Committee Name:
Senate Committee – Judiciary, Corrections and Privacy (SC–JCP)

Appointments

03hr_SC–JCP_Appt_pt00

Committee Hearings

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Committee Reports

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Clearinghouse Rules

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Hearing Records

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Misc.

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Record of Committee Proceedings

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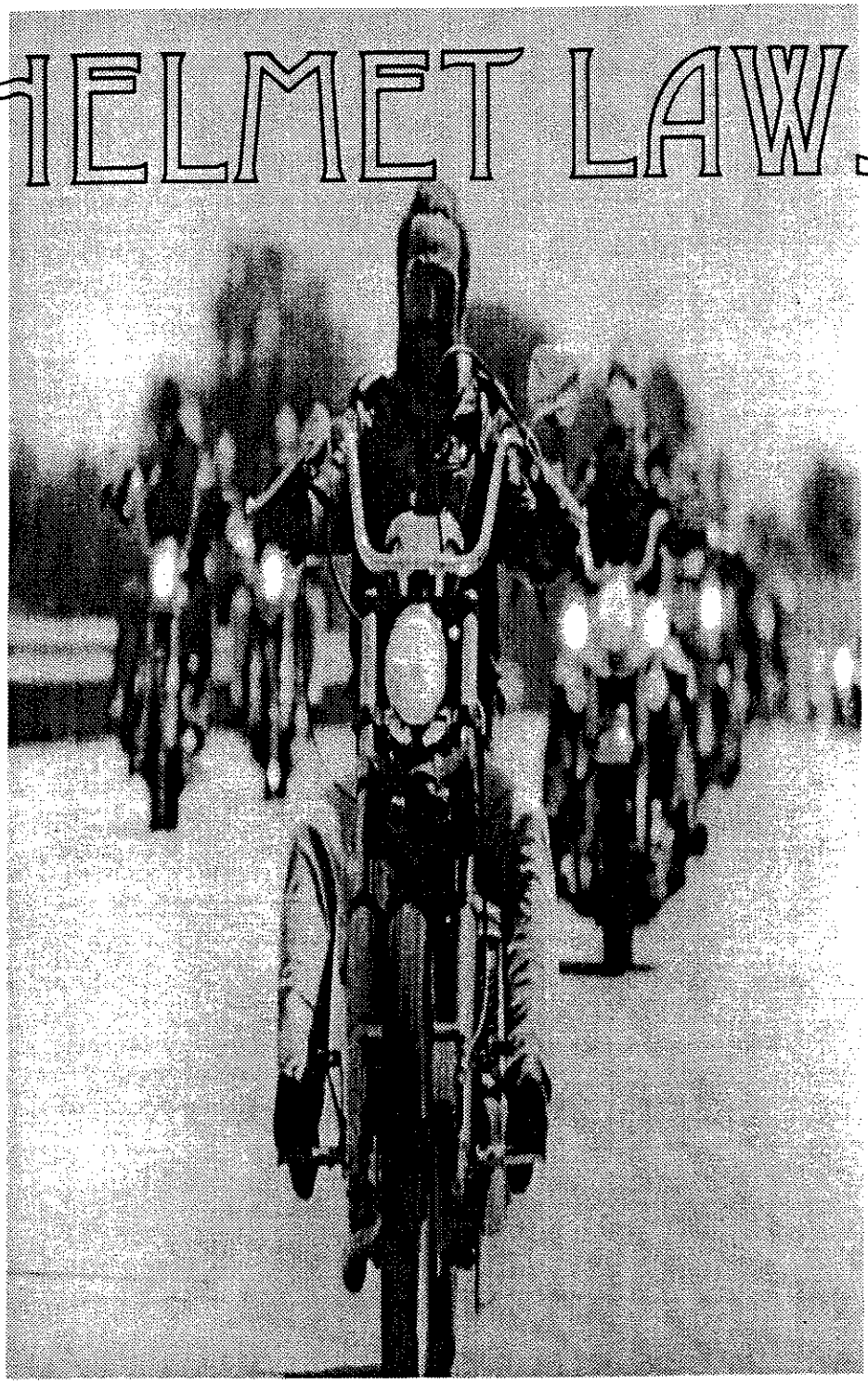
HELMET LAWS



An Opposing Viewpoint

This report was compiled by Tony Pan Sanfelipo, founder of ABATE of Wisconsin. Pan has ridden motorcycles for over 30 years and has been involved in motorcyclists' rights for 22 years. Besides being an ABATE member in Wisconsin and Illinois, he also has membership in the Motorcycle Riders Foundation, National Motorists Association, Helmet Law Defense League, B.O.L.T., Riders For Justice, Bikers Rights Action Group of Michigan, Impact on Legislation and the Jacobson & Hupy Accident Support Network.

He served on the governor's Motorcycle Safety Advisory Council in Wisconsin for six years. He testified at every Wisconsin state assembly and senate hearing on the helmet law. He also was involved with Motor Vehicle Administrative Code changes which effected motorcycles. He was a part of a coalition of motorcyclists who were successful in repealing the mandatory helmet law in Wisconsin in 1978.

He is currently an accident investigator specializing in motorcycle cases for the law firm of Jacobson & Hupy, S.C., a nationally known firm involved in motorcycle accident injury cases and motorcyclists' rights issues.

UNDERSTANDING HEAD AND NECK TRAUMA

Or, why helmets *increase* the danger!

HEAD AND NECK TRAUMA

Trauma is a type of injury which effects the body by external force being applied in a violent and sudden manner. When dealing with motorcycle accidents, it's important to understand the types of forces which a rider is subjected to, the body parts affected by these forces, and how the body reacts to certain inertia or 'g-forces'.

It has been suggested by NHTSA that helmets might prevent neck injury. This was prompted by testimony before the Tennessee Transportation Committee when I stated that helmets could cause cervical spine injury due to their weight. In order to rebut these remarks, a regional spokesman for NHTSA testified that more people receive neck injury without a helmet than those wearing helmets. Therefore, he concluded, without any foundation or authorities, that helmets might prevent neck injury. This of course is utter nonsense.

First, let's define the different types of trauma.

1. Penetrating trauma
2. Blunt trauma
3. Acceleration/deceleration trauma

Penetrating trauma is an object entering the body or head due to an object striking the body, or the body being placed in motion and striking an object which then penetrates the body.

Blunt trauma occurs when an object strikes the body or head with force causing a compression of body tissues which results in injury.

Acceleration/deceleration trauma occurs when the body is moving and strikes another moving or stationary object. This results in a change of motion for the body, or a complete stop of motion, which causes stretching and tearing of body tissues.

When considering the way the FMVSS 218 standard tests helmets, it's clear that these tests in no way simulate an actual crash situation. The headform in the helmet has no neck or neck sensors and the helmet is stationary with a weight dropped on it (compression) from an elevation.

To properly simulate a crash, a full form human crash test dummy should be used (or perhaps the regional spokesman for NHTSA), whereby the dummy is moving at a certain speed and then comes to an abrupt halt or strikes a stationary object (acceleration/deceleration).

'G-Forces'

'G-forces' are what determines the extent of injury to the head or neck in many motorcycle accidents. When a body is stopped (due to crashing into a stationary object) or is hurled into space with a three pound helmet flexing the neck, the force of gravity causes the body to weigh many times its actual weight. For example, a male human head, without helmet, weighs about 10 pounds. If subjected to 10 'G's', that head briefly weighs about 100 pounds, passing that stress and load onto the neck. Consider adding a 3 pound helmet, and you begin to appreciate the forces your neck has to contend with.

Going a little further, using a full form human dummy, developers of the Head and Neck Support (HANS) device found that the head briefly experiences 25 'G's' and weighs about 250 pounds in a 35 mile-per-hour impact. With those forces in play, the delicate human brain bounces around in side the skull (coup/contrecoup) with a force equal to weighing 75 pounds. A normal brain weighs about 3 pounds. Combined with this is the fact that the rotation of the head and neck during one of these crashes causes severe tearing and stretching of the tissues of the brain and brain stem. No helmet can prevent this collision of the brain within the skull.

It has been suggested that race car drivers exceed speeds of 200 miles-per-hour and walk away from crashes because they had a helmet on. Again, this is a half-truth, manipulated statement by pro-helmet forces. the truth is race cars are no longer built out of strong, resilient materials. Modern technicians have learned that in order to protect the driver, the race car must crush and disintegrate during a crash. This allows for a more gradual, extended period to distribute the force of the crash and decelerate the 'G's'. With a deformable structure construction, akin to airplane design, the chassis and body of the car takes up most of the 'G' forces, according to Rick Amabile in his book, Inside Indy Car Racing: 1990. Besides the chassis design, the internal cockpit of the cars is better designed also. Direct blows to the driver are minimized through a safety system integrating a seat angled backwards at 45 degrees and a six-point safety harness system. The weak link in this equation, again, is the neck.

The neck was listed on 31.5 percent of incident reports in races. The Sports Car Club of America (SCCA) performed some analyses on their races and found 17 percent of the injuries sustained were neck injuries. This led to the development of the HANS device, which supports the head and neck, helping prevent whiplash and rotational injuries. This device was developed by Biomechanical Design Inc., of East Lansing, Michigan. The importance of this type of device becomes very evident when one considers that according to one of the nations largest insurers of motorsports events, North American Racing Insurance (NARI), 93 percent of all driver injuries were caused by direct blows or sudden, twisting, deceleration forces applied to the body.

The mere fact that a racer is wearing a helmet has little or no impact on his survivability without the other safety engineering factors in place. With a complete safety engineered race car, the National Safety Council puts driving one of these units in the same hazard range as swimming and alpine skiing. In fact, according to their charts, a modern race car driver is at less risk than a scuba diver or mountain climber, and much less at risk than a parachutist or hang glider.

The problem with motorcycle design is we don't have the safety cockpit that would afford us the room and time for a disintegrating chassis to take up the 'G-forces' for us. And we don't have anything padded in front of us to reduce the loads reaching our neck, such as a break away steering wheel or padded dash panel. To say race car drivers walk away from crashes because they wear helmets is absurd. Several Indy car racers recently died of closed skull trauma to the brain, due to the exact twisting and tearing actions we said were caused by acceleration/deceleration, which helmets cannot protect against. Yet we don't hear NHTSA explain or comment about these cases.

According to SCCA data, the neck is the most often injured body part (31.5 percent), followed by the back (19.5 percent), and then the head (15.8 percent). Severe centrifugal forces exert tremendous shearing pressures on the brain. This causes the brain to impact on the inside of the skull, or tear at the medulla at the brain stem. Developers of the HANS used crash test dummies in their testing procedures and found the head can briefly encounter 25 'G's', amounting to about 250 pounds, in a 35 mph impact. Gravitational forces are dependent on speed, and a doubling of speed quadruples the 'G-forces'.

To determine the number of 'G-forces' in a collision, the formula is:

G's=.0333X(M.P.H. X M.P.H.) ÷ Distance. In other words, multiply the square of the vehicle's speed, in mph, times .0333 and divide it by the stopping distance in feet. This is for a direct, head on collision, and the formula is more complex in angular collisions due to the fact that the kinetic energy is expanded over a longer period of time, resulting in lower 'G-forces'.

Collision, collision, collision

There are actually three collisions occurring in a crash:

1. Vehicle vs whatever it contacts with
2. body vs whatever it contacts with
3. body tissues and organs vs body tissues and organs

Once your vehicle strikes another object, you have suffered a collision. At that point your body is slammed into some stationary or moving object, or perhaps ejected and is thrown to the ground. At that point, your internal organs, including the brain, began a collision course of their own. Brain injury can occur without any impact to the head, whether helmeted or not. If the body comes to a sudden stop, including the head and skull, the brain continues to move and slams into the inner skull wall. Brain tissue and blood vessels can shear in this violent, twisting action. The skull, even without a helmet, can withstand hundreds of 'G's', but the brain cannot. Other internal organs, especially

the heart and aorta, are subjected to these tremendous forces, and often rupture or tear. To give a graphic example, a 160 pound man will strain at his seat belt with a weight of 6,400 pounds at a 40'G' deceleration. Now you might understand why so many people die from ruptured or torn aortas in crashes. There is basically little connective tissue to anchor the heart, since it has to palpitate and move during its rhythmic beating.

'G-Force' Tolerance: Head vs Neck

It is believed that the head can withstand 300 'G-forces', which is higher than other body parts. The deceleration of 'G-forces', movement of the head and duration of the incident all determine the amount of injury the head will sustain. It is common to have skull fracture and no brain injury, and brain injury and no skull fracture. Helmets are designed to distribute the force of the impact over a wide surface in order to reduce the amount of 'G-forces' reaching the brain. The force of inertia in a crash can cause brain injury even without an impact to the head, thus a helmet cannot protect against this event. Brain tissue and blood vessels can be torn by inertia when the head rotates, common occurrence amplified with helmet use. The weight of the head and helmet pulling at the neck can be sufficient to fracture the skull. Known as basal skull fracture (hangman's noose analogy), these injuries can often be fatal.

According to NARI, the neck is the most often injured body part in their studies. this might account for the fact that the NHTSA regional spokesman said there are more neck injuries without helmets than with, thus leading him to his erroneous conclusion that helmets might prevent neck injury. Tests using human cadavers found that the neck can tolerate about 42 foot-pounds of backward whiplash force before injuries began to occur. The muscles in the rear of the neck are stronger than those in the front, thus a forward rotating head will allow the neck to withstand about 140 foot-pounds of force. Of course, these are ideal positions, direct forward or backward movement. In a real crash, the head is bounced in all sorts of directions, and the neck is less tolerant of sideways acceleration/deceleration. In these instances, the neck can handle about 33 foot-pounds of force.

How strong is the unhelmeted head? The amount of force a head can withstand depends on several factors, including the location of the impact, the size of the object striking the head and the density of the individuals bone tissue. The frontal bone (forehead) can withstand on average, 1,000 to 1,600 pounds of force. The temporo-parietal (sides of head) bones can tolerate around 700 to 1,900 pounds of force. the back of the skull can handle around 1,440 pounds of force. The bones of the face and cheek are less tolerant, standing forces of only 280 to 520 pounds.

Remember, the brain cannot withstand the same forces the skull can, and even a helmet cannot prevent dangerous forces from reaching the brain or the brain moving within the skull cavity.

When we said that the forward rotating head can transmit energy loads to the neck, and the neck can tolerate about 140 foot-pounds of force? Well, when the engineers conducted tests on their HANS safety restraint system, they used a full human form crash test dummy. With the HANS restraint system in place, the

dummy was held in position during a frontal impact collision, resulting in neck loads under 130 foot-pounds. When tested without the restraint system in place, the dummy's head rotated forward in the simulated 40 mph test collision, and the neck received loads of nearly 1,000 foot-pounds. The dummy was helmeted, and I suggest that if the spokesman for NHTSA really believes helmets can prevent neck injury, he climb onto the test sled, put on a helmet and see how his neck handles 1,000 foot-pounds of pressure.

