INEFFECTIVENESS OF HELMETS AND DETRIMENTAL EFFECTS OF HELMET USE

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The purpose of this report is to show through testing, engineering mathematics, true statistics and actual injuries that helmet usage is overall detrimental instead of beneficial.

HELMET TESTING

In 1986, Riders for Justice and American Eagle Engineering, Ltd. started testing helmets by a drop method. We used a ten foot drop with a total weight of helmet and mock head of eight to ten pounds. Generally, total weight was 8.5 pounds which generated 85 foot pounds of force. All of the helmets dropped failed to protect the head inside of the helmet. The tests were filmed with a video camera. The film was slowed so the effects of actual impact could be observed By slowing the film, it was apparent that the helmet flexed and caused the chin strap to draw tight across the throat. In several cases, the chin strap actually cut the mock head at the throat. We also tested stocking caps and leather flyers or "snoopy" caps. The leather flyer cap tested better for head protection than most of the helmets and did not draw tight across the throat. The stocking caps were better than some of the helmets.

MATHEMATICAL CALCULATIONS

Before any testing was done, it was calculated mathematically that the current helmets would not be effective as head protection. The calculations are as follows:

$KE = WH$ — KE = Kinetic Energy

$= \frac{1}{2} w/g\ V^2$ — V = Velocity

$V = at$ — W = Weight

$g = \frac{1}{2} at^2$ — H = Height

g = Acceleration of Gravity

t = Time

a = Distance

$KE = \frac{1}{2} w/g (at)^2$

The foregoing is a Newton equation.

Some calculations by Ed Armstrong, P.E. show the following helmet thicknesses required at various speeds for a 170 pound rider, with deceleration of the brain being the controlling factor.

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

Currently, we have 1" helmets available to us which weigh from 2 to 4.5 pounds. If we were to use a 6" thick helmet, it would weigh 15 to 20 pounds. The current 4 pound helmets put a terrible strain on the neck without impacting on anything. On impact, they increase the bending moment to the neck by more than double. The neck is a weak link, and the smaller and weaker the neck, the more likely the neck is to receive injury. There have been many young people who have become quadriplegics due to the effects of a helmet. A female passenger on a motorcycle is twice as likely to die as the operator. This is probably due to the smaller, weaker neck on a female.

SPINAL CORD INJURIES

In 1986, the Colorado Department of Health printed the first annual report of the Colorado Spinal Cord Injury Early Notification System. The report shows that 4 of the spinal cord injuries were wearing helmets, but only one of the injuries was not wearing a helmet. In 1987, the report included Wyoming as well as Colorado. There were 5 helmeted injuries and 8 non-helmeted injuries from motorcycle accidents. In 1988, they did not differentiate between helmeted and non-helmeted riders. (Probably because we used the statistics to prove helmets do cause neck injuries).

We have included a report performed by the U.S. Navy entitled, "The Cervicocranium and the Aviator's Protective Helmet". This report shows that the aviator or pilot is often killed or made paralyzed by the helmet he wears (only military pilots wear helmets). Bear in mind these are the best helmets our tax dollars can buy.

Also included in this report is a study by Utah Highway Safety Division showing that helmet usage has shown no evidence of reducing head injuries.

Another study by University of Utah shows a 40 to 65% reduction in hearing by someone wearing a helmet over someone not wearing one.

American College of Surgeons Committee on Trauma has published in 1980 a pamphlet on techniques of helmet removal from injured patients. In this pamphlet, they state "The rescuer who removes a helmet improperly might inadvertently aggravate cervical spine injuries". In England, you must be licensed to remove a helmet from someone. This should tell anyone there are some definite problems with helmets.

EFFECTS ON COORDINATION AND MOBILITY

One of the points seldom mentioned about helmet use is their effect on coordination and mobility. Riding a motorcycle well requires manual dexterity, mobility and certain athletic ability. Wearing a helmet has a very strong detrimental effect on coordination, mobility, and manual dexterity. To emphasize the adverse effects of a helmet, put one on and try to play tennis, golf or go swimming. Peripheral vision is also lost with most helmets. You could not pass a drivers test for peripheral vision if you were wearing a helmet.

