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

CIREN Program 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 state of Alabama has one of the highest death rates resulting from automobile accidents in the Nation. The University of Alabama at Birmingham Hospital serves a six county region with a population of approximately 2.1 million. The Level 1 Trauma Service treated more than 7,000 trauma-related injuries last year with 1,800 admissions. The trauma facility specializes in the treatment of burns, as well as head injuries, pelvis fractures, and multi-system injuries. UAB's Burn Center admits more than 200 patients per year and is the only American College of Surgeons/American Burn Association verified burn center in the state. The Mercedes-Benz CIREN Center is only one of several research initiatives focused on injury prevention housed in the Center for Injury Sciences at UAB.

The Mercedes-Benz CIREN Center was established in April 1999 as the 8th CIREN center. It was the first center voluntarily funded by a private sector partner. It is jointly funded by DaimlerChryslerAG (DCAG), Mercedes-Benz U.S. International, Inc. (MBUSI), and Mercedes-Benz USA, Inc. (MBUSA) to advance research on the causes of auto-related injuries and casualties. A very close and productive relationship has evolved between the Mercedes-Benz CIREN Center team and Mercedes-Benz safety engineers.

The Mercedes-Benz CIREN Center Team

The Mercedes-Benz CIREN center is directed by **Loring W. Rue, MD.** Dr. Rue obtained his undergraduate and medical degrees at the University of Virginia in Charlottesville. He undertook his residency in General Surgery at the University of Alabama at Birmingham and pursued a clinical and research fellowship at the U.S. Army Institution of Surgical Research in San Antonio. During that time, he conducted both clinical and basic research investigations concerning shock and burn resuscitation. In January 1992, Dr. Rue returned to the faculty at the University of Alabama at Birmingham and is currently Professor of Surgery. He also holds secondary appointments in the Department of Anesthesiology and Department of Civil and Environmental Engineering. He has held several administrative positions relative to trauma and surgical critical care as well as having been actively involved in the undergraduate and graduate medical education programs at UAB. His major research interests include the CIREN program and related epidemiologic research and trauma system development.

Other 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. Ashley Davis**.

Dr. Jorge Alonso is an Associate Professor of Surgery and Biomedical Engineering at UAB. He is also the chief of Orthopaedic Trauma at University Hospital and serves as the Associate Director for Clinical Diagnosis of the Center for Injury Sciences. Dr. Alonso's clinical practice is in the treatment of difficult fractures, with a special interest in

fractures of the pelvis and acetabulum. His extensive clinical experience has resulted in multiple publications.

Dr. Stephan Moran is the newest addition to the Mercedes-Benz CIREN Center team and is an Assistant Professor in the UAB Department of Surgery, Section of Trauma, Burns and Surgical Critical Care. Dr. Moran's research interest is in identifying the etiology and mechanisms of human injury as a result of blunt and penetrating forces. Dr. Moran is presently working on several projects looking at the association between occupant injury patterns in motor vehicle collisions with motor vehicle design and deformation patterns.

Through the first two years of CIREN activities at UAB, **Dr. Donald Reiff**, was an invaluable component of the team. Dr. Reiff's involvement was very productive as can be noted by his contributions to recent presentations and publications. Having completed the research phase of his training, Dr. Reiff has returned to the clinical aspect of his general surgery residency.

Dr. Gerald McGwin is an Assistant Professor in the Department of Epidemiology and Department of Surgery, and is the Associate Director for Research of the Center for Injury Sciences. Dr. McGwin's research focuses on injury and trauma, particularly among older adults. He is working on several projects related to medical and functional impairments and driving.

Dr. Alan Eberhardt is an Associate Professor in the UAB Department of Biomedical Engineering, with secondary appointments in Materials and Mechanical Engineering and in Civil Engineering. He is the Director of the UAB Musculoskeletal Mechanics Laboratory and directs both graduate and undergraduate research in biomechanics. For several years, Dr. Alonso and Dr. Eberhardt have partnered in investigating the etiology of pelvis ring and acetabular fractures from frontal, offset, and side impact crashes. A summary of current research being conducted by Drs. Alonso and Eberhardt is provided below.

Dr. Gregory Davis is a board certified forensic pathologist, an Associate Coroner with the Jefferson County Coroner/Medical Examiner Office (JCCMEO) and Associate Professor of Pathology at UAB. His interest is in adding to the UAB CIREN program the information gathered by postmortem examination of MVC occupant fatalities. A description of the recently formed partnership between the Mercedes-Benz CIREN Center and the Jefferson County Coroner/Medical Examiner Office is provided below.