Tony Pan Sanfelipo

Remarks from the California Motorcycle Association:

In 1986, California enacted the California Motorcycle Safety Program (CMSP), a mandatory rider education program requiring all applicants under 18 to complete a rider training course in order to receive a motorcycle license.

In the first three years of operation for the CMSP, injuries dropped 34% and fatalities dropped 28%. In 1989, the 19,527 motorcycle injury total was the lowest since 1969. However, 20 years ago, there were 12 million (or, 50%) fewer motor vehicles competing for motorcycle riders' rights-of-way on California highways.

These figures reflect an improvement far better than could be expected of a mandatory helmet law. It is important to point out that the CMSP is funded entirely by a surcharge on motorcycle registration fees. These great improvements (in accident and fatality rates) have been accomplished without using taxpayer money and without limiting individual freedom.

Introduction:

I've been a motorcyclist for over 30 years. I've been involved with the motorcyclists' rights movement for nearly 23 years. I've heard every claim, from both sides of the helmet controversy, read nearly every report, studied the statistics from both sides and have come to the same conclusion I reached back in 1975. The American public are the victims of a cruel hoax concerning helmets.

We can argue statistics all day long. One side says the death rate went up with helmet repeals, the other side contradicts. Depending on who's talking, and how they're arriving at the end figure, this all tends to confuse the issue even more for the unsuspecting observer. Although helmet law proponents refuse to admit helmets could be harmful, the facts are there for all the public to see. Product liability case after case has found against the helmet manufacturer. Magazine articles as recent as February, 1995, have expressed concerns over helmet induced neck injuries. Criticism of the Federal Motor Vehicle Safety Standard 218 test procedures have fallen on deaf ears in Washington. Using a headform to test helmet safety is like driving an automobile through a pile of jello to test for crash worthiness. A full human form crash test dummy should be used, period.

This argument is supported by several authors of a reference work for the National Library of Medicine, entitled The Biomechanics of Spinal Injuries, 244 Refs, 1984. In the article they review injuries to the spine, vertebral column and spinal ligaments. The injuries studied were attributed to sports, motorcycle helmets, industrial helmets and swimming pool accidents. The authors very clearly state in the article that it is very important to use crash dummies in the analysis of spinal injuries.

Another misconception the public has is that the NHTSA either tests or certifies motorcycle helmets. This is not true. NHTSA has developed a brochure that is supposed to help motorcyclists select a safe helmet. Many times, industry leaders will assist government, or put out their own helpful information guides. Two manufacturers that come to mind are Bell and Simpson. The plain and simple truth is nobody can tell if the helmet they purchase is safe, just by looking at how much foam insulation it contains, or if it appears to have a heavy duty chin strap. This is total nonsense. It is interesting to note that upon investigating huge volumes of product liability cases against helmet makers, it wasn't the so called "beanie" style helmets that were being implicated in serious injuries and deaths, but rather Bell, Simpson, Shoei, etc., top of the line expensive helmets. The recent move against the beanie style helmets seems to be because they do not meet the federal 218 standards, or so claims NHTSA. The fact that the above- mentioned industry leaders do comply must be why NHTSA has never moved against them, even though they have been found to cause serious injury, quadriplegia and death. But they did, for the most part, meet the 218 standard.

In 1993, the Helmet Law Defense League (HLDL) and Bikers of Lesser Tolerance (BOLT) posed a number of questions to NHTSA through several United States Senators. The questions and

answers may enlighten the reader as to NHTSA's stance, and how far they are willing to go to back up helmets.

This response came from John Womack, Acting Chief Counsel, NHTSA.

1. Does DOT or NHTSA maintain helmet testing facilities?

Neither DOT or NHTSA maintain a dedicated helmet testing facility. Because of the expense involved in procuring and maintaining the equipment needed to conduct helmet compliance tests, NHTSA contracts with private testing laboratories to perform compliance tests on motorcycle helmets.

2. Does DOT or NHTSA test helmets?

As stated above, NHTSA relies on private contractors to perform testing. The two contractors most frequently used are the Southwest Research Institute in Texas and U.S. Testing Co. Inc., in New Jersey.

3. Does DOT or NHTSA certify helmet test results? If yes, does DOT or NHTSA assume liability for these test results?

If a helmet is tested to determine compliance with Standard 218, the formal test results provided by the contractor are reviewed by engineers within NHTSA's Office of Vehicle Safety Compliance (OVSC). Test reports are accepted by OVSC if the reviewers are satisfied that the testing was performed correctly. While NHTSA does not certify the results of helmet tests, it will provide certified copies of the test reports upon request. All test reports performed by outside contractors contain standard form language stating that the United States and the agency do not assume liability for the contents of the report or it's use.

4. Does DOT or NHTSA maintain a list of approved or un-approved helmets?

Neither DOT nor NHTSA maintain a list of approved or un-approved helmets. However, the results of compliance tests performed for NHTSA are publicly available, as is information identifying helmets that have been recalled, because they fail to comply with Standard 218 or contain a safety related defect.

5. Has DOT or NHTSA ever removed or taken away the manufacturer's certification of any helmet?

NHTSA does not remove or take away a helmet manufacturer's certification. However, a certification is only valid if the helmet actually complies with Standard 218. If it does not, the certification is false and misleading and thereby constitutes a violation of Section 108 (a)(1)(c) of the Act. In addition, if NHTSA or the manufacturer determine that a helmet does not meet the requirements of Standard 218, the manufacturer must recall the helmet.

6. Has DOT or NHTSA ever ordered or issued a mandatory recall of any helmet?

To date, NHTSA has not ordered a helmet manufacturer to recall it's helmets following a formal determination of noncompliance by the agency. Rather, all recalls of motorcycle helmets have been carried out on the basis of a manufacturer's determination that it's product was non-compliant or contained a safety-related defect. While these recalls are often referred to as

voluntary, the Act imposes a clear mandatory duty on a manufacturer to perform a recall when it obtains knowledge of a defect or noncompliance. If the manufacturer fails to fulfill this duty, it has violated the Act and may be subject to legal action including, but not limited to, the imposition of civil penalties and injunctive relief. (NOTE: Subsequent to this inquiry, NHTSA did institute a suit for declaratory and injunctive relief against Chico Yasko, and his Florida Lite helmets for non-compliance, while ignoring deaths and injuries attributed to compliant brands.)

7. Has DOT or NHTSA ever started formal proceedings to remove a helmet manufacturer's certification?

As stated above, DOT and NHTSA do not remove a manufacturer's certification.

8. Has DOT or NHTSA ever made a formal determination of noncompliance with FMVSS 218 on any helmet?

No. See answer to question 6.

9. Under the provisions of the Safety Act of 1966, can any person other than the manufacturer/seller be held responsible for compliance of a helmet with FMVSS 218?

Yes. Section 108 (a)(2)(A) of the Act forbids manufacturers, distributors, dealers, or motor vehicle repair businesses from taking any action that will knowingly render inoperative any device or element of design installed on or in a motor vehicle or item of motor vehicle equipment in compliance with an applicable standard. (NOTE: Under the ACT, a helmet is considered a piece of motor vehicle equipment.)

10. Other than relying on the manufacturer's certification, is there any other method for a user to determine which helmets are certified and comply with FMVSS 218?

Compliance testing conducted for manufacturers and NHTSA since the adoption of Standard 218 demonstrates that, until recently, the vast majority of certified helmets complied with all aspects of the Standard. Thus, users could generally rely on the manufacturer's certification to identify a compliant helmet. Unfortunately, due to the recent proliferation of non-compliant helmets, some of which have been certified despite the manufacturer's knowledge that they fail to comply with the Standard, motorcyclists must now exercise judgment in the purchase and use of a helmet. (NOTE: The same holds true for the so-called legitimate helmets, which all do not pass the standard as NHTSA would have you believe. See page 11, "Proper Helmet Fit.")

11. Are there any provisions of the Act which delegate authority to the federal government or individual states to hold the user responsible for failure of a helmet to comply with FMVSS 218?

The Act does not delegate such authority. However, each state has inherent authority to adopt and enforce laws governing the operation of motor vehicles in the state that refer to NHTSA safety standards.

12. Has DOT or NHTSA delegated authority to any other agency outside of the federal

government for determining FMVSS 218 compliance?

Although there is no delegation as such, pursuant to Section 103 (d) of the Act, states may establish and enforce safety standards that are identical to federal safety standards.

Confusing? You bet. In fact, the matter of knowing if a helmet was compliant became an issue in many court challenges to the law, most notably in California, Florida and Washington state. Although all of the cases were based on the same arguments, a Florida court found the law unconstitutionally vague. That case relied on arguments by Attorney Ed Alden, used in Washington's Third District Court of Appeals, Basically, the court agreed with Alden, stating that the helmet law was unconstitutionally vague in that a person of ordinary intelligence would have no way of knowing whether any helmet was compliant or not. What's unusual is that California courts refuse to reach the same conclusion, probably in part because of pressure from the California Highway Patrol, who have assisted in the making of a nationally distributed video which teaches law enforcement officers how to "spot" illegal helmets, at least that's what they claim.

The Washington case brings to mind an article which was published in the Seattle Times, in 1990, on the editorial page. The editor says:

"The day that the mandatory motorcycle helmet law took effect (June 7, 1990), I saw two views expressed in *The Times*:"

1. Brian Basset drew a cartoon showing a biker sitting on a made-in-the-U.S.A. Harley Davidson, wearing no helmet. A motorcycle cop (wearing a helmet) was issuing him a ticket while insulting his intelligence. The cop's bike appeared to be a Honda.

Is this *The Times* position? If you are an American, ride an American-made motorcycle, and expect to be granted the freedoms guaranteed by the American Constitution, then you have concrete for brains and need to be told by some higher authority (Big Brother) on an imported vehicle how to live your life.

2. On the next page, Bill Healy expressed the real truth. Helmets do not protect against injury at speeds over 13 mph. The Washington State Patrol's own research shows that helmets do not affect motorcycle accident death rates. Helmets restrict vision, restrict hearing and restrict personal freedom.

That article was typical of letters sent in to newspapers around the country. What is more revealing about unpopular helmet laws are the number of legislators, state and federal, who are speaking out against federal mandates. Especially distasteful is the penalty sanctions against states which do not comply with the federal desire for helmet use and seat belt laws. The Tenth Amendment is becoming a rallying point for leaders, including Bob Dole, who recently announced his candidacy for the presidency, while pledging to affirm the states' rights issue.

Here in Wisconsin, nobody has made a stronger statement about state's rights than our governor, Tommy Thompson.

TOMMY G. THOMPSON

Governor
State of Wisconsin

March 23, 1995

Tony Sanfelipo
ABATE of Wisconsin, Inc.
438 N. Water Street
Black River Falls, WI 54615

Dear Mr. Sanfelipo:

Thank you for your letter and ABATE's report, *ISTEA & the Wisconsin Helmet Controversy, Understanding the Intermodal Surface Transportation Efficiency Act of 1991.*

Wisconsin's cycling community and their legislators have consistently said our state does not want or need a law requiring all motorcyclists to wear helmets. The most recent effort to enact such a law was unsuccessful in the 1994 legislative session. Instead, Wisconsin relies on a partnership approach marked by responsible riding and effective training and safety programs.

This approach is working well. During the past 12 years - without a mandatory helmet law - Wisconsin has continued to post one of the nation's best motorcycle safety records.

Still, federal laws require states to pass mandatory helmet laws covering all motorcyclists by October 1, 1995, or face strict penalties. If Wisconsin does not pass a mandatory motorcycle helmet law by this federal deadline, more than $7 million in federal funds will be taken away from highway projects and transferred to motorcycle safety programs over the next two years.

Instead of leading the charge for a mandatory helmet law in Wisconsin, I am leading the fight in Washington against burdensome federal mandates. Wisconsin must have the freedom to choose what works best for our state without facing costly, "one-size-fits-all" federal laws that tie our hands.

I hope you will support this effort by contacting your U.S. Senator and Representative and urging them to help repeal the helmet law mandate. The decision on whether to require helmet use must be made by individual states - not by the federal government.

Thank you again for your interest in mandatory helmet laws. For more information on Wisconsin's motorcycle safety program, please call 1/800/368-9677.

Sincerely,

TOMMY G. THOMPSON
Governor

TGT/cjt

Helmets: Fact and Fiction

Special Edition1995 Volume 1 Issue 1

New Bills Seek Penalty Remedies, While Statistical Data Questions Helmet Effectiveness

Substantial data exists pointing to the inability of helmets to protect the wearer from injury. Meanwhile states' rights issues are prompting more penalty repeal bills.

The continued debate surrounding helmets and government's role in mandating their use has become a very hot topic, not only in individual state legislatures, but also in congress.

The federal penalties enacted on states which do not have both mandatory helmet use and seat belt use laws in effect have ignited a trend to submit numerous bills addressing the problem. Of special interest is H.R. 899 (Don Young-R-Alaska), which calls for a repeal of the penalty on states without helmet laws. It is specific and singular to the helmet issue. To date (3/31/95), it has 154 co-sponsors, signifying the dissatisfaction among the states concerning the federal sanction.

On the Senate side, S. 388 (Olympia Snowe-R-Maine), which is a companion bill to H.R. 899, has 22 co-sponsors. In addition, S. 234 (Ben Nighthorse Campbell-R-Colorado), calls for an exemption from the penalties if the state has an existing motorcycle safety program. There are several other bills proposed which speak against federal mandates such as the helmet law, none more arduous in it's language than H.R. 607(Scott Klug-R-Wisconsin), also known as the State's Rights Empowerment Act.

Why does there seem to be so much opposition to using a helmet while riding a motorcycle? To answer that, you have to consider two separate and distinct arguments.

The first argument is the one you, as a legislator, will most likely consider and hopefully understand. It has to do with the state's rights issue, the imposition of penalty clauses and the federal government's role in promulgating or influencing legislation such as mandatory helmet and seat belt use laws.

Some of the issues are relatively clear, as evidenced by the number of bills seeking to exclude or remove the penalties from non-compliant states. The continued resurgence of federal interventions over the years concerning these types of laws has given birth to a renewed resistance from the individual states. With the "Contract with America" pledging to limit government dictates and with the plea for an end to unfunded mandates, it is clear the opposition to federal interventions of this sort is becoming more and more popular.

The second argument surrounding this debate comes from a segment of the motorcycle riding community who feel helmets are inherently dangerous, thus their use should not be mandated. To clear up a popular misconception, there is no such thing as a **DOT approved helmet.** There never was, and hopefully never will be. Many legislators, as well as laymen, believe there is some sort of program in effect which tests, and subsequently approves helmets. The truth of the matter is the helmet industry is self-certifying, meaning the manufacturer certifies that his product meets or surpasses the standards set down by NHTSA in FMVSS 218.

FMVSS 218 standards are woefully inadequate and do not simulate actual crash conditions nor do they address the energy forces which reach the cervical spine. We need to examine what causes head injury to understand why helmets won't work. We also have to understand how helmets are tested to meet FMVSS 218 and why this doesn't represent actual crash conditions.

