By Matthew J. DeGaetano, DC and Steve Baek, DC
Certified in Personal Injury

Neck injury risk is lower

Neck injury risk is lower if seats and head restraints are rated good.

The rate of neck injury complaints is 15 percent lower in cars and SUVs with seat/head restraint combinations rated good compared with poor. The results for serious injuries are more dramatic. Thirty-five percent fewer insurance claims for neck injuries lasting 3 months or more are filed for cars and SUVs with good seat/head restraints than for ones rated poor.

These are the main findings of a new Institute study of thousands of insurance claims filed for damage to vehicles, all 2015-16 models, that were struck in front-into-rear impacts. Conducted in cooperation with State Farm and Nationwide, the study is the first time seat/head restraint ratings based on dynamic tests conducted by the Institute have been compared with real-world neck injury results.

"In stop-and-go traffic, you're more likely to get in a rear-end collision than any other kind of crash, so you're more likely to need your seat and head restraint than any other safety system in your vehicle," says David Zuby, the Institute's senior vice president for vehicle research. "This is why it's so important to fit vehicles with seats and head restraints that earn good ratings for saving your neck."

The Institute has been measuring and rating head restraint geometry since 1995. The higher and closer a restraint is, the more likely it will be to prevent neck injury in a rear

collision. In 2004 the Institute added a dynamic test simulating a rear crash to refine the ratings. Vehicles are rated good, acceptable, marginal, or poor based on both restraint geometry and test results. The same rating system is used internationally by a consortium of insurer-sponsored organizations, the International Insurance Whiplash Prevention Group.

An estimated 4 million rear collisions occur each year in the United States. Neck sprain or strain is the most serious injury in one-third of insurance claims for injuries in all kinds of crashes. The annual cost of these claims exceeds $8 billion annually.

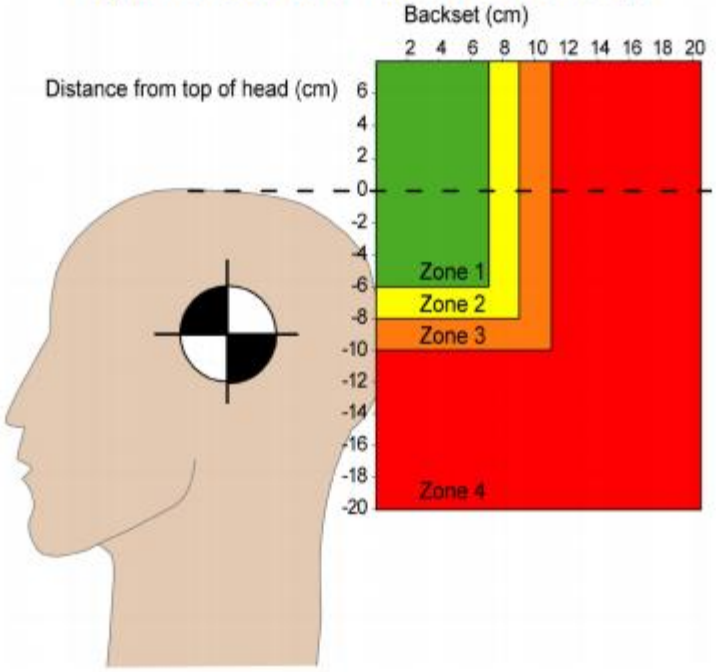
While findings about real-world neck injury in vehicle seats rated good and poor are clear, those for seats rated acceptable and marginal aren't as clear. There wasn't any reduction in initial neck injury complaints for acceptable and marginal seats, compared with poor, though long-term neck injuries were reduced.

"The long-term injuries are the very ones we want to reduce because they're the most serious," Zuby points out."While many neck injuries involve moderate discomfort that goes away in a week or so, about one of every four initial complaints still was being treated three months later. These longer term injuries involve more pain and cost more to treat. They're being reduced about one-third in vehicles with seat/head restraints rated good compared with poor. Serious neck injuries also are being reduced in seats that are rated acceptable or marginal.

IMPROVEMENTS

More and more passenger vehicles are being equipped with seats and head restraints rated good. When the Institute started evaluating and comparing the geometry of the head restraints in 1995 model cars, only a handful were rated good and 80 percent were poor. Then the automakers responded, and by 2004 about 4 of every 5 head restraints had good or acceptable geometry (see Status Report special issue: protection against neck injury in rear crashes, Nov. 20, 2004). Similarly, the dynamic performance of seat/head restraint combinations is improving. Only 12 percent of 2004 model cars had combinations rated good, but by the 2007 model year the proportion had increased to 29 percent.

