Harry Hurt Speaks Out

Legendary motorcycle researcher Harry Hurt has more to say about accident investigation and what's happening in motorcycling today than ever before, despite recovering from recent surgery.

Helmets, The Brain, Safety Studies & Rider Training

by Wendy Moon

OVER 20 YEARS ago, Harry Hurt discovered he had "built up a terrible concern that motorcycles were getting the bad rap in traffic accidents investigations" and the famous "Motorcycle Accidents: Cause Factors and Identification of Countermeasures," better known as the "Hurt Report"was his effort to counter that bias with objective, accurate analysis. That same passion for scientific accuracy and unbiased motorcycle research still drives him today. Recently, Hurt sat down with Dave Searle, Fred Rau, Walt Fulton III, and Wendy Moon at the Head Protection Research Laboratory and discussed the state of contemporary motorcycle research.

Hurt was a biker long before he became a researcher—and that love of the sport was what led to his life's work. He described himself as "scooter trash" as a youngster and he later worked in a Harley shop until he could save enough to buy a used police bike. In fact, he still has the first new motorcycle he ever bought, a "1947 Harley 61, with original paint on it, too."

After working in the aerospace industry, he began teaching engineering and safety science at the University of Southern California and doing in-depth investigations for the US Department of Transportation. In the course of his work with car collisions, he noticed that the police reports on motorcycle-car or single-vehicle motorcycle collisions were "absolute BS, trash first-class." In them, a big motorcycle was always identified as a Harley, he said, and a small one was always identified as a Honda, and they always "came out of nowhere going too fast." It took a long time, though, before he found "really good people who didn't like what was going on" including Executive Vice President Chet Hale at Honda, Ivan Wagar, head of the Safety Helmet Council, and Lewis Buchanan, the motorcycle specialist at DOT. Together, they were able to get Hurt's landmark comprehensive study funded and under way, through the efforts of the independent National Motor Vehicle Safety Advisory Committee.

Fifteen years later in 1998, Harry Hurt retired from USC, and, with their blessing, "took everything [involved with motorcycle research] but the paint" with him. That everything included mechanical testing devices and an archive of every helmet they ever tested since 1978. Hurt then began the Head Protection Research Laboratory in Paramount, California which tests helmets for various entities as well as participating in other massive research projects including the British MAIDS study and an accident causation study in Thailand, of which he's very proud. When it comes to helmets, the nature of head injuries and the world of safety studies, Harry is the go-to guy.

THE SURPRISING TRUTH ABOUT HELMETS

Helmets, he says, "have reached a level of perfection that's pretty hard to beat," although he has worked with an exciting possibility for the future. HPRL has done some testing for Skydex's cutting-edge technology for Navy flight crew helmets. The energy absorbing liner is made of small plastic cone-shaped elements that "crumple and absorbs energy very, very efficiently." Also, because the cones are lightweight and air can flow between them, the helmet is better ventilated and lighter than ever. He notes the cone system will pass even the severe Snell first-impact test with only about an inch of space between outer shell and inner covering of the liner. The problem, though, is getting it to conform to the many curves inside a motorcycle helmet, and the solution, he says, is "in the shape of a dollar-sign" but so far, no major motorcycle helmet manufacturer is interested in pursuing this technology for riders, although there are applications under way for football helmets and industrial safety helmets.

Even so, and surprisingly, he says "the plain old DOT helmet that you can get for 70–80 bucks is about as good as you can get. They just don't bring the raves from your friends, but they are great protection." Despite how preconditioned we all are to think that the more expensive helmet is always the better helmet, he says it's merely more features and not more protection that high-end helmets offer. In fact, cheaper helmets can even be *better* since they have softer liners and are made to DOT rather than Snell standards. "When you make a helmet withstand one or two 10–12' drops [the Snell standard], you've got a pretty stiff, hard helmet. But, falling from a motorcycle is typically a fall of 5 or 6', so the rider wants the softest, thickest helmet liner possible."