HELMETS, HEAD INJURY and MOTORCYCLING

While motorcycling has been targeted as a "public burden" and garner most of the public attention concerning head injury, motor cycling is actually a minor cause of head injury in the United States. Motor vehicle accidents, falls, assaults, pedestrian and bicycle accidents are all responsible for larger percentage of head injuries incurred in the U.S. While some ten million head injuries occur each year, it accounts for only two percent of all deaths in the U.S. The great debate over helmet laws has drawn attention away from the major causes of head injury and drawn it to motorcycling. How many motor cycle related head injuries are sustained each year?

Helmet usage itself does not preclude the occurrence of coup-contrecoup type brain injury that is suffered in most head injuries. The anatomy of the brain and mechanisms of head injury are given in non technical terms to provide an understanding of this problem. As motorcycling comes under closer scrutiny this information will be needed to answer to those who would place unreasonable restriction on motorcycling.

"Helmets have been shown to cause injuries not normally occurring without a helmet."

BRAIN INJURY IN THE U.S.

Within this country, it is estimated that ten million head injuries occur each year. Of these, 90% are minor. There are approximately 500,000 brain injuries each year which results in 70,000 deaths, with over 60% dying before reaching a hospital. There are 70,000 disabling injuries and 10,000 severe spinal cord injuries each year. The HI rate for men is three times higher than women and peaks in the 15-24 year old age group. In five selected studies on HI, the major cause of brain injury was transportation related. The second leading cause was falls with assault/gun shot wounds third. In these studies, transportation related accidents account for approximately 50% of the total. Even with the number of head injury deaths occurring in the U.S., this number only represents 2% of all deaths in this country.

In terms of head injury, motorcyclist in two studies, Olmsted County, MN. and North Central, VA. represented only 8% of the transportation related head injuries or less than 4% of the estimated total number of head injuries. Motor vehicle accidents accounted for 78% with pedestrian and bicyclists 14% of transportation related HI in both studies. The fatal accident reporting system of 1986 reports 1650 fatally injured riders wearing helmets with 2082 not using helmets and 788 were helmet use undetermined. The preliminary FARS 1986 states that helmet usage is essentially is the same for fatal injured and all riders. Two studies of motorcycle accidents showed head injury rates of 22% for all riders and near 30% head injury rate for fatalities, for both helmeted and non-helmeted riders.

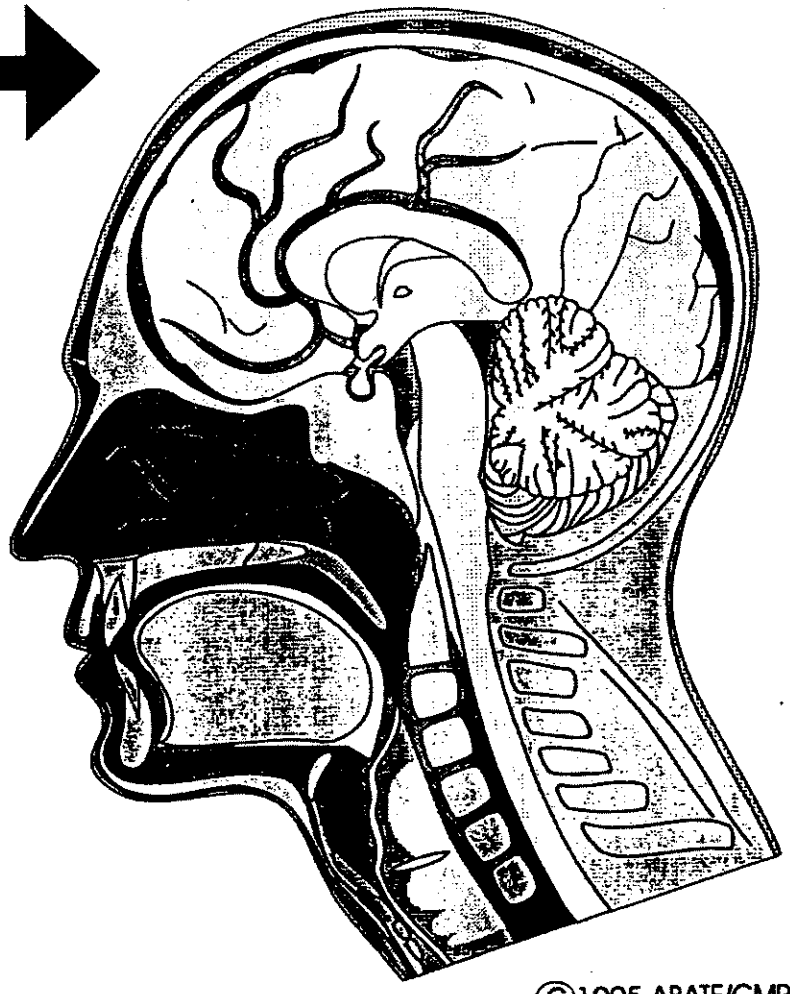
It should be noted that helmets have been shown to cause injuries not normally occurring without a helmet. The transfer of impact energy through helmet retention systems has been shown to cause brain stem tearing and basal skull fractures This has been noted as the mechanism of injury in a number of studies. The frontal impact causing hyperextension of neck is also likely in causing cervical dislocation and placing traction on the brain stem resulting in tearing of the pontomedullary junction. The pons is relatively thick compared to the medulla, it is at the thin point of the junction that the tearing occurs. D.A. Simpson, et. al. noted that of thirteen helmeted motorcyclists, nine had principal impacts to the chin bar or face causing tears of the pontomedullary junction. Although four who suffered either vertex or lateral impacts had corresponding brain stem tears. The mechanism is postulated to be similar to that of frontal impacts

HOW BRAIN INJURIES OCCUR

The brain floats within the skull in cerebro spinal fluid. When the body is in motion and stops suddenly the brain continues to move within the skull. The brain striks the skull and rebounds striking the other side.

COUP - CONTRECOUP

While a helmet provides impact protection, it can not stop the brain from moving inside the skull. This happens at speeds as slow as ten to thirteen miles per hour.



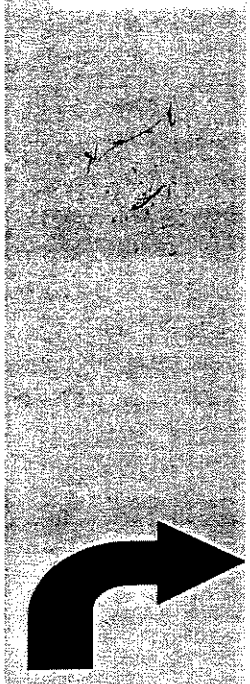
The Mechanics of Head Injury

According to Greg Trojan, an Emergency Medical Technician, 50% to 60% of those suffering severe head injury die before reaching a hospital. There are two types of mechanisms of injury to the brain, **contact** and **acceleration-deceleration**, each causing different types of injuries. **Contact** injury is the result of an object striking the head causing a local injury. When an object strikes the head, the use of a hard hat or helmet dissipates the energy of the impact by spreading it over a large area. It is important to note that the head and brain are ***not*** in motion.

"The transfer of impact energy through the retention systems (chin straps) also have been shown to cause brain stem tearing and basal skull fractures."

Acceleration-Deceleration injury occurs when the head is placed in motion or stopped suddenly. This is typically the situation in motorcycle accidents. When a person riding a motorcycle is involved in a collision they are most often thrown from the motorcycle. If the rider's helmet impacts with an object, the helmet and then the riders head stops in it's forward motion. The brain having it's own mass continues in motion until it strikes the inside of the skull. It then rebounds striking the opposite side of the skull. This phenomena is called coup-contrecoup and is used to describe any injury where the brain moves, impacting with the inside of the skull. This type of injury can result in anything from mild concussion to fatal diffuse axonal injury(DAI). DAI, in layman terms results from increased intracranial pressures. These pressures cause a shearing or tearing of the brain tissue. DAI injuries account for the greatest number of severely disabled cases, where patients may need permanent or long time residence in a rehabilitation facility or nursing home.

"Neck loads without something out there in front of you could be fatal."



While a helmet can provide protection from the contact injury, it is impossible to slow the head over sufficient time and distance to prevent the brain from moving inside the skull. The transfer of impact energy through the retention systems (chin straps) also have been shown to cause brain stem tearing and basal skull fractures. One other item of importance is that frontal impact, especially with the full helmet design, causes hyperextension of the neck, translating into cervical dislocation and brain stem injury. EMT Trojan states in conclusion, "helmet usage in inclosed vehicles would be much more effective than use on a motorcycle due to the inherent nature of accidents with cars." What he is talking about is that the victim usually stays with the vehicle in car accidents, and is traveling at the same speed as the vehicle. Mr. Trojan's assessment seems to be supported by the General Motors Motorsports Safety Technology Research Program. The MSTRP compiles data concerning the safety of Indy Cars. Besides utilizing the Instrumented Sensor Technology EDR-3, a digital recorder placed on the floor of the vehicle to measure energy loads attributed to accidents, they also use the Hybrid III crash test dummy, a state of the art instrumented human form. The dummy, manufactured on an articulating model of the human body, has nine instrumented cells to measure energy stress loads. What we are concerned most with, in the motorcycle accident scenario, are the multi-axis neck transducer and the tri-axial head accelerometers. GM Program Manager, John Melvin, in reviewing collected data on Indy Car test crashes, observed, "Initially, we were just looking at loads on the driver without any surrounding structure. We found that our dummy instrumentation told us that there shouldn't be any problem with the chest. The leg loads could get high from the inertia of the legs, ***but that the neck loads without something out there in front of you could be fatal."***

They found that as the driver was forced forward by the inertia of the crash, his head hits the cockpit, cowl or steering wheel, all of which are soft or padded. This prevents high neck loads, reducing the chance of injury. Melvin goes on to say, ***"if there are some circumstance where the head can't reach the surrounding structure to take up the load, then we might have a neck problem."***

The possibility of neck and basal skull injury is evidenced by an alarming number of product liability cases against helmet manufacturers. The following sampling of cases is taken from the thousands of cases on file, indicating the helme as causal in the injury or death.

Many manufacturers no longer do business in America, to avoid product liability lawsuits.

See page 16

35. TITLE
Coy v. Simpson Marine Safety Equipment Inc.

CITATION
787 F.2d 19 (1st Cir. 1986) (Cerezo, J.)
29 ATLA L. Rep. 87 (July 1986)

RECORD TYPE Case Abstract
DEFENDANT Simpson Marine Safety Equipment Inc.
DATE 1986
SUBJECT Motorcycle Helmets
ABSTRACT The court of appeals upholds a verdict for plaintiff in an action for the wrongful death of a motorcyclist. Decedent sustained fatal head injury when he fell from his motorcycle during a race, despite the fact that he was wearing a Simpson motorcycle helmet. There was sufficient evidence for the jury to find that the impact of the helmet against the ground was within the protective capabilities of a helmet which met 1975 Snell Memorial Foundation standards. The jury could also find that the helmet was defective since it deformed inward on impact, due either to the lack of adequate fiberglass layers or to improper curing of the resin shell.

COUNSEL Branch, Bartram C.: Manchester, NH
ACCESSION # = 0445159

42. TITLE
Harley-Davidson, Inc. v. Toomey

CITATION
521 So.2d 971 (Ala. 1988)

RECORD TYPE Case Abstract
DEFENDANT Harley-Davidson, Inc.
DATE 1988
SUBJECT Motorcycle Helmets
ABSTRACT The Alabama Supreme Court held that an expert engineer's testimony in a motorcycle helmet design defect case was admissible. In a suit by a plaintiff who suffered injuries from a motorcycle accident caused when his helmet face shield fogged up, plaintiff called a consulting engineer who testified that the helmet and face shield were defective because they did not provide sufficient ventilation to prevent fogging and did not have a means of removing the face shield if it became fogged. He testified that one of the goals of design and safety engineering is to identify hazards and eliminate them by design rather then guarding against them through warnings. He also stated that Harley-Davidson must have been aware of the defect, because it was manufacturing a non-fogging face shield at the time of the accident. The engineer testified that it was well within the state of the art to design a full - face helmet with an easily flipped up face shield with ventilation to prevent fogging. Affirming a plaintiff's verdict, the court rejected defendant's claim that the trial court had erred in admitting the engineer's testimony. The court found that the facts testified to by the expert were not necessarily within the common knowledge of the jury and therefore the testimony was admissible.

COUNSEL Breedlove, Gregory B.: Mobile, AL
Cunningham, Robert T., Jr.: Mobile, AL
Citrin, Andrew T.: Mobile, AL
ACCESSION # = 0469579

43. TITLE
Rheaume v. K-Mart Corp.
CITATION Wis., Milwaukee County Circuit Court, No. 684887, April 11, 1988
RECORD TYPE Case Abstract
DEFENDANT K-Mart Corp.
DATE 1988
OCCUPATION Student
SUBJECT Motorcycle Helmets
Damages - Quadriplegia
ABSTRACT When Rheaume lost control of his motorcycle and crashed, his helmet, manufactured by Norcon Manufacturing Co., fractured. He suffered cervical fractures and spinal cord damage, rendering him quadriplegic. Rheaume was in high school at the time of the accident. Rheaume sued Norcon, alleging that his helmet was defectively manufactured because it broke under less stress than that required by federal helmet drop tests. Federal Motor Vehicle Safety Standard 218 requires that helmets must be able to withstand a drop from a certain height onto a specified surface without fracturing. When plaintiff performed these standard drop tests on identical Norcon helmets, all the helmets withstood the higher stress without fracturing. K-Mart, the retailer, was also sued for defective manufacture. K-Mart then impleaded Norwesco, the supplier of the helmet, for contribution. Defendants contended that motorcycle helmets do not prevent cervical fractures. The parties settled for $1.65 million; Norcon paid $I.2 million; Norwesco and K-Mart each contributed $225,000.
COUNSEL Gesler, Alan: Milwaukee, WI
Domnitz, Merrick: Milwaukee, WI
Aiken, Tim: Milwaukee, WI
COMMENT EXPERTS : Willis, Terrence / Accident Reconstruction
(Arlington Heights, IL)
(Flagstaff, AZ)
ACCESSION # = 0469589

36. TITLE
Vandebark v. Bell Helmets Inc.
CITATION U.S. District Court, C.D. Ill. (Springfield), No. 85-3361 (June 27, 1985)
RECORD TYPE Case Filing
DEFENDANT Bell Helmets Inc.
DATE 1985
SUBJECT Motorcycle Helmets
ABSTRACT Injury as a result of defective helmet.
ACCESSION # = 0237519

37. TITLE
Byars v. Land Tool Co.
CITATION U.S. District Court, N.D. Miss. (Clarksdale), No. 85-257 (Oct. 1985)
RECORD TYPE Case Filing
DEFENDANT Land Tool Co.
DATE 1985
SUBJECT Motorcycle Helmets
ABSTRACT Defective helmet.
ACCESSION # = 0237529

38. TITLE
Collins v. Bell Helmets Inc.
CITATION U.S. District Court, N.D. Ill. (Chicago), No. 85-9756 (Dec. 19, 1985)
RECORD TYPE Case Filing
DEFENDANT Bell Helmets Inc.
DATE 1985
SUBJECT Motorcycle Helmets
ABSTRACT Injury from defective helmet manufactured by defendant.

