CIREN Center have been very prolific over the past year, publishing several articles in nationally and internationally recognized trauma care and injury analysis journals and presenting works at national and regional conferences. A list of recent publications and presentations, along with abstracts is presented under "Research Results".

Student Involvement

As part of the UAB Center for Injury Sciences (CIS), the Mercedes-Benz CIREN Center has had the opportunity to involve medical students and residents in its activities. Residents in general surgery participate in the collection and interpretation of data collected as part of a CIREN investigation and review. This past year, the Center's involvement with medical students expanded. Students were responsible for investigating hypotheses about injury patterns in motor vehicle collisions that are generated from individual CIREN cases. Working with CIS staff, these students addressed hypotheses using databases including NASS, FARS and GES.



Students have also participated in CIREN-related activities within the School of Engineering. Both graduate and undergraduate engineering students have been involved in the biomechanical lower extremity research being conducted by Drs. Eberhardt and Alonso. Several theses and publications have resulted. Also, through funding from the National Science Foundation, National Highway Traffic Safety Administration, and the University Transportation Center for Alabama, engineering students have explored, for example, causes and mechanisms of motor vehicle crash induced head injury, causes and mechanisms of injury in children, and technology needed for an integrated system for the remote determination of injuries incurred during motor vehicle crashes.

Partnerships

During the past year, the involvement of two important partnerships was expanded. As part of the partnership was with the Jefferson County Coroner/Medical Examiner Office (JCCMEO), 22 motor vehicle collision related fatalities were accepted as CIREN cases and reviewed. A partnership with The Children's Hospital of Alabama (TCHA) was also formed. Dr. William Hardin, Associate Professor of Surgery, and Carden Johnston, Professor of Pediatrics, participated in cases reviews over the past year and will lead the CIREN effort at TCHA.

Research Results

Differences in the Incidence and Etiology of Blunt Thoracic Aortic Injury in Motor Vehicle Collisions by Age

McGwin G, Reiff DA, Rue LW. Differences in the incidence and etiology of blunt thoracic aortic injury in motor vehicle collisions by age. *J Trauma*. 2002;52:859-65.

Introduction – Motor vehicle collision (MVC) related blunt thoracic aorta injury (BAI) is rare and highly lethal. Vascular disease as related to advancing age potentially subjects older adults to increased risk of BAI; the mechanisms associated with such injuries may be different as compared to younger adults. The goal of the present study is to test this hypothesis using population-based data. **Methods** – The 1995-1999 National Automotive Sampling System (NASS) data files were utilized. NASS is a national probability sample of passenger vehicles involved in police-reported tow-away crashes. BAI was defined according to the Abbreviated Injury Scale codes. Among those with BAI, information on occupant (age, seating position, restraint use), collision (collision type, delta-V, vehicle intrusion) and outcome characteristics were obtained and compared according to age. **Results** – The overall incidence of BAI was 6.8 per 10,000 occupants and a steady increase in the BAI rate for advancing decades of life. The proportion of occupants with BAI who die at the scene of the collision is relatively consistent across all age groups (~85%). Among those who survive to receive medical care, ultimate survival is lowest among those aged 60 and older. Near-side collisions were responsible for more BAI among older adults than other age groups (50% vs. 20.6%, $p < .05$). Older adults sustained BAI in collisions with lower delta-V values compared with younger persons ($p < .05$). **Conclusions** – Older adults have the highest rate of MVC related BAI and their injuries tend to occur in less severe collisions. Age associated atherosclerosis and calcification of the great vessels, which diminish vessel elasticity and compliance, may explain this difference. A high level of suspicion for BAI among older adults should not be reserved for high-energy collisions only.