Figure 1
Diagram of Geometric Head Restraint Ratings



Dynamic Test Requirements The dynamic test consists of a rear crash simulation in which a BioRID IIg dummy is positioned in the seat to be tested. The seat is attached to a crash simulation sled and accelerated/decelerated to represent a rear crash with a velocity change (delta V) of 16 km/h. The acceleration profile is roughly triangular, with a peak of 10 g and a total duration of 91 ms.

These improvements are being driven not only by ratings of seat/head restraints published by the Institute and other insurer-sponsored groups but also by a U.S. standard that will require the restraints to extend higher and fit closer to the backs of people's heads by the 2009 model year.

HOW THE INJURIES OCCUR

When a vehicle is struck in the rear and driven forward, its seats accelerate occupants' torsos forward. Unsupported, an occupant's head will lag behind this forward torso movement, and the differential motion causes the neck to bend and stretch. The higher the torso acceleration, the more sudden the motion, the higher the forces on the neck, and the more likely a neck injury is to occur.

INJURIES IN REAR CRASHES

NASS
These vehicles didn't sustain a lot of damage when they were struck from behind, but the drivers were treated for injuries suffered in the impacts. Neck sprains and strains are the most serious problems reported in about 1 of 3 insurance claims for injuries. This problem could be reduced by equipping vehicles with seat/head restraints rated good, based on Institute tests. Twenty-nine of all recent model cars and 22 percent of other passenger vehicles have systems rated good for protection against neck injury.

Factors that influence neck injury risk include gender and seating position in addition to the designs of seats and head restraints. Women are more likely than men to incur neck injuries in rear crashes, and front-seat occupants, especially drivers, are more likely to incur such injuries than people riding in back seats.

The key to reducing whiplash injury risk is to keep an occupant's head and torso moving together. To accomplish this, the geometry of a head restraint has to be adequate — high enough and near the back of the head. Then the seat structure and stiffness must be designed to work in concert with the head restraint to support an occupant's neck and head, accelerating them with the torso as the vehicle is pushed forward.

GOOD POSITIONING IS CRITICAL

Whatever car you drive, you'll get the maximum whiplash protection from a head restraint that's properly positioned. To work well, the top of the restraint should reach at least as high as the top of your ears, and preferably the top of your head, and be relatively close—4 inches or less—to the back of your head.

Adjustable restraints are the most common type. They can be raised or lowered to the proper height, and many can be tilted toward or away from the head. But they're only effective if occupants take the time to adjust them properly. Many people don't, which increases their risk of serious injury.

More and more automakers have introduced "active" head restraints, which automatically move up and forward to catch a person's head in a rear crash. Those are usually effective, but there's no guarantee "It's not just the head restraint but the seat architecture that determines what's going to happen," says Adrian Lund, president of the IIHS.

MAKING THE ADJUSTMENT

Correct head restraint adjustment
The top of a head restraint should reach as high as the top of your head if it will adjust that far, or at least as far as the top of your ears, and be set back no more than 4 inches from your head, as shown to the right.

WRONG HEAD RESTRAINT ADJUSTMENT

A head restraint that’s too low or too far back will not protect your head and neck in a crash. The four images below illustrate a typical impact.

ABOUT THE STUDY

To correlate seat/head restraint ratings with real-world neck injury risk, researchers studied about 3,000 insurance claims associated with rear crashes of 105 of the 175 passenger vehicles for which the Institute has ratings based on both restraint geometry and seat performance in dynamic tests. The claims were filed with State Farm Mutual Insurance and Nationwide Insurance, which together account for more than 20 percent of the personal auto insurance premiums paid in the United States in 2005. The researchers modeled the odds of a neck injury occurring in a rear-struck vehicle as a function of seat ratings (good, acceptable, marginal, or poor), while controlling for other factors that also affect neck injury risk, such as vehicle size and type and occupant age and gender.

The percentage of rear-struck drivers with neck injury claims was 16.2 in vehicles with seats rated good, based on dynamic testing. Corresponding percentages were 21.1 for seats rated acceptable, 17.7 for marginal seats, and 19.2 for poor ones. Neck injuries lasting 3 months or more were reported by 3.8 percent of drivers in good seats, 4.7 percent in acceptable seats, 3.6 percent in marginal seats, and 5.8 percent in seats rated poor.

"What these data show is that we're pushing seat designs in the right direction," Zuby says, "Results for acceptable and marginal seats weren't as clear as for good seats. Initial neck injury claims weren't significantly lower than for poor seats. Still we saw

reductions in claims for serious neck injuries in acceptable and marginal seats as well as in good ones."

This is the third study the Institute has conducted that indicates the superiority of seat/head restraint combinations rated good for reducing neck injury risk. The Institute found that head restraints rated good for geometry alone had lower insurance claims for neck injuries. The Institute researchers expanded the data, finding that modern features such as head restraints that automatically adjust in rear-end collisions and seats that absorb energy also reduce insurance claims.