44. TITLE
Rau v. Shoei Safety Helmet Corp.

CITATION U. S. District Court, E.D. Pa., No. 86-0900, Dec. 23, 1987
RECORD TYPE Case Abstract
DEFENDANT Shoei Safety Helmet Corp.
DATE Dec. 23, 1987
AGE 023 yr
OCCUPATION Waitress
SUBJECT Motorcycle Helmets
ABSTRACT Wendy Rau was a passenger on a motorcycle driven by her husband. When the motorcycle's rear tire blew out, she Raus were thrown from the vehicle. Although Wendy, age 23, was wearing a S27 A helmet manufactured by Shoei Kako Co., she sustained a skull fracture and severe brain injury. She was in a prolonged comatose state. She has abnormalities of ocular motility, profound motor impairment, and impaired oral pharyngeal mobility, dysarthric speech, and bowel and bladder incontinence. She is permanently hospitalized. Rau used to be a waitress, earning $15,000 annually. Suit alleged that the helmet was negligently designed in that it did not distribute contact forces evenly across its length and breadth. Unlike most motorcycle helmets, which have one piece fiberglass shells, this helmet had two pieces. One was made of fiberglass; the other, which was the lower two inches of the helmet, was made of a flexible plastic material. Although the two pieces were attached, they were structurally distinct.

Because there were two pieces, the stiffness of the junction's region was diminished and the ability of the helmet to distribute contact forces was decreased. Plaintiff claimed that if impact occurred in the junction region of the shell, more of the impact forces would have been transmitted to the polystyrene core, ceasing to provide head cushioning. This is where Wendy's helmet impacted the ground at the accident. Plaintiff claimed that had the helmet been of the standard one piece fiberglass construction, the skull fracture and associated injuries would have been prevented. Accident reconstruction further proved that a nondefective helmet would have protected the wearer against the impact speed at which Rau hit the ground. Shoei contended that the helmet met U. S. Department of Transportation Standards for Motorcycle Safety Standards FMVSS No. 218 and the American Safety Standard Institute requirements for motorcycle helmets. Shoei also claimed that Rau's helmet rotated on her head when she slid along the roadway, exposing the lower left skull to direct contact with the road. Testing performed by the Shell Foundation Lab, under Department of Transportation standards, proved that when Shoei helmets were dropped from six feet, between 22 percent and 42 percent residual crush occurred at the impact location at the joint between the plastic skin and fiberglass shell. Plaintiff's experts were Malcolm Newman, accident reconstruction, Mineola, N.Y.; A. Marshall Irving, helmet testing, Mineola, N.Y.; and, Herbert B. Kingsbury, physical properties of motorcycle helmets, University of Delaware. In the damages argument, plaintiff contended that Rau will require 6 to 12 months in an acute rehabilitation facility at a cost of approximately $15,000 per month. After that she will require 24-hour daily nursing care, an extensive therapy program, and home monitoring and medical equipment. The settlement was for policy limits of $2.84 million.

COUNSEL Specter, Shanin: Philadelphia, PA
ACCESSION # = 0474359

	PHILADELPHIA, PA 19103
PHONE NUMBER	(215) 545-4090
DATE	09/10/87
SUBJECT	Motorcycle Helmets
ABSTRACT	1975 Bell Star II Motorcycle Helmet. Helmet restricted peripheral vision. Serious head injuries.
ACCESSION #	= 0774376

402.	TITLE
RECORD TYPE	Inquirer
NAME	BERNSTEIN, MARSHALL A
ORGANIZATION	Bernstein, Bernstein, & Harrison
ADDRESS	1600 MARKET STREET, SUITE 2500
	PHILADELPHIA, PA 19103
PHONE NUMBER	(215) 864-0770
DATE	10/02/87
SUBJECT	Motorcycle Helmets
ABSTRACT	Nava Motorcycle helmet. Helmet flew off client's head after he hit a car. Helmet has a movable plexiglass face shield and webbing chin strap with a velcro clasp. Closed head injury, craniotomy, and paralysis of right side.
ACCESSION #	= 0779446

403.	TITLE
RECORD TYPE	Inquirer
NAME	BREIT, JOHN L
ORGANIZATION	Breit, Best, Richman, & Bosch
ADDRESS	1512 LARIMER, SUITE 900
	DENVER, CO 80202
PHONE NUMBER	(303) 573-7777
DATE	10/26/87
SUBJECT	Motorcycles
	Motorcycle Helmets
ABSTRACT	1985 CR250 Honda Motorcycle and Bell Helmet. Client experienced problems with stability and suspension. This caused him to be thrown over the handle bars. Helmet may have contributed to spinal cord injury and quadriplegia.
ACCESSION #	= 0784746

404.	TITLE
RECORD TYPE	Inquirer
NAME	APPEL, MICHAEL J
ORGANIZATION	Law Offices of Stanley Bell
ADDRESS	505 SANSOME STREET, 18TH FLOOR
	SAN FRANCISCO, CA 94111
PHONE NUMBER	(415) 391-3700
DATE	10/27/87
SUBJECT	Motorcycle Helmets
ABSTRACT	Land Tool Company motorcycle helmet model GP 2. Helmet hampered vision of driver causing a loss of control and collision. Both clients, driver and rider, sustained serious personal injuries.
ACCESSION #	= 0785656

17. TITLE
Schankin v. Seaway Importing Co.

CITATION
U.S. District Court, E.D. Mich., No. 77-2430, Aug. 24, 1979
23 ATLA L. Rep. 41 (Feb. 1980)

RECORD TYPE Case Abstract
DATE 1979
AGE 014
SUBJECT Motorcycle Helmets
Annuity Settlements

ABSTRACT
Structured settlement reached on behalf of a 14-year-old boy who sustained brain damage in a motorcycle collision while wearing a helmet manufactured and distributed by defendants. The accident occurred on a woodland trail when plaintiff collided head - on with another motorcycle. His head was thrown forward and struck the oncoming motorcycle. He received a puncture wound in the vertex of the skull, which should have been covered by the helmet. Plaintiff alleged that the helmet's retention system was not sufficient to hold the helmet in place during impact. As a result, the helmet momentarily rotated back during the collision, exposing part of plaintiff's head that should have been protected. Plaintiff further alleged that the design did not meet ANSI Standards in effect at the time of manufacture. Plaintiff was rendered blind in one eye with impaired vision in the other. He is mentally retarded due to frontal lobe damage and will not improve beyond sixth grade level. Under the settlement, plaintiff received a cash payment of $215,000. He will receive $685 per month, compounded by

4 TITLE per year until age 62 1/2, with maximum payout of $992,900. He will then receive a lump sum payment of $200,000 if he is still living. The present cash value of the package is $550,000.

COUNSEL
Hadden, Donnelly W.: Detroit, MI

ACCESSION #
= 0026539

18. TITLE
Hupp v. Accessory Distributors Inc.

CITATION
616 P.2d 233 (Hawaii App. 1980)

RECORD TYPE Case Abstract
DATE 1980
SUBJECT Motorcycle Helmets

ABSTRACT
The Hawaii Court of Appeals upholds the trial judge's refusal to set aside a default against the distributor of an allegedly defective motorcycle helmet. Plaintiff was involved in an auto accident while wearing the helmet. The helmet flew off and plaintiff suffered severe injuries when his head struck the ground. After the accident, it was discovered that the helmet's chin strap was still fastened. Plaintiff filed a products liability action and served a copy of the complaint upon defendant, which forwarded it to its insurer. Although plaintiff's attorney contacted defendant several times during the next 9 months, no answer was filed. A default was entered and the trial judge denied defendant's motion to set aside the default, but also denied plaintiff's motion for entry of a default judgment on grounds that plaintiff had failed to make out a prima facie case of liability. The Court of Appeals finds no abuse of discretion under Hawaii R. Civ. Pro. 55, substantially the same as the federal rule, in the denial of defendant's motion. Defendant's failure to answer the complaint, under the apparent belief that plaintiff's counsel had agreed to an open extension of time, was inexcusable neglect. The court also holds that the judge may require a party seeking a default judgment to make out a prima facie case which would be sufficient to withstand a motion for directed verdict. The court reverses the denial of judgment, finding that, even without expert testimony, plaintiff's evidence was sufficient to go to the jury.

COUNSEL
Schutter, David C.: Honolulu, HI
O'Brien, Francis T.: Honolulu, HI
Levinson, Steven H.: Honolulu, HI

SUBJECT Motorcycle Helmets

ABSTRACT Jury verdict of $701,500 for a 36-year-old union mason for injuries sustained when his motorcycle collided with an auto, including head injuries attributable to the failure of his Harley Davidson Model C half - helmet. Plaintiff's motorcycle collided head - on with a Pinto operated by defendant Segarra. During the collision, the leatherette webbing of plaintiff's helmet tore and the helmet flew off. In addition to arm, femur and pelvic fractures, plaintiff sustained a linear skull fracture and developed a major depressive syndrome controllable only by medication. The helmet bore the name and logo of Harley Davidson, though it was manufactured by a contractor. Plaintiff's strict liability claim against Harley Davidson alleged that the helmet's restraints were not adequate to keep it in place during an accident. Department of Transportation tests four months prior to the accident showed that the helmet failed to meet standards for retention. Plaintiff introduced evidence that while Harley Davidson recalled the Model C helmet from its dealers, in compliance with instructions from the Department of Transportation, it made no effort to recall the helmet from the 6,000 purchasers. Based on jury special interrogatories regarding the divisibility of plaintiff's injuries, the court apportioned the award $558,000 against the driver and $143,500 against Harley Davidson.

COUNSEL Karp, Adrian J.: Morris Plains, NJ

ACCESSION # = 0026819

22. TITLE
Hardin v. Brannon

CITATION Ala., Etowah County Circuit Court, No. 80-380-SW, Jan. 3, 1983
2 PLLR 60 (May, 1983)

RECORD TYPE Case Abstract

DATE 1983

AGE 009

SUBJECT Motorcycle Helmets

ABSTRACT $106,244 settlement for the wrongful death of a 9-year-old boy who was killed when his Griffin motorcycle helmet came off during a collision. Decedent was wearing a Griffin helmet while riding as a passenger on a motorcycle when the motorcycle was struck by an automobile. Decedent was thrown from the motorcycle, resulting in fatal brain injuries. At some point during the accident decedent's helmet came off even though the chin strap remained securely attached. Plaintiff's action against Griffin Corp. alleged that decedent's helmet, the smallest size marketed by Griffin, was improperly designed to remain on the head of a child in certain accident situations. Plaintiff further claimed that the helmet did not adequately attenuate the force of the impact and that the back of the helmet did not extend down far enough to provide proper head and neck protection. Pending trial, Griffin filed in bankruptcy and its insurer placed its policy limits of $1 million into a fund to cover personal injury claims filed against Griffin around the country. Plaintiff's recovery represented its share of that fund.

How Important Is Proper Helmet Fit?

A technical article published in **Trial** magazine, discussed proper helmet fit. Author, Larry E. Coben, addressed the question of helmet design and different sizes of particular models. The two component parts of a helmet are the shell and the shock absorbing liner. DOT standards are minimal at best, and can not truly offer reasonable head protection. The problem lies in the fact that although a particular model helmet may meet the DOT standards in a small or medium size, it will be insufficient in a larger size. This argument seems to be substantiated in a case against Premier Crown Corporation. A policeman died, after being in a coma for ten months. Although the claim on promotional brochures claimed the helmet met FMVSS 218, this was not the case in the larger sizes of that particular helmet. Besides the obvious misinformation a consumer may fall victim to, very few shops have qualified personnel trained in the proper fitting techniques associated with helmets. Those that do may not find the time to properly fit a customer anyway.

An improperly fit helmet will not provide any protection at all, especially if it comes off during an accident.

In One Study Of Motorcycle Crashes With Helmeted Riders, Researchers Found That 38% Of The Helmets Flew Off The Riders. In All Of These Cases The Head Injuries Were Fatal.

If a helmet slides on with no resistance, it's too big. A snug fit is required. Cheek pads should be tight against the face, but not painful. While wearing the helmet, have someone grasp the sides and try to rotate it from side to side. Also check up and down movement. These should be minimal. Your skin should move with the helmet when doing this exercise, or the helmet is too large. If the helmet can be rotated off of your head by pulling from the back, toward the front with the chin strap fastened, the helmet is too large.

Fit is very important, especially when you consider how many cases involved serious injury and the helmet flew off failing to provide any protection at all. John Melvin at GM concurs. "With a helmet on (properly), it's fine. But one of the things that we've seen in our testing is that the helmet begins to rotate as you begin to go forward. It's hard to keep a helmet from rotating; it's a round structure on a round head. A chin strap is not enough." In fact, helmet rotation and head contact with the unpadded internal structure of his car are the major contributing factors in Jovy Marchello's 1992 death at Indianapolis.

On May 27, 1988, the helmet that 11 year old Edward Waddell was wearing, while he was a passenger on his father's motorcycle, rotated forward during an accident exposing the back of his head. He received a broken neck and severe head injuries and will spend the remainder of his life dependent on a respirator to breathe.

How does the helmet industry cope with this problem. Basically, they have designed a safety device to protect you from the first safety device. Foam neck collars are now being hailed as the "fix" to ending rotating helmets. **WHAT'S NEXT???**

Helmet at left has foam collar in place, while helmet on right is over rotating, exposing the neck and back of head.

THE CALIFORNIA EXPERIENCE

California is proving the consistent trend that states with mandatory helmet laws have higher death rates than those which repealed the law. Instead of seeing a dramatic decrease in fatalities, as proponents predicted, the truth is California's death rate is 2% higher than the year before the helmet law went into effect. This falls in line with the experience of other states with mandatory helmet laws. In 1992, the states with the lowest fatality rates were Iowa, Minnesota, Wisconsin, New Hampshire, North Dakota and Wyoming, none of which have full helmet laws. Coincidentally, those states with the best overall safety records also have comprehensive rider education courses in place. This is the impetus for Senator Campbell's S. 234, which would exempt states from federal penalties for non-compliance with helmet mandates, if there were safety programs available. More evidence to the value of safety programs comes from the fact that in California, their award winning safety program accounted for a 43% decrease in fatalities and a 40% decrease in injuries from 1986 through 1991, before the helmet law was in effect. The decrease in injuries alone amounted to 12,258, compared to 5,829 which the California Highway Patrol attributes to the helmet law between 1992 and 1993. Did the helmet law in California cause a decrease in fatalities? While deaths did go down, the number of riders decreased at even a greater number. That coupled with a national trend of continued fatality decreases, it's hard to credit the helmet law with anything more than causing a financial disaster in California.