YOUR HEAD: A BOWL OF WARM JELL-O

In many fatal head traumas, the bones aren't broken at all because the skull is thickest in the forehead and back of the head where impacts are most likely. It's also thinnest on the sides, and the temporal regions are the most vulnerable of all. Although helmets do protect the skull, a helmet's primary benefit is to the brain inside, which isn't a solid, firm organ like the heart. It may look like cauliflower, but its actual consistency is more like warm, half-melted Jell-o. We were amazed. Even undamaged, it's so fragile that cheesecloth must be slipped between the skull and the brain to form a sort

of bed so the brain can be removed without falling apart or getting further damaged during an autopsy.

Helmets, though, can only do so much to protect the brain. His examples: In a simple 6' fall, much less than 300G of acceleration are generated, and this can be endured without permanent brain injury. However, beyond that—or with rotational trauma in addition to impact—brain damage will result. For those who would protest helmet laws by wearing a novelty "beanie" helmet, without an EPS liner, consider that a head so encased experiences 700–800G from a drop of only 18"! But, he says, "you can have the $15,000 helmet of the century and still get a very severe whack that produces critical rotational acceleration." All of the *major* injuries to the helmeted head, he says, are due to rotation—and not to the spine as many may think, but to the brain inside the skull.

Such rotational injuries are caused by inertial forces rather than direct contact. Linear acceleration coupled with the head rotating from the impact causes the brain, and even different parts of the brain, to move at different speeds compared to itself and to the skull. As a result, where the helmet is hit and where the brain is injured aren't necessarily the same—the brain can be injured anywhere. But remember that these are very severe impacts, and fortunately very rare.

HPRL manager Christopher Swanson demonstrates the headform used inside a helmet with the European-standard "bouncing" impact machine in the background.

What happens when the brain is injured?

In some of these rotational injuries, the brain shifts inside the skull and slides along the surface. However, the inside of the skull isn't as smooth as the outside—and particularly not at the base and the sides. As the brain scrapes itself on these bony bumps, bruises and lacerations on the surface of the brain, or "surface strain injuries" as they are known, occur. But the brain might also move at a different speed from the thin covering over it and that can cause blood vessels to snap and bleeding to occur between the brain covering and the skull—a "subdural hemorrhage." "Those are dangerous," Hurt says, "because the blood keeps on coming and displaces the brain. The brain has no place to go except to bug out your eyes or push the brain down through the big hole at the base of the skull (or foramen magnum)." These kinds of injuries can be treated if the rider gets to a hospital quickly enough. "If you're going to have an accident, have it next to the hospital," he says. "If you have it out there in the boondocks and you're counting on a county's rescue apparatus and some little podunk hospital…too bad for you. Even in L.A., you've gotta crash in the right place or you're in trouble. If you crash up on Glendora Mountain Road, you might as well jump off the edge of the road and save the trauma team the trouble."

Other brain injuries caused by rotation are called "deep strain injuries" and those he said are "really dangerous." But then he thought for a moment and added, "well, they all are." He described deep strain as the same effect one gets from stirring a cup of coffee: as you're stirring, most of the differential velocity is on the outside but, when you take the spoon out, a "free" vortex forms in the center. The same thing happens with the brain because of its semi-liquid form, and that vortex force can cause all the links within the brain, axons, and even minor blood vessels to shear apart. "Sometimes these injuries are so small you can't even see them even on MRIs. But, when that injury happens, it's like a busted wire filament in a lightbulb—nothing will ever come back."

And that's why riders should wear helmets, he believes. Even a "helmet you buy at K-mart" must meet DOT standards, which were specifically designed to prevent or minimize these horrible injuries to the "warm Jell-o." For instance, the DOT flat-anvil drop test is 6', and this corresponds to the 90th percentile accident impact.

Snell vs. DOT

Hurt insists that there is no reason why the vaunted Snell certification should be preferred by motorcyclists over the more common DOT certification, although Snell uses more severe test impacts. The Snell criteria, he says, "have never been based upon any rational evaluation of accident events…there are completely artificial, unsubstantiated elements in their [Snell] standards." It costs more to do the Snell tests and more for the Snell stickers, but the tests aren't any better. Neither are the several different standards used in other countries.