HEAT BUILD-UP

Helmets do cause heat build-up inside of them, which is a real problem in the desert. There have been some recent articles which state they only cause body temperature to increase 2 degrees. Body temperature is an overall measurement. The head itself will sometimes reach temperatures causing dizziness and fainting. We all know regulating our head temperature helps to regulate the rest of our body temperature.

JAPANESE CONTROL OF AMERICAN INDUSTRY

Most of the helmets today are produced in foreign countries. This is mainly due to product liability evasion. Forcing people to buy helmets will cause much more of our money to be sent to foreign countries, thereby furthering our imbalance of trade. Japanese motorcycle manufacturers produce the majority of the helmets sold in this country. It seems as though our D.O.T. standards are set around their helmets, standards which are not acceptable in England. Until the Japanese motorcycles infiltrated our country, there was not any pro-helmet use for street bikes. But since the propaganda has steadily rolled out of Japan, they have managed to start and control the Motorcycle Safety Foundation, which is the only motorcycle training course that is recognized in the United States. This is a course which encourages people to buy their products instead of American products. The same people

from Japan who control the Motor- cycle Industries Council also control the Motorcycle Safety Foundation.

SAFETY MARGIN

Another reason for deaths to rise in mandatory helmet law states is people normally ride in what they feel is a safe manner or "safety margin". Most ride faster and more recklessly with a helmet on because they feel it extends their "safety margin". An example of this is the Canyon Racers who wear helmets and ride recklessly and insanely.

A common statement made by pro-helmet law people is "If one life is saved it's worth having a mandatory helmet law". But if one life is lost or someone becomes a quadriplegic, is it still worth it?

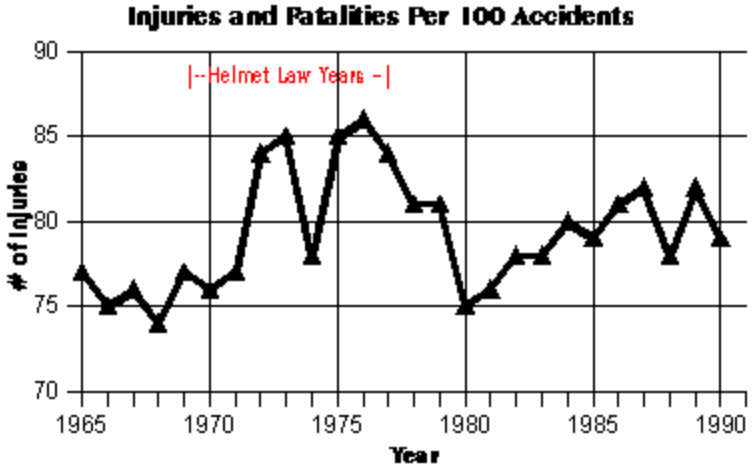
PERVERSION OF STATISTICS

There is a typical perversion of statistics by pro-helmet law people as follows:

A) Only 40% of motorcyclists deaths were wearing helmets: Actually only 40% were reported as not wearing helmets. The other 20% were undetermined. From RFJ research on accidents, we found the helmet and non-helmet deaths to be equal or slightly more wearing helmets.

b) The majority of motorcyclists wear helmets: In certain areas such as large metropolitan areas (Denver), this is true. However, in rural areas or away from Denver/ Colorado Springs military areas, less than 10% wear helmets.

c) The fatality rate has increased with repeal of helmet laws: It is actually lower for non-helmet law states than helmet law states. The injury and death rate in Colorado was never higher per accident than during the helmet law years. (See enclosed graph).



The Cervicocranium and the Aviator's Protective Helmet

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An analogy based on the similarities of the hospital transport (APH-6) aviator's protective helmet and the hangman's noose points up some interesting relationships to aircraft-accident investigation, and to the associated traumatic pathology.