There was a 26% drop in new motorcycle sales in 1992-1993. Ridership was down an estimated 18%. How does that compute to dollars lost to California? Over $1 million less was received in gasoline tax, over $15 million in sales taxes, payroll taxes and in state income taxes. The state lost $950,000 in registration fees. California used to account for 1/5 of all registered motorcycles in the United States. They are now experiencing the lowest totals since 1969. With the increase in court challenges to the law, at a great cost to the state, there is no way to estimate the total cost. But it was all unnecessary.

ABATE of California puts this problem into perspective. Today's violent society calls for an increased law enforcement presence at all levels. The primary and most important duty of those whom we elect to public office, and their enforcement arm, the police, is to protect the citizens of California from that which they cannot protect themselves. There has been a recent tendency to enact motor vehicle safety legislation which is designed to socially engineer our individual behavior after the image of those who have the political power to pass laws which regulate and control us. California's motorcycle helmet law is a prime example of this. This law was enacted, after years of controversy and little popular support, in spite of declining fatality and injury rates because of California's motorcycle safety and training program. The law has been strictly and rigidly enforced from the day it became effective. Unreasonable and uncharacteristically heavy handed police activity has created an adversarial situation between otherwise law abiding citizens and the very law enforcement personnel they rely on to protect them.

It's time to repeal California's mandatory motorcycle helmet law for adults, and this is why.

First. The helmet law has not delivered the safety benefit which was promised to justify it's passage. The rate of fatalities per accident in the second year of helmet law enforcement was higher than it was in 1991, the last year before the helmet law went into effect.

Second. The helmet law costs California money in two ways. It has severely depressed the motorcycle business in California with a resulting loss of jobs and tax revenue. In addition, zealous, but ill-advised enforcement of the law has cost the state valuable law enforcement, judicial and prosecutorial resources on citations which are, for the most part, ultimately dismissed when contested.

Third. Freedom of Choice! The main, and most important reason to modify the existing law to exempt adult riders from mandatory helmet use, is that it is simply wrong for the government to dictate to individuals on an issue of purely personal choice.

If a message was intended by the election results from November of 1994, it was that Californians and Americans want less government. The mandatory helmet law for adults represents a dramatic and largely unprecedented intrusion into the arena of individual rights.

Comparison Of Motorcyclist Fatalities From State To State, 1993

Note Totals Of Helmet Law States And Non-Helmet Law States

Traffic Safety Facts 1993 — Motorcycles

Table 2. Motorcyclist Fatalities and Fatality Rates by State, 1993

State	Total Traffic Fatalities	Registered Vehicles (thousands)	Motorcyclist Fatalities	Percent of Total	Motorcyclist Fatalities per 10,000 Registered Vehicles
Alabama[a]	1,042	42	32	3.1	7.6
Alaska[b]	118	12	3	2.5	2.5
Arizona[b]	801	68	66	8.2	9.7
Arkansas[a]	583	14	21	3.6	15.0
California[a]	4,163	610	310	7.4	5.1
Colorado[c]	559	89	48	8.6	5.4
Connecticut[b]	342	48	44	12.9	9.2
Delaware[d]	111	10	8	7.2	8.0
District of Columbia[a]	57	2	2	3.5	10.0
Florida[a]	2,635	192	197	7.5	10.3
Georgia[a]	1,394	83	52	3.7	6.3
Hawaii[b]	134	24	26	19.4	10.8
Idaho[b]	227	34	23	10.1	6.8
Illinois[c]	1,392	212	115	8.3	5.4
Indiana[b]	889	94	48	5.4	5.1
Iowa[c]	459	149	38	8.3	2.6
Kansas[b]	428	52	20	4.7	3.8
Kentucky[a]	871	36	36	4.1	10.0
Louisiana[a]	879	38	29	3.3	7.6
Maine[e]	185	28	10	5.4	3.6
Maryland[a]	665	51	44	6.6	8.6
Massachusetts[a]	475	65	44	9.3	6.8
Michigan[a]	1,408	144	58	4.1	4.0
Minnesota[b]	538	102	34	6.3	3.3
Mississippi[a]	813	28	12	1.5	4.3
Missouri[a]	947	59	30	3.2	5.1
Montana[b]	195	23	20	10.3	8.7
Nebraska[a]	254	19	6	2.4	3.2
Nevada[a]	263	20	15	5.7	7.5
New Hampshire[b]	121	33	16	13.2	4.8
New Jersey[a]	788	103	40	5.1	3.9
New Mexico[b]	431	30	29	6.7	9.7
New York[a]	1,781	190	115	6.5	6.1
North Carolina[a]	1,389	60	86	6.2	14.3
North Dakota[b]	89	18	7	7.9	3.9
Ohio[f]	1,482	225	134	9.0	6.0
Oklahoma[b]	671	55	34	5.1	6.2
Oregon[a]	524	62	28	5.3	4.5
Pennsylvania[a]	1,529	167	112	7.3	6.7
Rhode Island[g]	74	20	9	12.2	4.5
South Carolina[b]	846	32	57	6.7	17.8
South Dakota[b]	140	22	12	8.6	5.5
Tennessee[a]	1,171	76	61	5.2	8.0
Texas[a]	3,037	152	151	5.0	9.9
Utah[b]	303	24	15	5.0	6.3
Vermont[a]	110	16	13	11.8	8.1
Virginia[a]	878	57	32	3.6	5.6
Washington[a]	661	105	37	5.6	3.5
West Virginia[a]	429	19	19	4.4	10.0
Wisconsin[b]	714	172	40	5.6	2.3
Wyoming[b]	120	15	6	5.0	4.0
U.S. Total	40,115	4,001	2,444	6.1	6.1
Puerto Rico	600	NA	30	5.0	NA

Status of state motorcycle helmet use requirements (as of July 1993): [a]Required for all riders. [b]Required for riders under 18 years old. [c]No helmet use requirement. [d]Required for riders under 19 years old; helmets must be in possession of other riders, but use is not required. [e]Required for riders under 15 years old, novices (first-year operators), and holders of learner's permits. [f]Required for riders under 18 years old and novices. [g]Required for riders under 21 years old and novices.

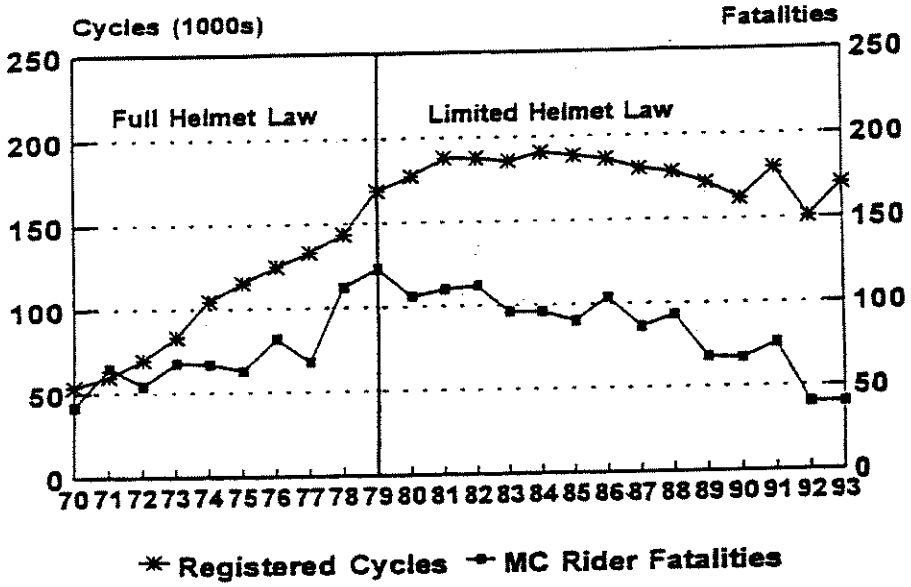
Note: Totals may not equal sum of components due to independent rounding.

Sources: Fatalities—Fatal Accident Reporting System, NHTSA. Registered vehicles—FHWA.

Registrations, Fatalities And Injury Statistics For Wisconsin, 1970-1993

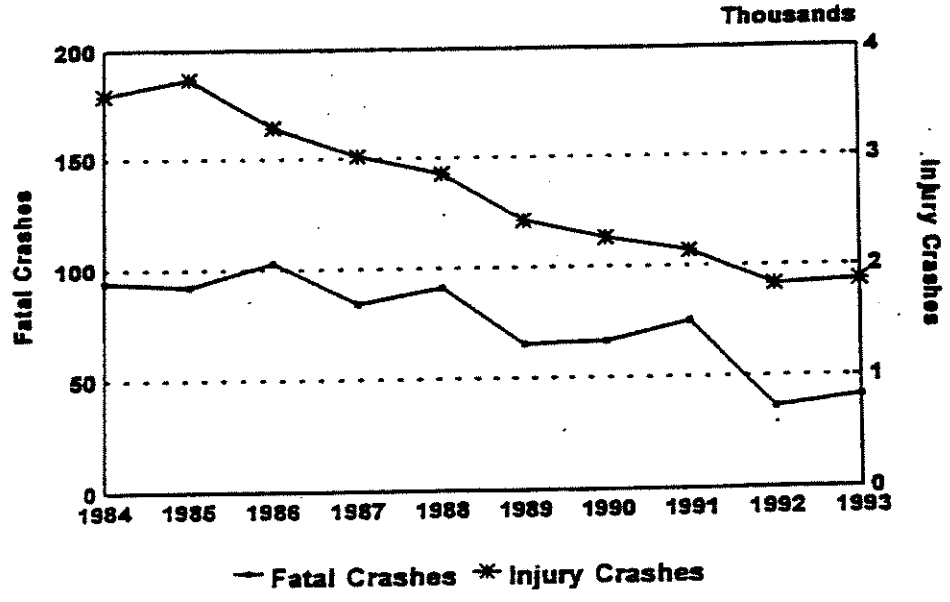
Wisconsin Repealed It's Helmet Law in 1978

Registered Cycles and Motorcycle Rider Fatalities (1970-1993)



Note: In 1991, WisDOT moved to a two-year registration cycle. Hence, the number jumped for one year.
Source: WisDOT/DMV/Accident Database

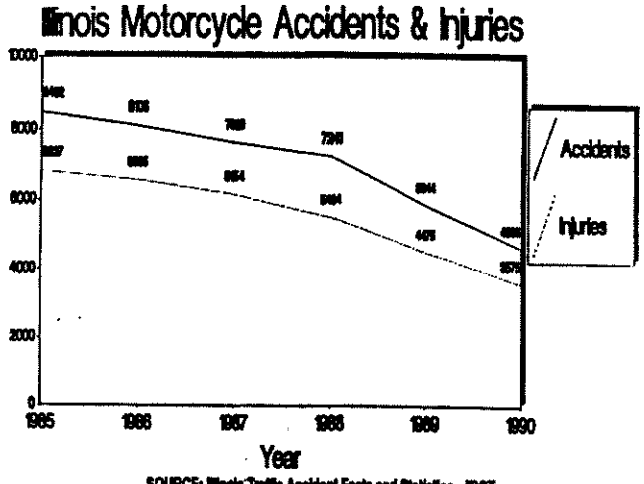
1984-1993 Fatal and Injury Motorcycle Crashes



Source: WisDOT/DMV/Accident Database

Illinois Award Winning Safety Program Hailed As Responsible For Reducing Deaths And Injuries

Although proponents of helmet laws refuse to recognize the benefits of safety and rider education programs, every state with such a program implemented has lower fatality rates than those states with helmet laws. There has been a national downward trend in fatalities for years. States with safety programs, and no helmet laws have shown the greatest improvements. Even so, cuts in funding for such programs continue, while the emphasis by government is always put on helmet laws. Why? When the public burden theory is used, helmet law proponents cite huge monetary costs for injured cyclists who are placed in rehabilitation facilities. Todd Vandermyde, ABATE of Illinois Legislative Director, questioned these figures. He asked just how many bikers actually were a burden to society. **The answer is at the bottom of the letter he received from the Illinois Department of Rehabilitation**



SOURCE: Illinois Traffic Accident Facts and Statistics—IDOT.
Prepared by ABATE of Illinois, Legislative Department

Illinois became the first state in the nation to graduate it's 100,000th student from a motorcycle rider education program.

This milestone becomes even more significant when compared with Illinois' declining number of motorcycle accidents and injuries. Between 1985 and 1990, motorcycle accidents have fallen 46%. Injuries to motorcyclists have dropped 48% (see Fig 1). This can be directly attributed to the increase in participation in Illinois rider ed program.

The Cycle Rider Safety Training Program has graduated 48,452 people from the both the beginner and experienced rider courses since 1985. The program has seen a 20% increase in the number since 1988.

25% CUT IN CLASSES IN 1992.

With the loss of $230,000, Illinois' rider education program was forced to cut classes across the state. Twenty-four percent of the classes in the southern part of the state were cancelled.

The number of cancelled beginner classes and loss of all experienced rider courses in the northern region amounted to a 25% cut in classes offered. This substantial loss of classes resulted in waiting lists three times the capacity of classes.

Who Pays for the Cycle Rider Safety Training Fund?

Motorcyclists do. Recognizing the need for education in better and safer riding techniques, motorcyclists supported an increase in motorcycle registration fees. Unfortunately, funding for the rider ed program did not increase proportionately with the fee increase. Presently $7 out of each $30 registration fee goes to the program. This means that pound for pound, motorcyclists pay more to have their vehicle on the road than automobiles. Since the Cycle Rider Safety Training Fund is paid for by motorcyclists for motorcycle education, we only ask that it be there for us to use.

HB-1129 doesn't restore any funding that was stripped away earlier this year. It merely seeks to protect the future of the best rider education program in the nation.

Illinois Department of Rehabilitation Services

Jim Edgar
Governor

Audrey McCrimon
Director

November 30, 1992

Todd Vandermyde
Legislative Director
ABATE of Illinois
5917 Pershing
Downers Grove, Illinois 60516

Dear Mr. Vandermyde:

This is in response to your request under the Freedom of Information Act (Ill. Rev. Stat. 1991, ch. 116, par. 201 et seq.) In your letter you requested:

1. Number of injured motorcyclists receiving assistance from DORS.
2. Number of those motorcyclists receiving assistance with head injuries.
3. Helmet status of motorcyclists receiving assistance from DORS.
4. Number of people involved in automobile accidents receiving assistance from DORS.
5. Top ten categories of activities resulting in injuries which DORS ends up providing assistance for.
6. DORS budget for 1991 and 1992.

Enclosed you will find information in response to request number six (6). Responses to request number one (1) through request number five (5) are not available because DORS does not collect statistics by cause of disability.