Dr. Jim Davidson's primary appointment is as an Assistant Professor in the Department of Civil and Environmental Engineering at UAB. He also has appointments with the Department of Surgery and the Department of Biomedical Engineering and is faculty of the University Transportation Center for Alabama. His research and teaching centers around the use of advanced modeling techniques for describing mechanical and structural behavior. As the Associate Director of the Mercedes-Benz CIREN Center, Dr. Davidson helps with all aspects of the CIREN activities, plus he is helping to build other collaborations between the School of Engineering and School of Medicine and to build capabilities needed for a comprehensive crash injury research program that includes a strong engineering component.

Daniel Selke is the Manager of Safety Engineering for Mercedes-Benz USA, Inc. Mr. Selke participates in the CIREN case review meetings and provides very valuable insight into the design of automotive safety features and upcoming technologies.

Marilyn Doss is the crash investigator for the Mercedes-Benz CIREN Center. She has over 15 years of experience with the National Automotive Sampling System program and the General Estimates System.

Holly Waller serves as study coordinator for the Mercedes-Benz CIREN Center. She is a registered nurse and received her bachelor's degree in nursing from Auburn University in 1992.

Ashley Davis has recently joined the team as the Data Information Coordinator in which she primarily assists in collecting CIREN data and preparing for case reviews.

Progress and Accomplishments

As of November 2001, the Mercedes-Benz CIREN Center team has screened 975 patients for enrollment since investigating its first case in November 1999. 84 cases have so far been enrolled. Each case is first organized and carefully reviewed in a meeting of the core UAB team, and then is presented formally to an extended group comprised of additional trauma specialists, orthopedic specialists, EMS providers, biomedical engineers, automotive safety engineers, etc. This group of disparate, yet vast expertise analyzes each case and agrees on the most likely injury mechanisms. More than a dozen formal case review meetings have occurred. Also, UAB has participated in joint meetings with other CIREN centers and has hosted meetings with the Baltimore CIREN team and the Michigan CIREN team to share experiences and methodology.

The team has presented their work at several CIREN conferences and other professional conferences and meetings. Quarterly CIREN conference presentations include: "Case Study of Lower Extremity Fractures" (May 5, 2000), "Clinical, Biomechanical, and Epidemiologic Perspectives on Side Impact Crashes" (July 21, 2000), "Gender Differences in Below Knee Fractures Following Offset Frontal Collisions" (March 16, 2001), "Passenger Cars, Minivans, and SUVs - An Exploratory Study in Relative Injury and Fatality Rates" (September 6, 2001).

In addition to the CIREN conferences, the team has presented their work at several other conferences and meetings as part of their outreach activities. This includes presentations to nurses and EMT's at the Annual Trauma Symposium, to the Emergency Nurses Association Injury Prevention Conference, and to the Alabama Transportation Conference. Now that the surveillance and data gathering activities of the Mercedes-Benz CIREN Center team are well established, the team plans to increase its use of CIREN in outreach activities.

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. Each year at least one resident in general surgery participates regularly in the collection and interpretation of data collected as part of a CIREN investigation and review. Recently, the Center's involvement with medical students has grown. Most often these students are responsible for investigating hypotheses about injury patterns in motor vehicle collisions that are generated from individual CIREN cases. Working with CIS staff, these students address these 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 crash.

Partnerships

During 2001 two important partnerships were formed with the Mercedes-Benz CIREN Center. The first partnership was with the Associate Coroner with the Jefferson County Coroner/Medical Examiner Office (JCCMEO). It had been observed by members of the CIREN team that an important population of motor vehicle collision victims do not survive the immediate effects of the collision and thus would never come to our attention. Therefore a relationship was formed between our Center and the JCCMEO. Dr. Davis identifies individuals who meet CIREN criteria and provides access to the necessary information to conduct an investigation. Dr. Davis has also been an invaluable resource during case reviews given his extensive experience in investigating causes of death.

The second partnership that has been formed is with The Children's Hospital of Alabama (TCHA). While this relationship is still being forged, resources are presently being organized to enroll children in CIREN very soon. Dr. William Hardin, Associate Professor of Surgery, and Carden Johnston, Professor of Pediatrics, participate regularly in cases reviews and will lead the CIREN effort at TCHA.

From the very beginning, the Mercedes-Benz CIREN Center has worked to incorporate a strong engineering research component into the program. This has facilitated a strong partnership between researchers of the School of Medicine and the UAB School of Engineering. The ultimate vision is to build the ability for comprehensive, collaborative crash injury research that includes the ability to analyze occupant motion and injury sources, forces that are incurred by particular body regions, and then conduct focused biomechanics studies on injury mechanisms and tolerances. There also are capabilities and strong interest from the School of Engineering in participating in the development of intelligent transportation technologies that will reduce the incidence and severity of motor vehicle crashes, and in developing and integrating technologies for automatic crash notification and remote injury determination.