Instead, he says, DOT standards, although they are old, "have the right stuff. We know their drop heights correspond to the 90th percentile of accident impacts. They can be enforced very strictly and the results of testing are repeatable." Currently, there's an evaluation of DOT standards going on in terms of a "very extensive, cost-benefit analysis," which is what the law requires before any federal standards are changed. So, in the future, they may change and, for instance, allow the inclusion of measures for modular helmets. "If a helmet can pass DOT standards," he says, "it can pass any set of standards anywhere in the world." That's good news in our view.

Getting the drop on helmets

But how are helmets actually tested? Hurt gladly led MCN's staff on a private tour so we could see for ourselves. The testing area is one long, large room with several arcane pieces of equipment. Christopher Swanson (the laboratory manager and a Ph.D. candidate in biomedical engineering at USC) and Hurt explained how each test was performed. In the first place, helmets are tested at real-world temperatures including those found in places like Alaska in the winter and Arizona in the summer. They do that by literally freezing or baking the helmets in an oven prior to testing. They also soak other helmets so they are as wet as they would be from the worst downpour. Helmets must pass all three conditions—hot, cold and wet—in all sizes in a variety of tests for a total of 32 impacts. Whole racks of identical looking helmets awaited destruction.

The drop tests are performed on the "monorail," which the DOT requires as the standard test apparatus. In it, a head form weighing 11–13 lbs. for an adult or 7.5 lbs. for a child is fitted inside the helmet and attached to the machine. Then it's dropped from a 6' height. This allows all the energy to be focused in a specific area of the hel-

met, which is a typical collision occurrence. The monorail can test up to four positions: back, top, and both sides. A "twinrail" machine is similar except it allows the helmet to be tested by impacts in more locations, including the chin bar. Oddly enough, the external finish of the helmet can make a difference—because any trendy chrome plating of the shell makes it softer, needing a reinforcement to the shell. Even though there are no legal standards yet for modular or system helmets, they must pass the same tests standard full-face helmets do, except for a direct hit upwards from the bottom of the chin bar. And according to the HPRL, that type of impact is extremely rare.

Helmets are also tested in terms of penetration resistance, which tests the rigidity of the shell. In this test, a cylindrical, conical 3kg (6.6 lbs.) plumb bob-like object is dropped from 3 meters (almost 10 feet). The sound this impact makes is shocking. The helmet fails if the penetrator passes into the liner and punctures the headform. It also means the ventholes have to be small enough, and maybe reinforced, to prevent the penetrator from piercing them. Face shields can also be tested but, Hurt says, they aren't "much of a problem. Practically anything made out of good, optical polycarbonate can pass the test." In the faceshield test, a far lighter penetrator is dropped directly on the faceshield. It's acceptable if the shield cracks, but if it's penetrated, it fails.

Helmets are carefully weighed and measured as part of the testing procedure. In this photo, the chin strap strength tester and the roll-off test machines are the devices to the right. In the corner is a large pail in which helmets are thoroughly soaked before wet testing. A refrigerator and an oven are also used to duplicate the effects of extremes of ambient temperature on helmet performance.

Chin straps and fasteners are tested by a direct pull test of 300 lbs. and a "roll-off test" tries to jerk the back of the helmet forward to see if it will come off the head form. Chin straps, though, aren't usually the problem. When helmets roll off, it's usually because they aren't the right fit. Riders can test their helmets for fit and chin strap retention by putting it on, then trying to pull it off forward and backwards. If it comes even partway off, you need a different helmet because it certainly will come off in a crash.

HPRL also can test to European standards with a special machine that allows the helmeted headform to bounce around after the test impact. While such testing may look more severe, Hurt says, it's actually less severe, since the helmet bouncing around corresponds to a less direct impact.

Helmet manufacturers, Hurt says, must pay very close attention to manufacturing quality because the DOT conducts many helmet tests at independent labs to ensure compliance with DOT standards. DOT doesn't hesitate to issue non-compliance notices for any critical failure, in which case the manufacturer must respond immediately or they have to issue a recall. If the results of the compliance testing are questionable rather than obvious, they inform the manufacturer, who must promptly provide further documentation of compliance.

