AFFIDAVIT

BEFORE ME, the undersigned official, on this day appeared Dr. Whitman E. McConnell, who is personally known to me. After being sworn, he stated:

My name is Whitman Eldredge McConnell, M.D. I am over eighteen years old. I have never been convicted of a crime and am fully competent to make this affidavit. I have personal knowledge of the facts stated herein and they are true and correct to the best of my knowledge and belief.

I am a consultant of Biodynamic Research Corporation (BRC), and have been a consultant since December of 1990. My business address is 9901 IH-10 West, Suite 1000, San Antonio, Texas 78230.

I have, beginning in December 1990, fully participated in two series of BRC sponsored low velocity vehicle-to-vehicle impact tests designed to investigate and document the associated physical responses of human and anthropomorphic test subjects and the post-test clinical effects of this multiple event biomechanical exposure to the human test subjects. I have also helped with several other related areas of inquiry and research, including the crash effects on the vehicles themselves. My participation has included helping with the development of the final test protocols, obtaining and maintaining the human use committee approval required for human experimentation, establishment and enforcement of safeguards for

the human test subjects, set-up and conduct of the two principal test series (February 1991 and July 1993) and was an active formal test subject participant in the second test series. I was a principal member of the BRC team which analyzed the resulting visual records and sensor measurement data and was the primary author of two of the peer reviewed and published scientific articles (presented in 1993 and 1995) that resulted from the acquired test data and subsequent analysis accomplished as a result of this research. This research was entirely funded from internal BRC resources without support from any other organization or group. These two articles, which are representative of much of the work that was accomplished, and my curriculum vitae, are attached.

Prior to the initial February 1990 BRC test series, there had been only a few documented car-to-car tests conducted using conscious and alert human test subjects in front-end to rear-end collisions. Much of this earlier work had been conducted more than twenty years before, principally by Severy, who was primarily researching human movements (occupant kinematics) and seatback interaction occurring during highway speed rear-end collisions using test dummies. Prior to BRC's work there had been no articles published in the scientific literature that documented testing with instrumented human test subjects during tests that were specifically designed to determine what typical human occupant kinematics are during low velocity rear-end collisions. Conversely, there had been many articles of a speculative or

anecdotal nature, articles describing testing of cadavers, anesthetized animals, anthropomorphic test devices (ATDs or dummies) and, more recently, mathematically based and computerized modeling, validated principally by comparison with the results of only two of Severy's human test subject rear-end collisions conducted in the 1950's. Much of the three decades of this literature seemed to support the popular conception that a large excursion head and cervical "whiplash" motion occurred in real world rear-end collisions, even those occurring with very low changes in velocity. These conclusions, at best, were extrapolated largely from the results of tests using human surrogates such as cadavers, ATDs and anesthetized animals. The most commonly accepted explanation for the absence of objective findings in the multiple symptom "whiplash syndrome" was that it must have been an injury related to some un-diagnosable cervical structure damage caused by cervical hyperextension (rearward bending) followed by hyperflexion (forward bending). Cervical hyperextension and hyperflexion is most accurately defined as forced cervical motion beyond the individual's normal neck range of motion. BRC's experimental work was designed, along with interests in several other related lines of investigation, to determine how the accelerative forces present in a low velocity rear-end collision actually caused the conscious human occupant seated in the vehicle to respond, with particular attention to the definition and measurement of the resulting head and neck kinematics.

The specific details of the test protocols and results are more completely contained within the two attached articles. The BRC test subject panel included four male physician-biomechanics in the first (1991) series and seven subjects in the second (1993) series. Also utilized was a 50th percentile male Hybrid III ATD in both series with instrumentation and markings similar to that utilized for the human test subjects. All but two of the second series test subjects were male physician-biomechanics; the two exceptions were male management employees of BRC. Each test subject was fully informed about the test series and its risks, provided a medical history and underwent a physical examination, including cervical spine radiographic imaging studies and determination of their normal range of cervical spine motion prior to being accepted as test subjects. All members of both test panels still remain actively employed at BRC and continue to be informally followed with regards to their physical status and have shown no persisting effects at all from their multiple exposures.

All struck vehicle occupants in both test series, all of the striking vehicle drivers during the first test series, and about one third of the runs for the striking drivers during the second series were similarly instrumented, their impact kinematics visually recorded, and the sensor data electronically captured. Instrumentation of the vehicles and the test subjects was accomplished using standard SAE research practice approved sensors and techniques. The visual recordings and the test vehicle sensor

arrays captured data that detailed each vehicle's response to the test collision. The collision-related motions of the test subjects was captured by arrays of high speed (500 and 250 frames per second) film and standard video cameras. The largest number of human test subject runs were also documented by an individually fabricated bite block assembly to which an array of accelerometers was mounted. The electronic data from this device, in conjunction with the data derived from the motion recorded on the high speed film, provided a non-harmful method for determining both the qualitative collision related motions of the subject's head, neck and lower body and quantitatively measuring the motion of the test subject's head.