Themes/Study Focus Areas

Elderly

The elderly are the most rapidly growing segment of the U.S. population and are increasingly active. The elderly also have one of the highest crash involvement and fatality rates of all age groups. This reflects a distinct pattern of risk factors for motor vehicle collisions as well as a reduced ability to survive given a collision. Dr. McGwin focuses much of his research interests on these topics. As such, the Mercedes-Benz CIREN Center has a particular interest in enrolling older adults, even if they do not meet CIREN criteria. These cases have formed the basis for several research activities by Dr. McGwin. Many of these activities have been presented and/or published (listed below).

Lower Extremity Injuries

Automotive collisions continue to be growing source of injury to the pelvis and lower extremities. Previous experimental and computational studies in the areas of pelvic and ankle fractures have provided valuable insight into injury mechanisms and means for prevention, however, much is still unknown. Specifically, the roles of femoral angle and loading axis on acetabular and pelvic stresses, and related fractures, have not been established. The stiffness of the talocrural joint at the bone-ligament level has not been well described, and is necessary to validate current finite element models of the ankle.

One primary aim of ongoing studies at UAB is to improve our understanding of the etiology of pelvic ring and acetabular fractures in frontal, offset and side impact automotive crashes. A combination of experimental and computational studies is being used to determine the effects of loading direction and femoral orientation on acetabular stresses, dynamic pelvic stresses and resulting fracture patterns. First, contact pressures are being measured in cadaver acetabulae using pressure-sensitive film under conditions of varying femoral angle and load path. These contact pressures will be implemented in finite element models to examine the effect of femoral angle and principal loading axis on pelvic stresses. Ultimately, select impacts will be performed in order to test the model predictions for acetabular and pelvic ring fractures.

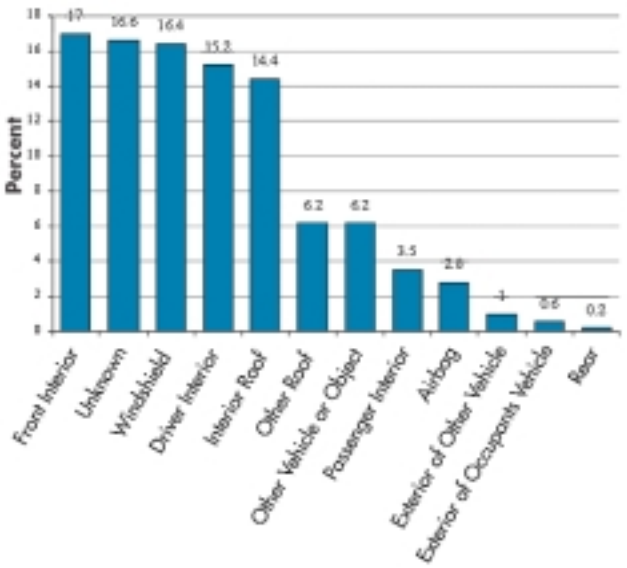
A second objective is to determine the stiffness/flexibility behavior of the ankle at the talocrural joint. This is being done using an experimental apparatus that imposes controlled moment loading about three orthogonal coordinate axes. Rotational and translational displacements are measured on isolated cadaver ankles, dissected to the bone-ligament level, using 3-D motion capture. Nonlinear profiles of talocrural flexibility behavior will be established for validation of existing finite element models. Secondary goals for the effort include continued surveillance activities related to pelvic fractures and a gait study of subjects recovering from pelvic reconstructive surgery.

Head Injury

Head injury remains one of the leading causes of trauma related death in the United States. It is estimated by the National Institute of Health's, Integrated Head Injury Task Force in 1992 that 500,000 Americans sustain traumatic brain injury annually with an economic impact of $7.6 billion. In the Southeast, approximately 100,000 people sustain TBI each year, at a rate higher than the rest of the Nation.

UAB has been involved in developing a head injury plan for Alabama. This plan parallels the ideal trauma system that considers prevention efforts, pre-hospital care, in-hospital care, and rehabilitative concerns. An integrated catchment program for patients with head injury and other critical neurologic diseases is being developed, and data relative to all facets of care for the severely injured is being integrated and interrelated. This program supports the development of a comprehensive head injury database to involve the pre-hospital care elements from the trauma

Source of Head Injury in Case Drivers



system, the in-hospital acute care aspect provided by the TRACS® trauma registry, and the rehabilitative data supported by NIH sponsored Model Center for Traumatic Brain Injury at UAB and the UAB Injury Control Research Center/Center for Disease Control supported data set for the National Center for Injury Prevention Control. This activity also partners with the Center for Health Promotion to develop an academically oriented prevention and outreach initiative. Although airbag and other safety technology have resulted in a substantial reduction in head injury during motor vehicle crashes, head injury remains a leading cause of death and long-term disability of motor vehicle crash victims. Since motor vehicle crashes account for over 70,000 serious head injuries each year, the ongoing head injury efforts are being partnered with the UAB CIREN efforts to specifically study causes and mechanisms of head injury occurring in crashes in today's fleet.