Studying the anatomy of crash studies

Beyond helmets, though, motorcycle safety and crashes are poorly understood. Hurt passionately believes that's because many investigators don't understand the difference between single-track and dual-track vehicles and they approach the subject with a car-centric bias instead of "looking to find what's there" rather than what seems to have happened. He used the common example of a bike "running off the road," when in reality it may have been forced off the road for some reason. He insists that investigators also need to be riders themselves. If they aren't motorcyclists, they can't accurately evaluate motorcycle accident cause factors.

To that end, his life's work has been to develop a Common International Methodology (or OECD) for investigation in cooperation with Dynamic Research, Inc. (DRI) If it's followed and doesn't exclude something simply because of financial issues or a preconceived agenda, it should produce accurate data. It may be hard for the uninitiated to appreciate how critical this point is, but just remember the old saying, "junk in, junk out." When we visited, this complete OECD methodology had been fully applied for the first time in what he termed a "genuinely gold-plated" Thailand safety study sponsored by Honda Research and Development. It took into account 1082 motorcycle crashes and took over 2.5 years to do.

But this kind of research is rare—particularly in the US. "If you go looking for data to support your own ideas of motorcycle accident causation—and this is what NHTSA is doing right now—you're going to find the wrong things." The current emphasis at the National Highway Traffic Safety Administration, he says, is their pre-conceived notion that "older, drinking motorcycle riders on big bikes" are the problem. Hurt went on, "yeah…but they're not looking at other vehicle drivers involved in the accidents and that's a horrible gap and oversight."

He mentioned that other studies have looked at "characteristics" of motorcycle operators that make them dangerous. But, he asked, "compared to what? They aren't doing any comparison to other populations." This faulty approach, he says, leads to self-determining results.

But, again, perhaps the greatest problem with most of the human factors research is that most of the researchers don't know "diddly-squat about motorcycles." Investigators, he says, "have the education and research experience by the bucket, but know nothing about motorcycles, only what they've been told or what they've read or seen on television…and it really puts the blinders on them." Such pre-conceptions and misconceptions can be dangerous and yield erroneous results, inspiring legislation that seriously affect all riders.

The appalling lack of genuine experience with motorcycles, particularly in government but even in the industry, who are responsi-

Helmet smackdown—the monorail machine drops a helmet with an instrumented headform inside it from a distance of 6' onto a flat anvil for the DOT standard test. Note that the DOT 6' test corresponds to the 90th percentile of actual accident impacts, unlike Snell's higher impact standards, which Hurt says were chosen simply to be tougher to pass. In fact, he says, in an accident, the harder construction necessary to pass Snell tests can do more damage to a rider's head than the softer DOT-spec helmet, and that a DOT-spec helmet can pass any government required testing in the world.

ble for motorcycle safety, is a "grudge match" with him, he says. They take the MSF's Basic RiderCourse but they don't ride after that limited experience, and, yet, he says, they have major obligations to direct effective motorcycle accident research. He says the same thing is happening in many motorcycle manufacturers' research and development departments and in the Motorcycle Safety Foundation; those in charge have little to no riding experience. This, he says, is very different from the past, "there's change there and it's not healthy."

HPRL was contracted to do some of the quality control work for the Motorcycle Accident In-Depth Study (MAIDS), and it convinced him that the results of the study are questionable at best: Only 18% of the investigators had significant motorcycle riding experience, much of the data were collected long after the crash, the rest of the quality assurance was inadequate, and, in some cases, the data were probably contrived to meet deadlines. He stated that many of these flaws were the result of the IMMA (International Motorcycle Manufacturers Association) and ACEM's (Association des Constructeurs Europeens de Motocycles) unwillingness to pay for adequate training for the investigators or comply with the requirements of the OECD standard for specific training for motorcycle investigations. In fact, he says, there was an obvious arrogance of the part of some of the research teams, who refused to believe that motorcycle dynamics would require specific technical knowledge beyond what they already possessed.