Restraint Use and Injury Patterns Among Children Involved in Motor Vehicle Collisions

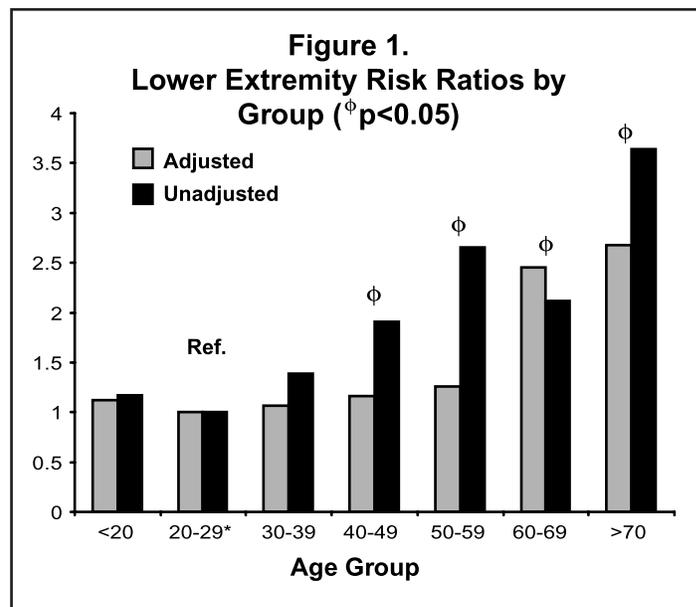
Valent F, McGwin G, Hardin W, Johnston C, Rue LW. Restraint use and injury patterns among children involved in motor vehicle collisions. *Journal of Trauma*. 2002;52(4):745-51.

Introduction – Motor vehicle collisions (MVC) are the leading cause of death among children over 1 year of age (YOA). Use of appropriate restraint systems is associated with reductions in morbidity and mortality in this age group. No studies have evaluated the association between specific injury patterns and restraint use among children. The purpose of this study was to evaluate differences in rates of specific injuries according to restraint use among children 0-11 YOA. **Methods** – The 1995-1999 National Automotive Sampling System (NASS) data files were utilized. NASS is a national probability sample of passenger vehicles involved in police-reported tow-away crashes. Information on occupant (seating position, restraint use), collision (change in velocity, vehicle intrusion) and outcome characteristics was evaluated. Rates for specific injuries (Abbreviated Injury Scale [AIS] ≥ 2) were calculated and compared according to restraint use. **Results** – Between 1995 and 1999 there were approximately 1.5 million children 0-11 YOA involved in police-reported tow-away MVCs; 36,640 experienced an injury of AIS ≥ 2 (2.4/100). Proper restraint use varied by YOA subgroups; 0-3 (53.9%), 4-7 (60.5%), 8-11 (74.7%). Injury rates were lower among properly restrained than among unrestrained children. Additionally, improperly restrained occupants had higher rates than those properly restrained, and rates of face, upper extremity, and lower extremity injury were significantly higher among improperly restrained children than among those properly restrained. **Conclusion** – Proper restraint use among children is associated with lower rates of injury. Educational initiatives should focus not only on encouraging restraint use but also ensuring that parents know the appropriate age dependent restraint method.

The Relationship Between Age and Lower Extremity Fractures in Motor Vehicle Collisions

Moran SG, Metzger JS, McGwin G, Alonso JE, Rue LW. The relationship between age and lower extremity fractures in motor vehicle collisions. Poster presentation at 62nd Annual Meeting of the Association for the Surgery of Trauma. *Journal of Trauma*. In press.

Background – Older adults (age > 65 years) represent the single fastest growing segment of the United States population and will comprise one in five Americans during the third decade of this century. As this population segment rapidly expands, lower extremity fractures (LE Fx) and their associated disability will become a greater public health concern. The purpose of this study was to quantify the risk



for LE Fx from motor vehicle collisions (MVC) according to age. **Methods** – The 1995-2000 National Automotive Sampling System data files were utilized. Study entry was limited to front seated occupants involved in frontal MVCs. Risk ratios for LE Fx and age were adjusted for gender, driver vs. passenger, seatbelt use, airbag deployment, delta-V, intrusion and vehicle type. **Results** – Beginning in the fourth decade, there was a trend of higher relative risk for LE Fx with age that reached statistical significance in the seventh decade of life. **Conclusion** – This study documented an increased risk of LE Fx in older MVC occupants. Efforts to prevent these disabling injuries and to better protect occupants' lower extremities in MVCs should include improved vehicle design and reevaluation of the existing Federal Motor Vehicle Safety Standards.