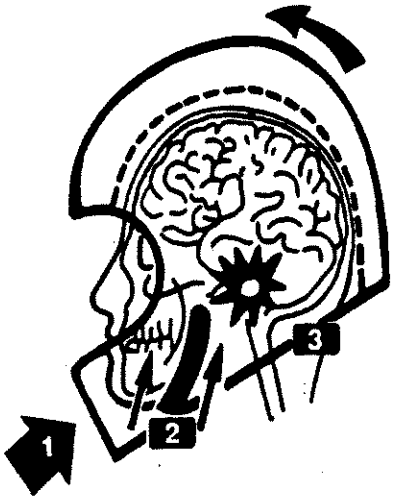
623 East Adams, P.O. Box 19429, Springfield, Illinois 62794-9429 ■ 217/782-2093 (voice) ■ 217/782-9743 (TDD) ■ 217/785-4515 (FAX)
100 West Randolph, Suite 8-300, Chicago, Illinois 60601 ■ 312/814-2931 (voice) ■ 312/814-5000 (TDD) ■ 312/814-7149 (FAX)

HOW HELMETS CAN KILL

1. Impact to the lower face bar is transmitted via the jaw to the skull

2. The chin strap forces the jawbone upward

3. The brain stem is severed



*This pattern of death emerged after four years of research.

Despite the scrupulousness of his methods, Dr. Rodney Cooter has been the victim of some absolutely vicious attacks. Why? Because he has dared to show that helmets can be deadly.

Australian Researchers Find Helmets To Be Killers

Chin Straps Kill Like A Hangman's Noose

Reprint from the *Australian Post*, December 2, 1989

***Easyriders* #206 - August 1990**

Researchers at Adelaide's world-renowned Cranio Facial Unit have found the standard helmet worn by 80% of riders may cause fatal injuries rather than act as a lifesaver.

The unit has discovered flaws in helmet design that contribute to fatal injury—the rider's skull base is fractured as if he were hanged!

The Cranio Facial Unit has joined the South Australian Centre for Manufacturing to design a new helmet to reduce fatal injuries.

For four years, researchers, Doctor Rodney Cooter and Unit Chief Mr. David David have been studying injuries caused by various accidents to see if there was a pattern.

"We looked at the influence of things such as spectacles, dentures, and, of course, helmets," Dr. Cooter told the Post. "It surprised us that when motorcyclists suffered a lot of facial fracturing, they often had little or no brain damage. It seemed their faces had absorbed most of the impact.

"On the other hand, we examined riders who had been wearing full-face helmets and had suffered little face injury, yet died from skull-base fractures, often running from ear to ear."

The findings were backed by accident reports from both Europe and the United States.

"Naturally, we were keen to find out why these injuries were occurring and the best way was to examine where and how a dead rider's head had impacted on the inside," Dr. Cooter said.

Rather than cutting helmets into sections, Dr. Cooter decided on a novel approach—subjecting helmets to CAT scans at Adelaide Children's Hospital.

One individual who showed keen interest in the research was Formula One Racer Ayrton Senna.

"While in Adelaide for the 1987 Grand Prix, he came to the hospital and I showed him the CAT scans we'd performed on helmets and the X-rays of riders' heads," Dr. Cooter said.

Senna was fascinated and eager to help. He lent Dr. Cooter two of his own helmets, which were subjected to a scan from different angles.

"Our research led us to conclude that the modern full-face helmet has a weak aspect," Dr. Cooter said. "They have been designed not to break on impact, but the combination of rigid face bar and position of the chin strap, which holds the helmet tightly on the rider's head, can be lethal."

Helmets For Car Drivers Makes Much More Sense Than Helmets For Motorcyclists

When the GM Motorsports Safety Technology Program team set out to study the crashworthiness of Indy Cars, they found a number of devices need to be in place to protect drivers from the high speed crashes associated with the sport. Their findings concluded that to afford the most safety to the drivers, the seat backrest should be angled at 45°, a six-point harness system should be used, a full face helmet with foam neck collar in place and fire-resistant head sock (balaclava), a padded dash, padding on the inner structures and a soft steering wheel all are needed.

Of course, without the soft padded, compartmentalized unit, the helmet could not prevent the energy and stress loads to the neck and head, which could very well prove fatal. This lends to the argument that helmet use in cars would be beneficial, but on the non-compartmental motorcycle, where the occupant is usually thrown off, the helmet presents a whole different set of problems.

When looking at the distribution of fatal brain injuries according to type of victim, we find in a study conducted in San Diego County, California, in 1978, of the 5,055 cases studied, 74% were the result of a motor vehicle accident, 15% were pedestrians and 10% were attributed to motorcyclists.

A similar study in Olmstead County, Minnesota (1965-1974), showed that in 3,587 fatal head injury accidents, 78% were motor vehicle related, 14% were bicyclists and only 8% were motorcycle related.

Another study in Virginia had very similar results. Of 735 fatal head injury accidents studied, 78% were motor vehicles, 14% pedestrians and 8% due to motorcycle accidents. In fact there are studies reported in the Journal of the American Medical Association, October 27, 1989, which list motor vehicles, falls, assaults and pedestrian head injuries all above the totals for motorcyclists, at 95 trauma centers investigated.

Let's Put Helmets Where They Belong And Really Save Some Lives And Money

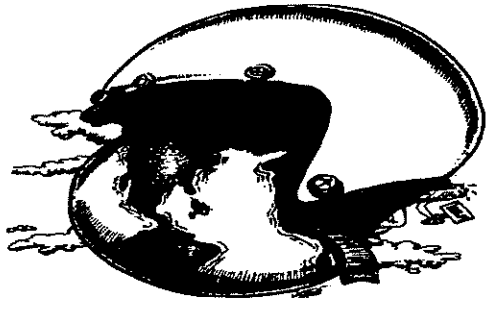
One blazon attempt to justify helmets for motorcyclists came from the Oklahoma Department of Health. They predicted that a helmet law would prevent 40-50 severe or fatal head injuries a year. They went on to say that preventing those injuries would save the state $4.1 million a year. That means they are placing a figure of $82,000 on each head injury. While saving the state $4.1 million is a commendable task, why not put helmets on car drivers? In fact, if we refer to the numbers indicated by the following chart, we can assume that if all of those accident victims were wearing helmets at the time of the accident, there would have been drastic reductions in severe injuries and fatalities, if we truly believe helmets work.

Those 7,518 head injuries attributed to motor vehicles represents a $616,476,000 public burden to the state, using their $82,000 benchmark figure. How much could have been saved, if motorists wore helmets?

Injuries, 95 Trauma Centers, 1982-1986

Source of injury	Number of victims	% of all head inj.
motor vehicles	7,518	45.5
falls	2,478	15.0
assaults	2,263	13.7
pedestrians	1,867	11.3
motorcyclist	1,569	9.5
gunshot	760	4.9
stabbings	66	.4

Helmeting the 2,478 fall victims could represent an additional $203,196,000 savings. And if we go the limit, then helmeting pedestrians would have prevented those 1,867 pedestrian head injuries for another $153,099,000 savings to the state. If reducing the public burden is the intent of this sort of legislation, then why do we stop with helmet laws for motorcyclists? All we have to do is mandate helmet use for everyone, from the moment they get out of bed, and, using the mathematics provided by the Oklahoma Department of Health, we would save $1,158,332,000 a year. We could eliminate the national deficit in a very short time if this were forced on the citizenry.



Inferior Helmet Design, Or Can A Helmet Actually Be Manufactured That Will Work?

We see more and more evidence that helmets just can't do the job they're supposed to do. Cervical spine injuries point to helmet rotation, which presented a major problem to race car drivers and football players. The helmet industry actually had to invent a safety device to protect you from the other safety device. Sound a little strange? Helmet rotation is a major factor in what was known as the Hangman's Noose Analogy. This problem was identified in the 1970's, although ignored for the most part by NHTSA. In fact, **on July 18th, 1973**, the National Transportation Safety Board forwarded to James E. Wilson, then Acting Administrator for NHTSA, Safety Recommendation H-73-30. The NTSB was concerned about a report put out by State of New York DMV researchers, Raeder and Negri. They studied the effects of the mandatory helmet law for New York, which went into effect in 1967. They compared 1966 to 1967. The findings were: a) a 34% decrease in serious head injury, b) 27% decrease in serious facial injury, c) **75% increase in serious neck injuries**. Neck injuries which resulted in death rose from 4 (1966) to 14 (1967). The conclusions of the researchers were the increased weight of the helmet added appreciably to the momentum of the moving head. The rigid construction of the helmet helps to protect the skull, but the energy forces are then transmitted directly and almost entirely to the neck. The NTSB's recommendation: "NHTSA take immediate steps to confirm or disconfirm the implications of the New York State report that the wearing of helmets, as currently designed, increases the number of fatal neck injuries."

"Helmet rotation is a major factor in what was known as the Hangman's Noose Analogy."

In 1974, NHTSA official, Lew Buchanan, stated that the NHTSA Research Institute has been requested to comply with the recommendation and that the necessary data collection was underway. Because not enough data had been collected, a research program would be set up to study the issue, and would began work in **1975**. In **1976**, Congressman Tom Sneed, Oklahoma, requested information on this research project, on behalf of one of his constituents. Webster B. Todd, Jr., Chairman of NTSB responded on **March 22, 1976,** by stating that NHTSA published DOT HS-801-137 (a technical report entitled, "A Motorcycle Safety Helmet Study") with an explanation that **the findings of the report were inconclusive with respect to neck injuries**. To date, 1995, we don't know of any conclusive report by NHTSA refuting the claims of increased neck injury due to helmets.

CDR E.J. Colangelo, MC, USN, also published a report entitled, "The Cervicocranium and the Aviator's Protective Helmet." Again, this was a case report investigating the presence of C2-C3 vertebral dislocations in accidents involving aviators wearing helmets. It appears, according to Colangelo, that the cervicocranium as an entity, moves as a single unit above C3. The implied mechanical weakness at C3 makes it a likely site for dislocations in injuries sustained by forces being applied to the back of the neck by the helmet rim, during normal rotation, such as found in motorcycle accidents.

The apparent refusal of NHTSA to recognize a problem exists concerning the cervical spine, and their refusal to acknowledge the problem can only mean that they do know the problem exists, and that if helmets were tested in a manner which identified the energy loads to the neck, none of the helmets on the market today would pass the test. That is of course, if the test were properly conducted and the minimum loads were honestly applied to the standard.

The following reprint helps to explain how helmets cannot prevent neck injuries, and may even cause them.

Keep in mind that motorcyclists have been claiming problems with neck related injuries for years. NHTSA's response has been no data supports the claim, even though they admit their investigation was inconclusive. **How hard did they look?**

New data recognizes the problem which NHTSA continues to ignore.

The Foreseeability of Helmet Induced Neck Injuries

by J.B. Sevart and R. Lewis Hall

This paper presents an example of the use of human factors engineering at the design stage to predict the foreseeability of cervical spine injury to the user of a protective helmet. An actual case study with illustrative drawing is presented and a supportive list of technical references is included. All source materials used to prepare this case study predate the actual design of the protective helmet involved.

Introduction:

For many years the designers of mechanical products recognized that materials have physical limitations such as yield and fatigue strengths, elastic stiffness, wear and temperature resistances and similar characteristics. Consideration of these limitations at the design stage is necessary if the product is to function properly. Most all products require some interaction with a human to complement or complete their function and it is no less of a design constraint to consider the normal limitations of the human.

"Protection of one part of the body at the expense of another is not an acceptable design philosophy."

Human limitations fall into two general categories: physical and psychological. Human factors in product or machine design is nothing more than the recognition of these limitations by the designer. Just as the ignoring of material limitations at the design stage will lead to foreseeable product failure, so also will the ignoring of human limitation. The topic of this paper is the consideration of human physical limitations in the design of a protective helmet in order to reduce the risk associated with the use of the product.

Background:

Much of the research which prompted this paper was done while reviewing an accident where a young adult male received serious cervical injuries, and eventually died from a relatively simple fall from a standing position. The victim was wearing an expensive protective helmet when he was caused to topple over striking the ground with the upper portion of the helmet. The injuries received by the victim were determined from x-rays taken at the treating hospital to be exactly the same as those predicted by the study. Thus, it was established that helmet induced injuries were foreseeable by the application of human factors engineering.

To briefly discuss two types of foreseeablility exist in the literature:

1. The "Head Count" method—counting to see how many accidents occur before a design deficiency is recognized.
2. The Ergonomics or Human Factors Engineering method—using recognized engineering concepts to predict a design deficiency.

Helmet Design History

In general, design emphasis has been placed on cranial impact protection, product appearance and cost factors. **Helmet induced neck injuries have not been adequately considered** and have been called a myth by some.(1) Product standards (2,3,4) have been greatly influenced by the industry and do not address the problem of neck injury. It is quite probable that the true cause of many neck injuries is never established. Whereas such injuries have been recognized in football as being helmet induced, they have not been considered in many other instances such as motorcycle accidents.

In most instances, helmets used for sporting activities provide the user with cranial impact protection and have reduced injuries and associated deaths caused by these same helmets. A review of the maximum amplitude and velocity of movement of the head to thorax linkage for extension/hyperextension, as related to helmet design, revealed serious design deficiencies. It is evident that protection should prevent injuries, not cause them, and protection of one part of the body at the expense of another is not an acceptable design philosophy.

Many medical and engineering studies provide a clear account of the anthropometry and anatomical range of motion as well as body centers of gravity and weights. An often referenced study, published in 1937 (5), gave reference to a study, published in 1888 (6), addressing the methods of determining ranges of joint motion. These and many other studies have led to the development of anthropometric data and test forms to study the prevention of injuries and death in engineering design without subjecting people to those hazards. Much has been done to reduce injuries and death by establishing experience and reference data for the designer to apply in the development of equipment. Two publications, by their very titles alone, The Human Body in Equipment Design,(7) and Human Engineering Guide for Equipment Design,(8), demonstrate the evaluation and considerations that must take place during the design process. This becomes even more important when designing safety or protective equipment.

The Case Study

The accident description was of a cervical spine injury to an

adult male falling face forward and impacting the ground with the front portion of a protective helmet he was wearing. What was sought was the mechanism for a fracture, or fracture-dislocation, and to predict the cervical vertebrae involved if the injury were helmet induced. Also, it was desired, from a study of the literature, to determine what hyperextension injuries may have been involved that were not helmet induced. As a ground rule, all literature used had to predate the design and manufacture of the subject helmet.

This investigation was initiated by preparing an illustrative drawing. An average or 50th percentile man (9) was drawn showing extension of the articular assembly, which constitutes the head-neck assembly (Figure 1). The next step was to superimpose the outline of a cross section of an average size helmet onto the head-neck assembly. It can be seen that even in normal extension the helmet has met the cervical column at the third and fourth cervical vertebrae and acts as a fulcrum to resist or oppose the force of translation of the head relative to the thorax. This translation about the helmet fulcrum slides the upper vertebrae over the underlying vertebrae and the cervical rachis is thus subjected to shearing forces or vertebrae fracture. The resulting risk of injury to the upper part of the spinal cord is quite significant with its potential for extensive paralysis. Damage to the muscular and vascular structures can occur by direct pressure of the posterior lateral edge of the helmet as force is applied to the front of the helmet and the head is forced into hyperextension.

The Literature Survey:

This synopsis of the literature survey of neck mechanics and hyperextension injuries is included to enhance the reader's understanding of the total process. The text references should be consulted or other medical sources for precise information of a medical nature as the authors claim no special knowledge in this field.