THE HANGMAN'S-NOOSE ANALOGY

The inferior edge of the helmet, when visualized as part of the continuous circle completed by the nape strap and the chin strap, forms a loop that can be likened to a hangman's noose. The analogy might be further extended to include the lesions made about the neck by the straps or the edge of the helmet, paralleling the abrasions and contusions that might be associated with a rope having encircled the same structures. When the knot is situated at the side of the head (subaural), such a hangman's noose produces fractures of the base of the skull, tending to extend bitemporally through the basisphenoid.[1] When the knot is situated anteriorly and beneath the chin (submental), the hangman's noose causes a fracture dislocation at the axis. Characteristically the posterior arch is fractured and, interestingly enough, the odontoid process is not involved. Many of us had anticipated that a fractured, displaced odontoid process would represent the prototype lesion which so precariously endangers the patient with cervical cord compromise and death, similar to the hangman's fracture. More recent assessments of the odontoid fracture mortality, however, suggest an incidence of less than ten percent.[2]

A CASE REPORT

One interesting and compelling aircraft accident investigated by the Naval Safety Center, Norfolk, Va., served to emphasize the practical application of the theoretical exercise. A Navy A-4 jet aircraft experienced difficulties in flight which caused the pilot to eject at an altitude, attitude, and air speed that were within the operating envelope of the ejection seat. Supported by a fully blossomed functioning parachute, however, the pilot reached the ground severely injured and died shortly after the accident, as a result of a transverse laceration of the cervical spinal cord.

The details of the investigation (omitted here for the sake of brevity) established that the energy responsible for the fatal lesion was transmitted through the helmet and its inferior edge, into the posterolateral neck. A vertebral dislocation of C-2 on C-3 resulted, which in turn severed the spinal cord. The essential mechanism of injury involved the application of blunt force to one side of the helmet, causing it to rotate about the pilot's head in such a way that the opposite side of the helmet was forced interiorly and, medially, into the adjacent neck region. Similar observations had prompted an earlier modification of the helmet, to incorporate a thicker protective edge roll. The actual helmet involved in this case is pictured in Figure 1. Note that the damage to the helmet is slight and hardly commensurate with the significance or severity of the associated injury. It is often tacitly assumed when a helmet which has been subjected to large impact forces exhibits only slight damage, that the head which it is designed to protect should remain proportionally secure. This unfortunate case illustrates that nothing could be further from the truth.

The pathology itself was distinctive in that a dislocation without fracture occurred at the C-2/C-3 level of the cervical vertebrae. A roentgenographic study of the specimen is reproduced in Figure 2. A laminectomy was performed post mortem to expose the spinal cord. Histologic sections made through the C-2/C-3 vertebrae confirmed that no fracture was present, despite common observations in the literature that fracture is the usual, if not the invariable accompaniment of such severe dislocations.[3]

DISCUSSION

It is especially interesting that "hangman's fracture" has been fairly recently defined as a bilateral avulsion fracture through the neural arch of the axis, with or without fracture dislocation of the second cervical vertebral body upon the third.[4] The concept of the "Cervicocranium" as an entity constituted by the cranium, the atlas, and the axis suggests that this functional segment above the C-3 tends to move as a single unit, in dislocation as well as in flexion, extension, and rotation. The implied mechanical weakness at C-3, or the junction of the Cervicocranium with the lower cervical spine makes it a likely site for dislocations in injuries sustained by mechanisms resembling that presented in this particular accident. The "hangman's fracture" is probably most frequently encountered in automobile-accident victims. What is its frequency in aviation accidents?

Unfortunately, the review of cases at the Naval Safety Center is impeded by the limited medical observations reported in cases of this sort. It is distinctly rare to receive an autopsy protocol describing the dissection of the cervical spine, with full documentation of the nature and extent of such lesions. Yet that information is greatly needed to develop an

accurate understanding of the pathogenesis of this lesion, as well as a sound basis for recommendations on the design of protective headgear.

CONCLUSION

When you study and interpret your next aircraft accident, why not consider whether any of the linear abrasions and contusions about the victim's neck exactly correspond to part of the helmet and, if so, determine whether there is an associated lesion involving the Cervicocranium. The simple procedure of fitting the helmet to the head, at autopsy, can define interesting relationships in reconstructing the mechanism of injury.

The Safety Center is most anxious to relate such findings to accumulated information stored in the existing data bank, in an attempt to better define the role this lesion in aviation safety. Telephone us at the Naval Safety Center for any help we can offer in this, or any other related problems. (Autovon: 690-7926. Commercial: (804) 444-7926.)

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PHD note:
The figures '1 and 2' mentioned in the above article, were not included in the copy of the article we received.
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