Splenic Injury in Side Impact Motor Vehicle Collisions – The Effect of Occupant Restraints

Reiff DA, McGwin G, Rue LW. Splenic injury in side impact motor vehicle collisions – The effect of occupant restraints. *J Trauma*. 2001; 51:340-5.

Introduction – Side impact motor vehicle collisions (MVCs) are associated with higher morbidity and mortality compared to other types of MVCs. The stiffness of the lateral aspect of the vehicle and restraint use may play a role. The purpose of this study was to evaluate the role of restraint use, vehicle size and compartment intrusion on the incidence of splenic injury in side impact MVCs. **Methods** – The National Automotive Sampling System (NASS) was used to identify drivers involved in side impact collisions for the years 1996-1998. The incidence of splenic injury in these collisions was compared according to restraint use, vehicle size and magnitude of vehicle crush. Information on the perceived etiology of splenic injuries sustained in the MVC was also obtained from

NASS investigator records. **Results** – Overall, among drivers involved in side impact MVCs, restraint use was associated with a significantly reduced rate of mortality (odds ratio [OR]= 0.40, $p<0.0001$) and splenic injury (OR=0.76, $p<0.0001$). Restrained drivers of small vehicles (<2,500 lbs.), however, had a higher incidence of splenic injury in both minimal (lateral intrusion < 30 cm.) (OR=60.1, $p<0.0001$) and severe (lateral intrusion > 30 cm.) (OR=4.0, $p<0.0001$) magnitudes of vehicle crush on the driver's side of the vehicle. For both mid-sized (2,500 – 3,000 lbs.) and large (>3,000 lbs.) vehicles, restraint use was associated with a lower risk of splenic injury regardless of the magnitude of crush. In nearly all cases of splenic injury, the left vehicle interior was the source of injury. **Conclusion** – Overall, restraint use is associated with lower rates of splenic injury and mortality in side impacts. Despite this fact, restrained drivers of small vehicles have a higher risk of splenic injury following lateral impact MVCs when compared with unrestrained drivers. Evaluation of the combined role of restraint use, crash and injury patterns may provide novel insight regarding vehicle safety design features.

Injury Rates among Restrained Drivers in Motor Vehicle Collisions: The Role of Body Habitus

Moran SG, McGwin G Jr, Metzger JS, Windham ST, Reiff DA, Rue LW. Injury rates among restrained drivers in motor vehicle collisions: the role of body habitus. *J Trauma*. 2002;52:1116-20.

Background – Previous studies have examined the independent effects of occupant height, obesity, and body mass index in motor vehicle collisions and identified related injury patterns. The hypothesis of this study was that as the driver's body habitus diverges from the 50% percentile male Hybrid III Crash Dummy (H3CD), the frequency of injury changes. **Methods** – The 1995 to 1999 National Automotive Sampling System Crashworthiness Data System was used. Study entry was limited to restrained drivers who were then subdivided into height and weight categories. Incidence rates were calculated for injuries to selected body regions as defined by the Abbreviated Injury Scale for overall, frontal, and driver's side collisions. **Results** – When grouped according to height and weight as descriptors of body habitus, injury rates for restrained drivers were increased as well as decreased in several subgroups. This association was seen in overall, frontal, and driver's side collisions. **Conclusion** – The H3CD plays a major role in vehicular cabin interior design and crash testing. For drivers with a body habitus different from that of the H3CD, the vehicle cabin/body fit changes and the safety features may perform differently, which could account for these observations.

The Association between Body Mass Index, Restraint Use, and Fatality in Motor Vehicle Collisions

Moran SG, McGwin G, Reiff DA, Rue LW. The association between body mass index, restraint use, and fatality in motor vehicle collisions. *Proceedings of the Association for the Advancement of Automotive Medicine*. 2001;45:107-123.