The first and second test series, for reasons of safety and reproducible precision, depended upon a fail-safe method of closely controlling the impact speed between a stationary test vehicle in front and the striking test vehicle coming from behind. The method used involved a specially constructed ramp upon which the striking vehicle was driven up, backwards, to a specifically marked distance and elevation point on the ramp. It had been determined that, by allowing gravity to move the vehicle (engine running with transmission in neutral to maintain the power steering and brake function) down the ramp, the striking vehicle's velocity, as it passed over velocity sensors at the intended impact point, could be reliably reproduced. There were four different vehicle types that were used in the first (1991) test series as striking and struck

test vehicles: a sedan, a convertible, a van and a pick-up truck. The second (1993) test series used primarily the pick-up truck as the striking vehicle, with the sedan or the convertible serving as the struck vehicles. In preparation for each protocol test collision, velocity calibration trial runs for the selected striking vehicle were run. When the striking vehicle's speed over the test impact point stabilized for several runs to within about a tenth of a mile per hour of the desired test velocity, the striking vehicle was returned to the established mark on the ramp to await the protocol test. The vehicle intended to be struck was then placed onto the impact point test grid area. The instrumentation hook-up and visual marking of the struck vehicle and its test subject(s), the visual documentation equipment (multiple video and high speed film cameras) and the electronic data recorder preparation was then completed for the particular test and the test subject(s) were put into position in the test vehicle. When all was ready, data recording was begun and the test driver operating the striking vehicle released the brakes of the striking vehicle which rolled down the ramp onto a short stretch of pavement and then into the rear-end of the struck test vehicle. The test subjects in the struck vehicle were kept unaware of exactly when the collision would occur. The test subjects were asked to remain, as much as possible, in a normally relaxed state, as they would while waiting at a stoplight. The test subjects positioned in the driver's seat in the struck vehicle had the responsibility for stopping the vehicle with the foot brake within

10 to 20 feet after the collision and there was no test run in which this wasn't accomplished. During the beginning of the first (1991) test series, the rear-end impact velocity changes of the test runs were planned to be very low and were held below two and one-half miles per hour. After analysis of the results and discussion with the physician-biomechanic test subjects, the test runs at this level were found to be quite tolerable, so thereafter a cautious increase in the test exposures up to the protocol planned velocity changes of about five miles per hour were conducted. During the second (1993) test series, the majority of the human test subject runs were within the range of five mile per hour velocity change up to a maximum of 6.8 miles per hour for two test subjects. In both test series the majority of the test subjects were involved in multiple test exposures and all but one individual in the first test series and all test subjects in the second series had some transient discomfort symptoms. These symptoms all resolved within a few hours to a maximum of three days after their test exposures were over. Among the principal findings observed during the testing, as reported in the BRC articles, was the fact that at no time was cervical hyperextension or hyperflexion observed in our test subjects, despite the occurrence of typical cervical strain symptoms. This fact, subsequently reconfirmed by others, placed new doubt upon the role that hyperextension/flexion had traditionally been thought to play in the causation of the "whiplash syndrome".

After each test series the data was evaluated and methods were developed using standard engineering, mathematical and physics practices to analyze what had occurred during and after the collisions. Since this work was largely observational and descriptive in nature and used actual humans in real vehicles, the possible rates of error related only to the measurement errors of the sensor and recording equipment, digitizing errors when positioning selected tracking points on the high speed film and very slight film speed variations of the high speed film cameras. It has been estimated that the quantitative error rates in the worst case situation were less than ten percent. There was no error in the qualitative portrayal of the actual occupant kinematics observed during testing. The two BRC test series results, in the form of the two attached articles (along with several other related companion articles) were submitted for peer review, accepted (after one revision for the second article), presented and published for review and comment by the scientific community. This work has been accepted, referenced in peer-reviewed articles by multiple authors, and referred to as pioneering work in this area of biomechanics. Our findings have now been replicated many times by other researchers using human test subjects in low velocity rear-end collision testing.

The experimental protocols for the two BRC test series were not designed to be, nor did they need to be, statistically based population studies similar to those required to address problems

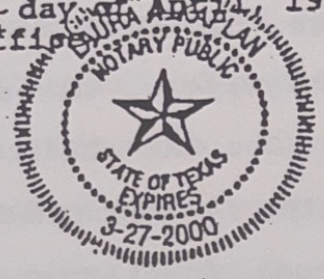
such as drug efficacy and side effects or the risk/benefit ratio of one type of surgical procedure over another for the general population.* The BRC tests were not conducted to statistically establish injury rates or thresholds for large populations of normal or previously injured people. The study design and protocol was not intended to achieve that purpose, nor did the reported results state those conclusions. The BRC studies were conceived and conducted to determine the biomechanical effects of accelerative forces (of the magnitude, duration and direction found in low velocity rear-end collisions) when applied to a person seated in a typical automobile seat. These conditions were experimentally applied to a group of human test subjects seated in colliding vehicles. The results were recorded and analyzed in terms of acceleration, velocity and displacements. More studies covering a larger representation of the motoring public could certainly add precision to the quantitative analysis of specific individual kinematic responses in particular seats and positions. However, since all of us share the same basic anatomical structure, the results of such testing can be expected to show quantitative variations in different portions of the basic head and neck kinematics that have been described in the BRC and other author's articles, but not globally different biomechanical behavior within or near the range of velocity change that has currently been tested.

The BRC studies are therefore relevant and reliable for their stated purposes and are useful in understanding the behavior of

Further Affiant sayeth not.

Whitman E. McConnell, M.D.

Sworn and subscribed to me by Whitman E. McConnell, M.D. on this the 18th day of April, 1997, to certify which witness my hand and seal of office.



Notary Public in and for the
State of Texas
My commission expires March 27, 2000