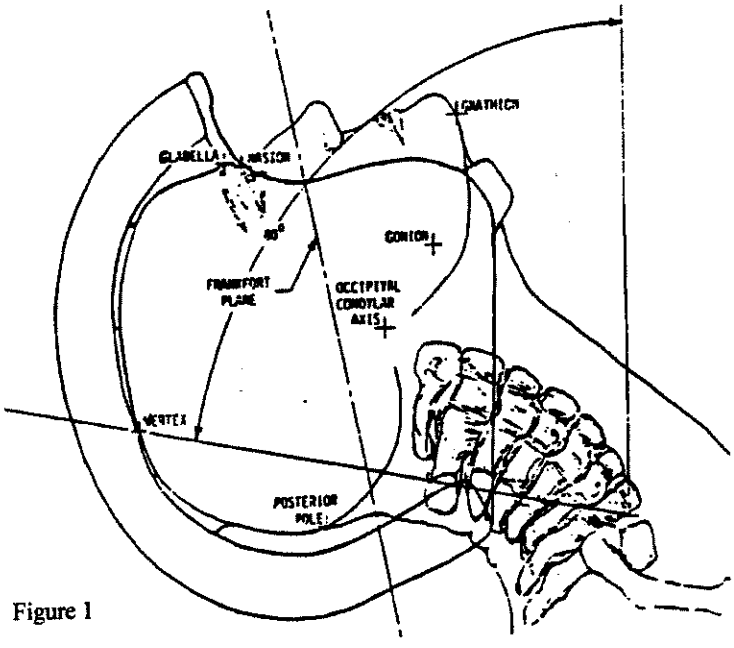


Figure 1

In a mechanical sense the human body is a complex nonlinear, damped, multimass system. This means that the response or actual acceleration-time history experienced by the body, or a portion thereof, may differ markedly from acceleration-time input applied to the body. Impact biomechanics can show on one hand the fragility of the human body, and on the other hand the possibility of maintaining body integrity in violent impacts, on condition the part can be protected.

In extension, as shown in Figure 1, the cervical column is vulnerable to hyperextension and is restrained by the resistance of the anterior ligamentous plane which joins the vertebrae to each other at the base of the cranium. If a force is applied to further rotate the head-neck assembly, neck torque at the occipital condyles will be the limiting factor in neck injury rather than the shear or axial forces (10). Tolerance levels pertinent to hyperextension of the neck are given as 10.6 ft. lbs. of torque when the head was upright in a normal position and 17.5 ft. lbs. of torque when the head was in an extended position. The increase is primarily due to a change in the point of rotation of the head with respect to the neck. Instead of rotating about the condyles at the base of the skull, the head rotates about the posterior portion of the first cervical vertebrae.(11)

The neck for the most part does not react to injury the same as other body regions in that low velocity impacts often produce injury as severe, or more severe, than do high velocity impacts. It is not unusual for post-impact symptoms to arise six months after the impact. (12). Although injury to the neck is not as common reported as injury to other body regions, it may often be fatal. The human neck contains vital nerve, vascular and respiratory structures which are particularly unprotected.

Injuries from hyperextension may involve the spinal cord, cervical nerves, blood vessels and musculoligamentous structures. In severe hyperextension injuries, spinal cord contusion, or laceration and damage to the blood supply may occur. The carotid and the vertebral arteries may be injured by stretching or by bone fractures. Stretching of the cervical nerves may result in minimal to severe damage. Hyperextension may also cause chip fractures of the anterior border of the body as the anterior longitudinal ligament is pulled or torn with fragments of bone attached. (13).

Discussion:

The literature survey and results of the associated biomechanical analysis were compared with the cervical spine injuries suffered by the case study victim. These injuries did indeed involve the third and fourth cervical vertebrae. Damage resulted in quadriplegic paralysis and death two years later. On the basis of the described study, **it is the technical opinion of the authors that the subject was an unsuspecting victim of predictable helmet induced mechanical forces** that produced biological alterations to the spinal structure and further, that the injury differed from the classical injury patterns of hyperextension. This opinion however, was never verified by medical testimony as the litigation arising from the accident was terminated by an out of court

settlement by the helmet manufacturer with the widow and two surviving children of the victim.

To identify injury potential of equipment is an activity that will eventually lead to a reduction of injury and death and such research in biophysical/bioengineering areas will improve safety. Designers need to ask question such as:

1. What are the mechanical factors likely to lead to injury?
2. What are the predisposing circumstances and conditions favorable to injury?
3. What biological alterations are entailed by the injury?
4. How is it possible to connect the mechanical factors with the biological alterations?
5. In what matter can mechanical factors be modified to reduce or eliminate the injury?

In developmental design of helmets these factors, as well as use environment, must be considered before a final design is accepted. It is important that design parameters be established which are not a compromise to the overall premise of personal protection. The protection afforded must attempt to prevent or reduce localized impacts that result from acceleration, deceleration or compression of the head and neck or a combination thereof. This would serve to assure consumers that the protective equipment enhances their survivability without inducing secondary injuries..

(1) E.L. Kramer, The Great Arkansas Motorcycle Helmet Law Fight, Traffic Safety Vol 79, No.11, Oct., 1979, National Safety Council.

(2) Motor Vehicle Safety Standard, No 218, Motorcycle Helmets Effective March 1, 1974 CFR 571.218, Title 49.

(3) American National Standard, ANSI Z90, 1971, Specifications for Protective Headgear for Vehicular Users.

(4) Standard for Protective Headgear, 1970, Snell Memorial Foundation.

(5) Glawville and Kreezer, The Maximum Amplitude and Velocity of Joint Movement in Normal Human Adults.

(6) Kingsley, A Method of Determining the Angle of Flexion of the Diseased Leg in Hip Disease, Boston Med. & Surg., 1888.

(7) Damon, Stoudt and McFarland, The Human Body in Equipment Design.

(8) Woodson and Conover, Human Engineering Guide For Equipment Design.

(9) Hubbard and McLeod, Definition and Development of a Crash Dummy Head, proceedings of Eighteenth Stapp Car Crash Conference, 1974.

(10) Tarriere and Sapin, Biokinetic Study of the Head to Thorax Linkage, Thirteenth Stapp Car Crash Conf., 1969.

(11) Mertz and Patrick, Investigation of the Kinematics and Kinetics of Whiplash, Eleventh Stapp Car Crash Conf., 1967

(12) Richard Snyder, Human Impact Tolerance, 1970 Inter. Auto Safety Conf.

(13)Gurdjian, Lissner & Patric, Protection of the Head and Neck in Sports, 1962.

Motorcycle Helmets Are Not Safe

by Steve "Red" Barron

The present testing standard for motorcycle helmets (FMVSS 218) was created almost 30 years ago. The helmet manufacturers are required to perform all motorcycle helmet testing in a laboratory on a test headform. The result is a motorcycle helmet designed to pass the testing standard, not necessarily to protect the wearer. The testing does not simulate what would happen to a motorcyclist wearing that helmet in the event of an actual accident. The present testing standard does not exceed a simulated impact speed of 13.66 mph, nor does it take into account the energy that would be trasferred to a motorcyclist's neck and spinal cord, the reduced vision and hearing, the effects of a chinstrap around the throat, or the effect on the brain when the helmet bounces. As many states have enacted laws that mandate helmet use, the testing standards should reflect what a helmet could do to a motorcyclist in the event of an accident. If the safety of the motorcyclist is the primary concern, then the testing standards

Unfortunately, test headforms do not ride motorcycles, people do.

should reflect that. Instead of headforms, full crash test dummies should be used, with sensors to detect the stresses applied to the cervical spine, in order to determine whether helmets might cause injury. Remember, a four pound helmet traveling at 50 mph becomes a 200 pound weight strapped to your head. Ignoring the impact test required by NHTSA which simulates an accident at 13.66 mph, lets examine the helmet thickness required to decelerate *g* forces reaching the brain, at variable speeds.

IMPACT VELOCITY (mph)	HELMET THICKNESS 1 (in inches)
4	1.8
10	4
15	6.5
20	15
30	29
40	

The current one inch thick helmets weigh from 2 to 4.5 pounds. Imagine what a 29 inch thick helmet would weigh, but that's how big the helmet would have to be to protect you at 40 mph. Of course, the weak part of the equation is the neck. It could not withstand the stress of a heavy helmet, not even one of the 4.5 pound versions. Yet, NHTSA does not require full crash dummy tests, only headform tests (with no neck or neck sensors). Until NHTSA addresses this problem seriously, the helmet law is nothing more than a mandatory dress code with the ability to cause injury or death. Until the testing requirements take into consideration the cervical spine, closed skull and basal skull fractures and other idiosyncrasies associated with helmet use, the only thing helmet advocates can truthfully state is that a helmet may protect a test headform in a laboratory environment at impact speeds of up to 13.66 mph.

Hazardous Headgear

Defects in Motorcycle Helmets

JOSEPH W. MOCH, TERESA M. HENDRICKS

Joseph Moch practices in Grand Rapids, MI, and serves as an Associate Editor for Trial Lawyer. *Teresa Hendricks has co-authored a book with Mr. Moch called* Winning Recreational Motor Vehicle Cases *and is a recent graduate of Thomas M. Cooley Law School in Lansing, MI.*

What's more important, one's head or one's feet? Isn't it interesting that shoes come in sizes and half sizes, yet helmets come in only four sizes--small, medium, large and one size fits all?

Head injuries are the leading cause of death in motorcycle crashes. In a June 1991 study by the Washington Traffic Safety Commission, comparing head injuries in helmeted versus unhelmeted riders, researchers found that 55 percent of the fatally injured riders had worn helmets.

For all the dropping, stretching, heating and cooling that helmet manufacturers do and industry standards require, motorcycle riders still must be wary because: (1) safety standards are limited to four basic parts of a helmet; (2) even helmets that have been approved may be dangerous; and (3) the existing standards virtually ignore vital "functional factors."

Not every helmet will protect like its sticker promises. The stickers on each helmet indicate only what standard the helmet claims to meet, not what the standard or law requires. And still many areas of helmet function and design go untested and unperfected. The danger for the unwitting soul who relies on these standards comes from the methods of testing. The tests merely gauge the construction and performance of helmets, rather than the crucial characteristics of design and function.

How Existing Standards Fail

Existing standards fail to test properly for helmet safety. The result is that helmets are being manufactured which may be ineffective in a crash.

The three organizations that set industry standards for motorcycle helmets and influence manufacturers are the U.S. Department of Transportation (DOT),[1] the American National Standards Institute (ANSI),[2] and the Snell Memorial Foundation.[3] These organizations test four basic parts of the helmet's structure: the shell, the energy-absorbing liner, the comfort liner, and the retention system.

The standards test three areas: helmet resistance to penetration by a sharp object, resistance to impact on a hard surface, and resistance of breakage of the retention system (chin strap). However, the test procedures required by these standards don't adequately simulate a crash.

The ANSI, DOT and Snell standards are similar to each other, but the difficulty varies from standard to standard.

Penetration test. In the test for resistance to penetration, a conical striker of specified mass is dropped a fixed distance onto the helmet.[4] The test situations hold the helmet completely motionless while a weight falls on it. The problem with this test is that a rider is rarely sitting still on his bike when something heavy suddenly falls from the sky. The test *should* simulate a typical accident scenario, i.e., the helmeted driver is usually in motion when he collides, often at high speed.

A more valid test for resistance to penetration would simulate an actual motorcycle crash, just as automobile tests simulate car crashes. This penetration test might involve the use of a full dummy, fitted with a helmet and catapulted at varying speeds and angles into different objects.

Impact resistance. The tests used for impact resistance would also benefit from a full dummy accident scenario. Instead, the tests use only a metal headform strapped to a helmet, which is dropped a certain distance onto flat and hemispherical surfaces.[5] The helmet is then checked to measure the degree of impact (the G load) on the headform. This result is then translated into the amount of brain injury suffered from the blow. DOT standards allow a harder hit (400 G) than Snell standards (285 G), but unlike DOT, Snell has no standard for how long the G force of the impact can last. The length

of time a G force can last is called "dwell time," and "the difference between taking 285 Gs for a millisecond and taking it for 10 milliseconds could mean a scrambled brain."[6]

The shortcoming of the impact test is that the head is dropped from a static position above onto a hard surface, which does not reflect the conditions in most motorcycle wrecks. Typically, the motorcycle is in motion before it crashes and the rider collides into something at an angle not perfectly perpendicular to the ground. Commonly, head fatalities occur when the victim is catapulted over the handlebars of his cycle, striking his face against a hard object.[7] Since the headform alone is fitted to the helmet, it ignores the forces at work on the body and doesn't test for neck injury or effectiveness of the chin strap retention in full body impact situations.

TEST SITUATIONS HOLD THE HELMET COMPLETELY MOTIONLESS WHILE A WEIGHT FALLS ON IT. THE PROBLEM WITH THIS TEST IS THAT A RIDER IS RARELY SITTING STILL ON HIS BIKE WHEN SOMETHING HEAVY SUDDENLY FALLS FROM THE SKY.

Thus, the best way to test impact resistance would be the full dummy scenario mentioned above. Using such a method, researchers could test penetration and impact resistance, neck injury, and chin strap retention in each simulation.

Retention system. ANSI requires that the retention system on a helmet be so constructed that it remain on the head in impact conditions.[8] However, testing of the retention system is wholly inadequate. Buckled-up chin straps are loaded with 300 pounds of pressure for two minutes, and during the procedure the retention system must not stretch or break.[9] The inadequacy of this test is not the amount of pressure applied or the length of time, but rather that it is not combined with other forces acting on the head and body that cause a fastened helmet to pop off under impact conditions.

Even the best helmet is useless if it sails off the head in a spill, yet the standards fail to require testing beyond just material strength of the chin strap. For example, the Snell standards, which are touted as the most rigorous, merely require that one person fasten the helmet to his head while someone tries to push it off.[10]

Helmet detachment. Too often, the rider's helmet *does* fly off in a crash and cause serious injuries. The *British Medical Journal* reported cases of helmet detachment in its study of the problem in 1984.[11] In one reported case, an 18-year-old girl was thrown from a motorcycle after colliding with an oncoming vehicle. Her helmet popped off before and was found with intact strap and fixing bolts. She suffered diffuse brain injury and died.

In another case, two racing motorcyclists collided and were catapulted from their machines. A film of the accident showed both helmets clearly coming off over the backs of the riders' heads. Both died after suffering diffuse brain injuries.

The study concluded that the fixing bolts of the chin strap were too close to the front and base of the helmet, allowing the helmet to pivot forward on the strap. The author of the *British Medical Journal* report found that when he tested a random group of 14 motorcyclists with apparently well fitting, comfortable and properly fastened helmets, he was able to remove four of the helmets by pushing from behind.

Many people may be inadvertently wearing a dangerously ineffective helmet. Several cases of helmet detachment are still surfacing. In Ohio, *Blanton v. Kiwi*,[12] the helmet flew off the rider's head when it appeared to be properly fastened, causing serious facial and head injuries. In a Tennessee case, *Pitner v. Kiwi*,[13] the rider was killed in a motorcycle accident when his helmet flew off before his head slammed into the ground.