Background – The purpose of this study was to characterize the association between BMI, body habitus (height and weight) and risk of death for restrained drivers involved in MVCs. In characterizing any association, the authors sought to identify patterns of the rare occurrence of fatality in MVCs. **Methods** – The 1995-1999 National Automotive Sampling System Crashworthiness Data System was utilized. Fatality rates were calculated and compared between BMI and body habitus categories. The data was further stratified according to general area of damage; fatality rates were then compared. To quantify the magnitude of these associations, fatality relative odds ratios (ORs) and 95 percent confidence intervals (CIs) were calculated with the 50th percentile Hybrid III male crash dummy as the reference point, p -values of ≤ 0.05 were considered statistically significant. SUDAAN[®] 7.52 was used for all statistical analyses. **Results** – Body mass index as a descriptor of body habitus was not associated with fatality rates. When grouped according to height and weight as descriptors of body habitus, fatality rates for restrained drivers were significantly different in several subgroups. In MVCs overall, fatality rates were decreased in three of the lighter subgroups. The fatality rate was increased in the subgroup shorter than the Hybrid III in driver's side collisions and the lighter subgroup in frontal collisions. The 5th percentile female subgroup did not have fatality rates and ORs significantly different from the H3CD. **Conclusions** – The 50th percentile male Hybrid III Crash Dummy plays a major role in vehicular cabin interior design and crash testing. For drivers with a dissimilar body habitus, the vehicle cabin/body fit changes and the safety features perform differently which may account for these observations.

Identifying Injuries and Motor Vehicle Collision Characteristics That Together Are Suggestive of Diaphragmatic Rupture

Reiff DA, McGwin G, Metzger J, Doss M, Rue LW. Identifying injuries and motor vehicle collision characteristics that together are suggestive of diaphragmatic rupture. *Journal of Trauma*. In press.

Introduction – Diaphragmatic rupture (DR) remains a diagnostic challenge due to the lack of an accurate test demonstrating the injury. As non-operative management of solid organ injury is more frequently employed, early recognition of DR has become more complicated. Our purpose was to identify motor vehicle collision (MVC) characteris-

tics and patient injuries, which collectively could indicate DR. **Methods** – The National Automotive Sampling System was used to identify front seat occupants involved in MVCs from 1995-99 who sustained abdominal (Abbreviated Injury Scale (AIS) ≥ 2) and/or thoracic injuries (AIS ≥ 3). The frequency of specific injuries and MVC characteristics, alone and in combination, were compared among patients with and without a DR. Odds ratios (OR) and 95% confidence intervals (CI) were calculated to quantify the association between patient injuries, vehicle collision characteristics and DR. Sensitivity and specificity were also calculated to determine the ability of organ injury and MVC characteristics to correctly classify patients with and without DR. **Results** – Overall, among drivers and front seat passengers involved in MVCs, patients with DR had a significantly higher delta-v (DV) (50.3 kph vs. 36.4 kph, $p < 0.0001$) and a greater degree of occupant compartment intrusion (70.6 cm vs. 52.3 cm, $p < 0.0001$). Specific abdominal and thoracic organ injuries were associated with DR including thoracic aortic tears (OR, 4.2; 95% CI 1.8-10.1), splenic injury (OR, 5.4; 95% CI 2.5-11.8), pelvic fractures (OR, 4.0; 95% CI 2.4-6.7) and hepatic injuries (OR, 2.3; 95% CI 0.9-5.7). Combining frontal or near-side lateral occupant compartment intrusion ≥ 30 cm or (DV) ≥ 40 kph with specific organ injuries generated a sensitivity for detecting diaphragm injury ranging from 85-88%. Patients with any of the following characteristics; splenic injury, pelvic fracture, DV ≥ 40 kph or occupant compartment intrusion from any direction ≥ 30 cm had a sensitivity for detecting DR of 91%. **Conclusion** – We have identified specific MVC characteristics combined with patient injuries, which together are highly suggestive of DR. For this subpopulation, additional invasive procedures including exploratory laparotomy, laparoscopy or thoracoscopy may be warranted to exclude DR.

Common Bile Duct Transection in Blunt Abdominal Trauma: Case Report Emphasizing Mechanism of Injury and Therapeutic Management

Melton SM, McGwin G, Cross JM, Davidson J, Waller H, Doss MW, Vickers S, Rue LW. Common bile duct transection in blunt abdominal trauma: Case report emphasizing mechanism of injury and therapeutic management. *Journal of Trauma*. In press.