In some cases, the MAIDS investigators made serious errors, such as having the motorcycle going the wrong way. "We ended up with an extremely large number of these cases that, despite sincere objectives and although they were done by some very highly qualified technical people, they were missing motorcycle experience and thus unqualified to make the proper responses in the data collection." Even though Hurt and his group informed IMMA and DRI of their findings, their concerns were ignored. MAIDS then, he says, yielded "absolutely maverick evaluations…the kind of things you'd expect to see when non-motorcyclists reconstruct a motorcycle accident."

Why Hurt II won't happen

"The same thing," Hurt says, "is most likely going to happen in the USA," if NHTSA undertakes a comprehensive study. In part, he says, because of the cost; dealing with a large population in a research study is "a horrible expense" because investigating even a single crash requires such an extensive collection of data as well as thoroughly trained investigators.

"There's a lot of things out there that we don't know about," he says, and, "a lot of people want to [have a comprehensive study], but there's no one reaching for their wallet to pay for it." That would include the US motorcycle manufacturers. Although MAIDS was funded by the manufacturers in Europe, in the US, we get no such support.

In 2003, HPRL sent a proposal to the Motorcycle Industry Council and Motorcycle Safety Foundation proposing an OECD type study that would cost roughly $1.6 million, with the costs spread out over five years—just $320,000 per year—but received no support.

A surprising reason he doesn't believe a new US comprehensive study will be done is because the results could potentially increase the industry's liability. He used the example of sportbikes with raised gastanks as an example: This design is perfect for racing, as a rider can tuck in, resting his torso on the shape, to maximize straight-line speed. But there aren't many frontal collisions on the track. In real life, though, frontal collisions are the most common form of crash. Based on 70 in-depth evaluations of specific cases they have already done, they discovered that the racing gastank design results in far more serious pelvic and groin injuries, including the so-called "Open Book Fracture" of the pelvis—ugly. In such frontal crashes, the riders are literally hung up on the tank with the family jewels, and their upper legs are caught by the short rigid handlebars, resulting in major fractures. And sportbike riders can hit their own windshields as well—causing a variety of serious injuries even before the rider's body hits the other vehicle. Although he and a team of experts are slowly researching this serious problem, he has been unable to find external funding. He's even tried to interest the Centers for Disease Control (CDC) in a such a study of the problem, but the agency is reluctant to fund motorcycle injury research when the government's own DOT/NHTSA doesn't do anything.

Unless some independent agency or foundation underwrites the research, he says, it won't be done. The manufacturers don't want to pay for it because, if, for instance, sportbike gastanks are inherently unsafe, why provide this information to a plaintiff's lawyer who will use it to sue the company? However, he points out their underlying fear of accident research being used to sue them is unjustified; previous research has been used by most manufacturers to defend themselves in product liability lawsuits. Blame it on the accountants and lawyers, he says.

The lack of good motorcycle accident research is also due, he believes, to a change in the motorcycle industry. The "bean counters," he says, are now in charge and those industry members who actually rode motorcycles have been retired or transferred out of research and development at major manufacturers. Decisions are made in terms of cost—and one of those costs is the potential of lawsuits. However, a telling comparison exists between the motorcycle and automobile industries: The automobile industry supports at least a dozen safety research projects in the US, while the motorcycle industry supports none!

"There are dollar-type priorities about accidents, lawsuits and regulations at the MSF," he says, and "there's a lot of conflict there that doesn't reach the public." The state takeovers and other issues that have come up recently, he says, "are not just accidental—that's part of a deliberate plan. The industry wants to control what's going on for their own purposes, which may or may not match motorcyclist's purposes." He says that the industry wants to promote the idea that they are educating the public to be safe, even though no study has shown it [training] has anything more than a temporary effect. The United States, he says, puts a high value on education as a "magic bullet," believing it will make one smarter, more employable, and safer. "MSF has always hung its hat on that since Charlie Hartman's days [Dr. Charles F. Hartman, the first president of MSF]; education is good for motorcycling," Hurt says. "But, in the past decade or so, there've been some priorities that aren't quite compatible."