Among the causes of action raised in these cases are negligence in design, research, development, manufacture, testing and warning; breach of implied or express warranty; and strict product liability. Michigan law recognizes that compliance with industry standards may not be the best indication of a manufacturer's reasonableness; thus the question is open for a jury.[14]

Motorcycle accessory dealers have warned of certain hazardous helmets still circulating.[15] The Simpson Bandit, in one dealer's opinion, if made by Heltech, is known for flying off heads in a crash. He warns customers to stay away from this dangerous helmet if they see it for sale, and he demonstrates how they can be properly fastened and still lift off the head.[16]

Chin strap defects. Recently, a new problem has surfaced with "Velcro closures" on chin straps, and Snell has recently issued a warning that use of these straps could cause serious or fatal injuries if the rider has an accident. Snell warned manufacturers that "adding Velcro to a chin strap ... violates good engineering practice" because it makes it easy to improperly thread the strap through the ring closure.[17]

Loss of helmets in motorcycle accidents is not an uncommon occurrence. In one study of 617 cases of motorcycle

wrecks involving helmeted riders, researchers discovered that 38 percent of the helmets flew off the riders. In all of these cases, the head injuries were fatal.[18] With all the possible dangers of a poorly designed retention system, it seems that by now the motorcycle helmet manufacturers would have thought of what the sports and bicycle helmet manufacturers have known for years: A safe and effective retention system requires a double strap.

Compare design of other protective helmets.

The chin strap construction for football helmets was designed to prevent the helmet from moving forward or backward, even when subjected to severe blows.[19] The first strap is attached at the rear of the helmet and engages the front portion of the wearer's chin. The second strap, which is attached to the helmet at the front and crosses the first strap in two places, then extends beneath the wearer's chin. The advantage of a double strap is that the helmet is locked in place, protecting the wearer from front, rearward and sideways blows.

In bicycle helmets, the retention system also involves two straps. The first strap runs from the back of the helmet to beneath the chin, and hooks to another strap that comes down from the front portion of the helmet to beneath the chin. The strap system is designed to prevent the helmet from shifting or detaching during an accident.[20] The safety technology of bike helmet retention systems seems not to have benefited motorcycle riders, even though many motorcycle helmet manufacturers also make bicycle helmets.[21]

The Dangers of Approved Helmets

Helmets that *are* tested and approved by DOT or Snell standards may fail to live up to their claims.[22] In certain crashes, one could be playing roulette with the helmet he chooses, even if he looks for both DOT and Snell stickers on it.

For example, one victim of a dangerously defective helmet suffered brain damage after the motorcycle she was riding collided with an oncoming car. She flew through the air and landed 72 feet from the point of impact. The Super Magnum Helmet by Bell Helmet Corporation cracked during the incident. The helmet had violated minimum safety standards.[23]

The head is a fragile object when compared to the pavement of the street, or metal of an oncoming vehicle. That's why the helmet's shell is such a critical part of its design. A helmet's shell is usually made of polycarbonate or fiberglass, or a combination of fiberglass and Kevlar. Although all shell types may receive certification by safety standards, some dealers say that not all absorb the impact to the head effectively.[24]

IN ONE STUDY OF MOTORCYCLE CRASHES WITH HELMETED RIDERS, RESEARCHERS FOUND THAT 38 PERCENT OF THE HELMETS FLEW OFF THE RIDERS. IN ALL OF THESE CASES THE HEAD INJURIES WERE FATAL.

Retailers and riders know from experience that fiberglass shells in helmets are superior to polycarbonate shells at protecting your noggin. The reason fiberglass is the best for impact absorption is because it takes the blow and reduces its force by the time it gets to your head.

Although polycarbonate shells get approval by safety standards, they are useless at absorbing the impact. The disadvantage with a polycarbonate shell is that it transfers the impact directly to the head without absorbing it, the same way energy is transferred through pool balls or bowling pins. The reason the polycarbonate shells may get safety certification is that the helmet can effectively stave off a blow, even though it ineffectively absorbs the impact.[25]

In fact, after a crash, the polycarbonate shell may not look as if it had been through a wreck, whereas the fiberglass shell helmet will be visibly torn up. This is because the layers of the fiberglass have taken and absorbed some of the impact.[26] Those shells with a Kevlar and fiberglass mix are also more effective at absorbing impact, and the Kevlar gives the helmet added strength.

Researchers know that many of the helmets that have DOT and Snell stickers actually fail the tests those stickers represent.[27] Professor Harry Hunt, a leading authority in motorcycle safety, when interviewed in *Motorcyclist* (Oct. 1989), said that "hardly anybody really passes the Snell test, and many Snell helmets really don't pass the DOT dwell-time test standard." In his studies, he found that "the design requirements to meet Snell '80 and '85 standards almost necessitate that you *don't* pass the DOT." Professor Hunt believes the problem with meeting both DOT and Snell standards in the same helmet comes from the higher drop heights in the Snell standards:

> "The Snell standard's higher drop heights force manufacturers to use a very strong outer shell and a very stiff layer of expanded polystyrene on the inside, and it's the polystyrene that does most of the work of dissipating impact force. This same stiffness makes the helmet transmit more force to the head when dropped from a lower height, and thus the problem in meeting

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both DOT and Snell standards in the same helmet."[28]

Note: DOT drop heights are 4.5 feet for hitting hemispherical surfaces, and 6 feet for hitting a flat surface, whereas Snell drop height is 10.5 feet on either flat or hemispherical surfaces.

As a result, Professor Hunt predicts that manufacturers will be faced with government-mandated recalls as Snell-certified helmets begin to fail the DOT tests. The Snell Foundation itself makes it clear that their standards are not meant to be safety standards, only performance and construction requirements.[29]

Remember that by placing a styrofoam six-pack cooler into a plastic wash pail and putting a nylon strap around the combination, you can pass all real controlling standards for helmets in this country.

The Neglected "Functional Factors"

In addition to the defects in the tests already required by helmet safety standards, the testing procedures disregard numerous functional factors of a helmet that are every bit as important as the rest of the helmet's components. And since the DOT or Snell stickers on helmets are a selling point, manufacturers will be influenced by the lack of these standards in producing helmets, even if those standards are incomplete.

Motorcyclists and research experts tell us that these other "functional" factors are of utmost importance in averting fatal crashes. They are the rider's ability to see, hear, speak and move the head, which stem from the helmet's comfort, fit and ventilation.[30] However, the three biggest pushers of helmet standards are so concerned with impact resistance and material strength that they virtually ignore the rest of these critical safety factors that contribute to a helmet's effectiveness.

Helmets place limitations on essential abilities to see, hear, breathe and perspire. This is evident from a nine-year study in 50 states, which attributed the increase in accidents among helmet wearers to heat, fatigue, and diminished hearing and vision.[31] Thus, helmets preserving these abilities. Unfortunately, these functional factors have been passed over by safety standards and, in turn, by manufacturers.

Ventilation. Proper ventilation is a vital functional factor that allows the rider to breathe easily and perspire normally.[32] Ventilation that is ineffective could cause impeded heat loss, thermal discomfort (which affects equilibrium), heat exhaustion, heat stroke, discomfort, dizziness or increased physiological strain,[33] all of which contribute to severe accidents.

This is even more important with active riders who sweat, such as bicycle and motocross racers, since it allows the body's natural process of evaporative cooling (perspiration) to regulate skin temperature.[34] On a hot day, a helmet wearer's evaporative system could break down, causing him to possibly run a fever inside his helmet, and temperatures can climb to the 100-degree mark.[35]

Absent good design, riders are left to find their own solutions for keeping a cool head. Riders recommend to each other, "drink lots of water, sweat, or douse your head with a towel before putting on your lid." This advice is hardly a safe alternative to an effective ventilation design. Most helmets that are made today have some kind of vent that claims to promote internal air flow; however, in reality, many of them simply do not work.[36]

Ventilation is also important to prevent fogging of the face shield that can block the rider's view. In *Harley-Davidson v. Thomey*,[37] the plaintiff was riding his motorcycle with his helmet on one clear morning when his face shield suddenly clouded completely with condensation, totally blocking his vision. The rider stated that "it was just like milk went in front of the mask; I couldn't even see at all." He then lost control of his machine and collided head-on with a car. Consequently, he shattered one elbow and had to have a leg amputated from the knee down.

The expert witness in the case, a consulting engineer, testified that "the manufactured and sold were defective because they did not provide ventilation to prevent fogging and did not have a means of removing the face shield if it became fogged." The expert also stated:

> "One of the specific goals of design and safety engineering is to identify hazards and eliminate them by design rather than guard against them with warnings... Fogging is a well known occurrence and ... Harley-Davidson was aware of it, because it also manufactured non-fogging face shields during the same time [the plaintiff's] full-face shield was made."[38]

BY PLACING A STYROFOAM SIX-PACK COOLER INTO A PLASTIC WASH PAIL AND PUTTING A NYLON STRAP AROUND IT, YOU CAN PASS ALL CONTROLLING STANDARDS FOR HELMETS IN THIS COUNTRY.

The hazards from poor ventilation are easily guarded against by simple engineering. Some full-face helmet manufacturers have added vent holes in the back of the helmet near the neck to

Other manufacturers have put a small "air scoop" on the top of the helmet which sticks up into the flow of air, similar to the idea of an air scoop on a car hood which cools the engine.

Diminished hearing. Diminished hearing is another functional factor completely disregarded by safety standards. Motorcyclists must be able to hear sirens, horns, screeches and other street sounds in order to maneuver safely through traffic. Yet helmets reduce the wearer's natural ability to hear. Many helmets advertise a quiet ride[40] without realizing that a silent ride could translate into a deadly ride in an emergency situation. Some helmets even come with insertable ear pads that lower sound levels too much to be safe.[41] For example, in one study with the Bell 500 TX helmet, it was found that moderate to severe hearing loss resulted when sounds were presented with the helmet on. This hearing deficit would also affect decisions of locating sound origin, or directional sounds.[42] The danger, of course, is that a rider would not be able to avoid an accident that he otherwise could if he heard a warning horn, screeching tires or even the sound of his own engine.

A NINE-YEAR STUDY IN 50 STATES ATTRIBUTED THE INCREASE IN ACCIDENTS AMONG HELMET WEARERS TO HEAT, FATIGUE, AND DIMINISHED HEARING AND VISION.

Since hearing can be as important to a rider's safety as vision and ventilation, it seems strange that manufacturers have not designed vents for hearing around the ear area of the helmet. Even Snell requires no hearing or cooling vents. Snell merely says that *if* a helmet has ventilation holes, they should not exceed 13 mm in diameter.[43] The overall safety of helmets would be greatly improved by a combination of hearing and air vents and a larger vision port, since a rider's best judgments come from a combination of these senses.

Reduced vision. The reduced vision is another potential hazard of poorly designed full-face helmets. Although the standards require at least a 105-degree peripheral vision allowance to each side, many riders still complain of reduced vision while wearing their helmets. It has been suggested to riders who complain about their vision that they solve the problem by "turning their heads" to see more.[44] But moving your head to look in another direction, even for a second, could cause a devastating accident.

Another vision complaint that arises is that sometimes the rider can't see his gauges with his helmet on,[45] which could cause an accident if he had to turn his head down to check his oil, speed or other readings.

To eliminate dangers caused by restricted vision, helmets should be designed to counteract these complaints. The design must keep in mind that a motorcycle rider only has two mirrors to work with (one on each side), whereas a car has three, with lots of clear glass to see through. Therefore, the cycle rider needs all the more latitude to see with. A design that extends the range of sight is essential, such as making the vision port opening larger, or by extending it back further using a transparent shell.

One design that helps riders read their gauges is that of the Bell Wedge helmet. The vision port of this helmet points down farther toward the chin than most helmets.[46] Thus, a rider need only glance down to view the gauge cluster, which is a safer way to monitor the machine while in motion.

Face shield problems. The face shields are also a source of potential danger. The bubble-shaped face shield of Western Auto was found to distort vision a little, and some face shields with locking snaps could present a problem if a sudden splash covered part of the rider's view. In the case of the three-quarter models, the snap-on shield can't be lifted up, so a rider would have to wipe off a splash of dirty water or a squashed bug.[47]

The problem with wiping off a face shield is that they are extremely susceptible to scratches. Manufacturers recommend that they be cleaned with soap and water alone, without rubbing or scrubbing,[48] since this causes scratches that can hinder vision.

Face shields that are tinted or mirrored may cause problems with vision also. One retailer reported that while he was riding with the face shield open on his certified helmet, it suddenly dropped down over his eyes and caused him to hit a tree and sustain grave injuries.[49]

Moreover, the manufacturers' warnings not to wear the tinted face shields at night are barely visible transparent stickers, smaller than one square inch, which are highly inadequate to effectively instruct consumers on proper use, or warn them of the restricted vision.

Recognizing the hazards of motorcycling, most states now require that helmets have reflective strips on them,[50] so that even though a motorcycle rider's vision is limited, other vehicles will be able to see him better. All helmets should be designed to reflect at night, whether it be reflective tape or reflective paint on the helmet, to ensure the rider's safety against inattentive drivers.

Comfort and fit shortcomings. The last functional factor is by far the most overlooked by safety standards and manufacturers. It is simply the comfort and fit of a helmet to the head of the

rider. The ANSI standards recognize the critical importance of fit to motorcycle helmet protection. These safety standards require manufacturers to label their helmets to inform consumers that the helmet should be of "good fit," but fail to define the characteristics of what "good fit" means.[51]

Therefore, for maximum head protection, it is essential that the helmet be fitted in the store, and better yet, tried out on the road, since some helmets that fit at a standstill will be uncomfortable when in motion.[52] The retailer should personally fit the helmet to the customer and see that the helmet doesn't detach when the strap is properly fastened.

Some helmets that are extremely uncomfortable to wear still receive certification stickers. Often the sizes labeled on helmets are poor guides, and the head openings are too small for the appropriate size of head to get through. Helmets with too small an opening cause the consumer to buy a larger helmet size just to be able to get it on, but it then fits loosely and will "wobble annoyingly on the head."[53]

In a case in Florida against a helmet manufacturer, a plaintiff sued for negligent design of a helmet that was made for "one size fits all," contending that the size of the helmet did not offer a good fit and was, therefore, unsafe and unstable on the wearer's head.[54]

In order for consumers to buy helmets that fit right, they must have a clear, concise way of determining proper fit. Motorcycle helmets should come with detailed instructions on proper fit and function of the helmet so that consumers can choose a good, proper fit for the safest riding. Retailers should also offer pamphlets with instructions for determining the safest fit for your noodle.

If the leading helmet safety standards do not become more comprehensive to include the crucial functional factors, manufacturers will not be persuaded to correct the inherent defects in design and function that plague riders in helmet law states. Ensuring a helmet's construction and performance is not enough; manufacturers must go further in developing safe helmets. Even the best rider in the world is powerless against a defectively designed and poorly manufactured helmet. Many a rider has learned the hard way not to trust the stickers, and been made painfully aware of hazards from improper function and design of helmets.

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