Extrahepatic biliary tract injuries occur in three to five percent of all abdominal trauma victims with 85% resulting from penetrating wounds. Of the remaining 15%, the vast majority, 85%, involve the gallbladder alone. Consequently, common bile duct injuries from blunt abdominal trauma are exceedingly rare, especially those resulting in complete transection of the duct. A patient sustaining complete transection to the CBD following blunt force motor vehicular trauma will be presented. A review of diagnostic techniques and therapeutic management is summarized. The details of

the mechanism of injury in this motor vehicle crash are closely examined using data obtained from an in-depth crash investigation and analysis.

The Association Between Restraint Systems and Frontal Motor Vehicle Collision-Related Morbidity and Mortality

McGwin G, Metzger J, Alonso JE, Rue LW. The association between restraint systems and frontal motor vehicle collision-related morbidity and mortality. *Journal of Trauma*. In press.

Background – An evaluation of seat belt use and air bag deployment, either alone or in combination, on risk of injury to specific body regions has yet to be completed. **Methods** – A retrospective cohort study of front seat occupants involved in police-reported, tow-away frontal MVCs using data from the 1995 through 2000 National Automotive Sampling System was conducted. Only vehicles with a change in velocity (ΔV) of ≥ 15 kmph were included. Risk of injury (Abbreviated Injury Scale [AIS], ≥ 2) to specific body regions was compared according to seat belt use and air bag deployment. **Results** – Compared to completely unrestrained occupants, those using a seat belt alone or in combination with an air bag had a reduced overall risk of injury (relative risk [RR] 0.42 and 0.71, respectively); no association was observed for those restrained with an air bag only (RR 0.98). This pattern of results was similar for specific body regions with the exception of the lower extremity wherein a significantly increased risk was observed for air bag deployment alone. **Conclusion** – Air bag deployment does not appear to significantly reduce the risk of injury either alone or in combination with seat belts. Air bag deployment without associated seat belt use may increase the risk of lower extremity injury.

Gender Differences in the Incidence of Below Knee Fractures following Offset Frontal Motor Vehicle Collisions

McGwin G, Reiff D, George R, Davidson J, Rue LW. Gender differences in below knee fractures following offset frontal collisions. *Journal of Trauma*. Submitted.

Introduction – Motor vehicle collisions (MVCs) are the leading cause of injury-related deaths in the United States. While the fatality rate associated with MVCs has dramatically fallen as personal restraint use has increased, the rate of lower extremity (LE) injuries has not been significantly affected by their use. Lower extremity injuries are costly and the cause of permanent disability and impairment following MVCs. Previous authors have found females to be at particular risk of LE fractures and attributed this gender dimorphism to their shorter stature. **Methods** – The National Automotive Sampling System was used to identify

drivers involved in frontal MVCs from 1995-99. The rate of below knee fractures was compared between males and females both overall and stratified by occupant and crash characteristics. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated to quantify the association between gender and below knee LE fractures. **Results** – Below knee fractures following offset frontal MVCs occur less frequently among males compared with females (OR 0.61, 95% CI 0.43-0.85). Neither age nor DV, the change in velocity at the time of collision, was able to explain this observed difference. Among occupants who sat with the seat in the middle or back position, males had a lower incidence of below knee fractures (OR 0.67, 95% CI 0.46-0.97); this pattern was also present among those seated in the forward position (OR 0.26, 95% CI 0.07-0.93).

Conclusion – Females are at greater risk of below knee fracture regardless of height, seat position and DV following offset-frontal MVCs. Possible explanations of these findings include footwear, driving habits and/or bone density. These findings warrant further investigation by automobile and federal agencies in an effort to reduce these lifelong disabling injuries.

Injury Patterns Among Older Adults Involved in Motor Vehicle Collisions – The Role of Near Side Collisions

McGwin G, McRae WE, Taylor AJ, Davidson JS, Rue LW. Injury patterns among older adults involved in motor vehicle collisions – The role of near side collisions. *Journal of Orthopaedic Trauma*. Submitted.