You could use any motorcycle company in the US as an example. Their legal department's nightmares, according to Hurt, "consists, in great part, of someone suing the company saying 'The company should have trained me to avoid accidents, and they didn't.'" That puts the liability on the manufacturer—and millions of dollars could be at stake. But if there's training offered by a credible, state-approved, industry supported organization, the responsibility *and liability* shifts back to the rider.

MSF has built up that credible image over the years. Therefore, if MSF is "running the whole show in states," there's some authority behind it—which is good as long as, he says, "it's not watered down."

However, taking an MSF course, he says, weakens the rider's ability to sue the manufacturer or dealer, as they are no longer legally liable for a rider's lack of skill. Nor is MSF liable, since the state has approved their curriculum—in fact, the onus, if any, goes on the state for not providing adequate training. What results is layers of insulation for the industry. "So, when the rider who's been in a crash comes knocking at the door, there ain't nobody home! All these companies have really smart lawyers working for them and they've been developing this for years, trying to isolate the manufacturers. This web has been spun for the past 15 years—it didn't happen yesterday." David Hough's articles in MCN, he says, have accurately described the present process and the results in various states.

The further courses the MSF wants so much for states to provide, such as experienced riding, or further practice or Advanced Braking and Traction Management then, while they should help riders, continues to distance the manufacturers from liability. That's also why MSF launched the dirt bike, ATV training and now the ScooterSchool: Training must be offered to prevent future lawsuits because this puts the onus on the riders—they could've, should've, taken a course.

"Every graduate from an MSF course is a guaranteed no lawsuit," Hurt said. If the rider is unable to operate a high performance machine at the end of the course, it doesn't matter—they were duly warned when instructors tell them they weren't street-ready upon graduation, that they should buy a bike they feel comfortable with, and that they should wear gear and helmets—"It's 100% asbestos."

But the liability insulation doesn't work if training isn't available, and that makes it critical to ensure there is training available somewhere and somehow. If riders choose not to take the course when it's available, then they also assume the liability, not the manufacturers. Since the states set the standards and grant a license waiver, the state, not MSF, is affirming the course is sufficient—therefore MSF and the manufacturers and dealers are all the better protected from liability.

The industry, through MSF, *needs* to take over state programs, then, according to Hurt, because "they don't want someone who has a lot of motorcycle training experience setting authoritative objective standards, based on good science and educational principles and practices." Once those who don't remember what training used to be, could be, and should be are gone, the course can be made easier to pass, thereby increasing the insulation against lawsuits.

However self-protective the industry is, he says rider education is still a very good thing. "It makes MSF appear like a real ghoul, in trying to sidestep or prevent legal actions, but there's still some really good motivation in there to train riders." The concern Hurt has is the web that's been created is "changing the whole relationship between rider safety and the industry itself" and that does not serve motorcyclists' concerns.

After you've witnessed the violence of actual helmet testing, you know a "novelty" helmet is a suicidal way to protest helmet laws. This one didn't protect its wearer from fatal head trauma. What appears to be a lining is only a baseball cap and the dark stain is the rider's blood…ugh.

Motorcyclists need an Advocacy Group

Hurt pointed out that there's no independent body that stands between the industry and the consumer to protect their interests as there is with automobile drivers. In his opinion, the AMA doesn't do it and the Auto Club won't do it.

"For years," he said, "we've believed that [organization] was the MSF, but MSF is itself the problem." He had hoped that "something" would "come along to change things," and he had "hoped it would be the government," but the MSF has become "partners" in a relationship with the National Highway Traffic Safety Administration (NHTSA) to such a degree, he says, that it won't happen.

As we left that day, we realized that, even though much has improved since the original Hurt Study, and especially in terms of helmets, Hurt was right—without a consumer watchdog group, motorcycle safety will get no better and may get worse in the future. What is needed is another National Motor Vehicle Safety Advisory Group to study the problems and make recommendations to NHTSA/DOT. This last sentence is the way Harry wants to end the article:

"It's your decision."