Research Efforts/Publications/Submissions

Although the Mercedes-Benz CIREN Center at UAB has been collecting cases for only a couple of years, the activities of the center have already led to several discrete studies related to motor vehicle crash trauma. CIREN provides center participants and other researchers direct, real-life insight into mechanisms of injury resulting from motor vehicle collisions. Hypotheses regarding injury patterns and mechanisms are easily discerned from CIREN cases. These hypotheses then lead to comprehensive studies that involve NASS, occupant kinematics modeling, biomechanics laboratory testing, etc. The results of these studies are ultimately used by the automotive safety industry to make automobiles safer. Several recent UAB publications and manuscripts that initiated from UAB CIREN case studies are outlined below.

Incidence and Characteristics of Motor Vehicle Collision Related Blunt Thoracic Aortic Injury According to Age

McGwin G, Reiff DA, Rue LW. "Differences in the incidence and etiology of blunt thoracic aortic injury in motor vehicle collisions by age." In press. *Journal of Trauma.*

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%, $p \leq 05$). Older adults sustained BAI in collisions with lower delta-V values compared with younger persons ($p \leq 05$). **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.

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

Reiff DA, McGwin G, Rue LW. "Risk factors for diaphragm rupture in motor vehicle collisions." Accepted for presentation at the 2002 EAST meeting.

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) characteristics 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 (ΔV) (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 (ΔV) ≥ 40 kph with specific organ injuries generated sensitivity for detecting diaphragm injury ranging from 85-88%. Patients with any of the following characteristics; splenic injury, pelvic fracture, ΔV ≥ 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 laparatomy, laparoscopy or thoracoscopy may be warranted to exclude DR.

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

Valent F, McGwin G, Rue LW. "Restraint use and injury patterns among children aged 0 to 11." Submitted. *Journal of Trauma*.

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.

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." In press. *Journal of Trauma*.

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.

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." In preparation.

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 ΔV, 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 ΔV 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." 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.

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." In press. *45th Annual Proceedings of the Association for the Advancement of Automotive Medicine, 2001.*

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.

Injury Rates Among Restrained Drivers in Motor Vehicle Collisions – The Role of Body Habitus

Moran SG, McGwin G, Metzger J, Windham ST, Reiff DA, Rue LW. "Injury rates among restrained drivers in motor vehicle collisions – The role of body habitus." In press. *Journal of Trauma.*

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 1995-1999 National Automotive Sampling System Crashworthiness Data System was utilized. 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. **Conclusions** – The H3CD plays a major role in vehicular cabin interior design and crash testing. For drivers with a dissimilar body habitus from that of the H3CD, the vehicle cabin/body fit changes and the safety features may perform differently which could account for these observations.

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

Melton SM, McGwin G, Reiff DA, Waller H, Davidson JS, Vickers S, Rue LW, "Common bile duct transection in blunt abdominal trauma: case report emphasizing mechanism of injury and therapeutic management," submitted. *Journal of Trauma.*

Extrahepatic biliary tract injuries occur in three to five percent of all abdominal trauma victims with 85% resulting from penetrating wounds. Extrahepatic biliary tract injuries from blunt abdominal trauma involve the gallbladder alone in 85% of the cases. Therefore, common bile duct injuries from blunt abdominal trauma are exceeding rare, especially those resulting in complete transection of the duct. A case of blunt abdominal trauma following a motor vehicle crash resulting in complete transection of the common bile duct will be presented with a review of diagnostic techniques. The management of such injuries will be delineated and details of the mechanism of injury in this motor vehicle crash will be closely examined using data obtained from an in-depth crash investigation and analysis.

Summary

The Mercedes-Benz CIREN Center at UAB focuses on the evaluation of pelvic fractures, head injuries, and injuries sustained by elderly crash victims and collaborates with faculty from UAB's School of Engineering, Public Health and Medicine. CIREN analyses have served as the intellectual spark for multiple population-based studies to help better understand and improve the translation from automotive design and crash testing to real world MVCs and the associated fatality/injury. Questions that arose from these analyses have also lead to involving The Children's Hospital and Coroner's Office as major contributors and collaborators in the CIREN review process. Future plans include expanding outreach by taking our findings to pre-hospital entities in an effort to raise acuity level and improve patient care. Additionally, our surgeons and researchers will be involving the expertise of Mercedes-Benz safety and test engineers in the early phases of injury analysis research to bring together the science of vehicle design and testing with what occurs in the real world environment.