Background – Automobile collisions are more likely to result in injury and result in poorer outcomes for older adults. Of particular concern are side-impact collisions which have been shown to result in elevated morbidity and mortality for older adults. The objective of this study is to compare injury patterns in near-side (NS) versus non-NS collisions among patients 60 years of age and older treated at a Level I trauma center. **Methods** – The study population was 201 patients aged 60 years and older admitted to a Level I trauma center for injuries sustained in motor vehicle collisions. Injury patterns were compared between patients involved in NS versus non-NS collisions. **Results** – Differences in injury patterns between NS and non-NS patients were a function of seatbelt use and vehicle speed. Among restrained patients and those involved in high-speed collisions, NS patients were more likely to sustain head injuries and pelvic fractures. Among unrestrained patients, tibia/fibula fractures were more common among NS compared with non-NS patients (NS: 42.9% vs. non-NS: 11.4%; $p=0.07$). **Conclusion** – Injury patterns among older adults involved in motor vehicle collisions differ according to characteristics of the collision. Future research should determine whether these injury patterns are independent of age.

Occupant and Collision Related Risk Factors for Blunt Thoracic Aorta Injury

McGwin G, Metzger J, Moran SG, Rue LW. Occupant and collision related risk factors for blunt thoracic aorta injury. *Journal of Trauma*. Submitted.

Introduction – Blunt thoracic aortic injury (BAI) is a rare and highly lethal injury. We sought to identify occupant and collision characteristics associated with motor vehicle collision (MVC) related BAI. **Methods** – The 1995-2000 National Automotive Sampling System (NASS) data files were utilized. NASS is a national probability sample of passenger vehicles involved in police-reported tow-away MVCs. The risk of BAI was calculated according to specific occupant (e.g., age, seat belt use) and collision (e.g., ΔV , vehicular intrusion) characteristics. The association between BAI and these characteristics was calculated using risk ratios (RRs) and associated 95% confidence intervals (CIs). **Results** – Specific occupant and collision characteristics demonstrated independent association with BAI. Occupant characteristics included age ≥ 60 (RR 3.61, 95% CI 2.53-5.15), seat belt use (RR 0.33, 95% CI 0.21-0.53), and being a front-seated occupant (RR 3.11, 95% CI 1.51-6.34). Frontal and near-side collision were associated an increased (RR 3.10, 95% CI 1.88-5.11 and RR 4.30, 95% CI 2.58-7.18, respectively) relative to other collision types. Collisions with a $\Delta V \geq 40$ km/h (RR 3.80, 95% CI 2.59-5.57) or that produce extensive vehicle crush (≥ 40 cm.) (RR 4.11, 95% CI 2.70-6.27) or intrusion (≥ 15 cm.) (RR 5.03, 95% CI 3.47-7.30) also increase the risk of BAI. **Conclusion** – The risk factors for BAI identified in this study support generally accepted etiologic mechanisms for this injury.

Is Seat Belt Use Associated with Fewer Days of Lost Work Following Motor Vehicle Collisions?

Metzger J, McGwin G, Rue LW. Is seat belt use associated with fewer days of lost work following motor vehicle collisions? *Journal of Trauma*. Submitted.

Introduction – Seat belt use has consistently been shown to reduce motor vehicle collision (MVC) related morbidity and mortality. The goal of this study is to determine whether seat belt use is associated with fewer lost workdays among occupants involved in MVCs. **Methods** – The 1995-2000 National Automotive Sampling System (NASS) data files were utilized. NASS is a national probability sample of passenger vehicles involved in police-reported tow-away MVCs. Occupants' lost workdays, which are routinely collected as part of a NASS investigation, were compared according seat belt use. **Results** – During 1995-2000 in the United States, surviving occupants involved in MVCs lost a total of 36.8 million workdays (~6.1 million lost workdays per year; 2.1 lost workdays per person). The overall difference in lost workdays between

the belted and unbelted occupants was 1.38 days (1.75 days vs. 3.13 days, respectively; $p=0.002$). After adjusting for potentially confounding factors, belted occupants had 1.29 fewer lost workdays compared with unbelted occupants ($p=0.002$). This translates to an estimated 6.2 million lost workdays and an associated \$480 million in lost wages and \$910 million in workplace costs attributable to lack of seat belt use in the United States during 1995-2000.

Conclusion – Lost workdays attributable to MVCs in the United States have sizable financial implications. Furthermore, seat belt use significantly reduces lost time at work and is associated with a significant cost savings. The national impact of unbelted driving on work productivity is dramatic and further efforts to promote appropriate seat belt use should continue as part of the national safety agenda.

The Association Between Side Air Bags and Risk of Injury in Near-Side Impact Motor Vehicle Collisions

McGwin G, Metzger J, Porterfield JR, Moran SG, Rue LW. The Association Between Side Air Bags and Risk of Injury in Near-Side Impact Motor Vehicle Collisions. Presentation at the 2003 EAST Meeting.

Context – Side air bags (SABs) have been introduced in an attempt to reduce the risk of injury in near-side impact motor vehicle collisions (MVCs). The impact of SABs on MVC-related mortality and morbidity has yet to be evaluated with a large population-based study. **Objective** – To assess the effectiveness of SABs in reducing the risk of injury or death in near-side impact MVCs. **Design, Setting, Subjects** – A retrospective study of outboard front-seated occupants involved in police-reported, near-side impact MVCs using data from the General Estimates System (1997-2000). **Main Outcomes Measures** – MVC-related non-fatal and fatal injury. **Results** – Front seated occupants in vehicles with SABs had a similar risk of injury as those occupants in vehicles without SABs (relative risk [RR] 0.96, 95% confidence interval [CI] 0.79 -1.15). Adjustment for the potentially confounding effects of age, gender, seat belt use, seating position, damage severity and location and vehicle body type did not meaningfully affect the association (RR 0.90, 95% CI 0.76-1.08). **Conclusion** – There is no association between the availability of SABs and overall injury risk in near-side impact MVCs. Future research will be necessary to determine the effectiveness of SABs in preventing those injuries for which they were specifically designed.

Risk of Injury and Death for Occupants of Motor Vehicle Collisions from Unbelted Occupants

MacLennan P, McGwin G, Metzger J, Rue LW, Moran SG. Risk of Injury and Death for Occupants of Motor Vehicle Collisions from Unbelted Occupants. Presentation at the 2003 EAST Meeting.

Context – In a motor vehicle collision (MVC), unbelted occupants may increase the risk of injury and death for other occupants by becoming projectiles within the vehicle. Few studies have investigated this issue. **Objective** – The purpose of the study was to evaluate the association between occupant restraint use and the risk of injury and death to other vehicle occupants. **Design** – A population based case-control study. **Setting** – The 1991-1999 General Estimates System (GES), a probability sample of all police reported MVCs annually in the United States. **Patients** – At-risk subjects were defined as MVC occupants seated with a belted or unbelted occupant contiguous to them and in the line of the principal direction of force (PDOF).

Main Outcome Measure – Cases were occupants with a known, non-incapacitating, incapacitating, fatal or severity unknown injury, while controls were occupants that were not injured. The primary exposure of interest was seat belt usage of the occupant contiguous to the at-risk occupant.

Results – For all at-risk occupants, exposure to unbelted occupants was associated with a 2.4 fold increased risk of injury or death (OR=2.4, 95% CI 2.2-2.6) when adjusted for age, seating position, vehicle type and crash severity. This association was modified by the seat belt use of the at risk occupant. When at risk occupants were belted, they were at increased risk (OR=1.7, 95% CI 1.5-1.8), though less than if they were unbelted (OR=3.2, 95% CI 2.9-3.6). For belted at-risk occupants, there was a 70% increased risk of injury or death associated with exposure, but among unbelted at-risk occupants, the association was absent (OR=1.0, 95% CI 0.8-1.1). **Conclusions** – Belted occupants seated with an unbelted occupant contiguous to them and in the line of the PDOF are at an increased risk of injury and death in the event of a MVC.