Air Bags - injuries to occupants from the protective devices.

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A client walks into your office. He says he was in an auto accident. The air bag in his car did not deploy and he was badly hurt. Another client has various injuries; TMJ, facial contusions, lower limb fractures and chest trauma. She says the air bag came out of the container but did not inflate. Yet another client says there was lots of smoke coming from the air bag and he was burned by the hot exhaust gases.

Sound familiar? These are all complaints received from consumers regarding air bags. Television commercials show air bags in extreme slow motion, giving the perception air bags deploy gently, like a hot air balloon. Movies show air bags remaining inflated long after a collision. Both show the actors coming out of the situations with absolutely no trace of discomfort. All distorted and contrived presentations.

This is what your client has been exposed to and how it is in his mind that this is the way air bags are supposed to work. Slow, gentle, inflations. Walk away from terrific collisions completely unharmed. You're protected with an air bag and won't get hurt. Presentations that lead the consumer into a false concept of what happens in real collisions and the all-to-real effects of collision forces on the human body.

Hollywood movie directors. Madison Avenue advertising executives. They can get away with it. The advocate cannot.

Safety sells a lot of cars today. Most major auto manufacturers got on the safety bandwagon

in 1987 with the introduction of air bags and anti-lock brake systems. It's true these systems save hundreds of lives each year and reduce the number and severity of injuries many times over that. But despite the advertising and cinema exaggerations, they are not beyond the laws of physics and cannot prevent all deaths and injuries.

Air bags are a supplemental restraint system, SRS for short. As of 1998, all new passenger cars must come equipped with them. It is designed to be a supplement to the seat belt and shoulder harness, not a replacement. Seat belts protect an occupant in many types of accidents such as rollovers, rear-end collisions, side impacts and secondary impacts. An air bag is designed to provide protection in frontal impacts only and then only one impact.

An air bag system consists of several components. First are the sensors, usually mounted near the front. The sensors detect a collision by measuring the deceleration rate and direction. An impact with a solid barrier, between 8 and 17 miles per hour, will cause the sensors to activate the air bag system. Not all accidents are frontal collisions and higher speeds may be present but the air bags will not activate because the threshold velocity change, or delta V to traffic accident recontructionists, has not been reached. This can result in a fairly high speed collision without the deployment of the air bags. If the deployment threshold levels were lower, air bags could inflate at inappropriate times such as very minor fender benders or when going over speed bumps.

Once the sensors detect a strong enough collision, a signal is sent to the control module, usually mounted up behind the dashboard. This module, basically a small computer, runs diagnostic checks and activates the air bags in case of an accident. From the control module, the signal goes to the gas generator in the container holding the stowed air bag. The gas is generated by a hot filament running through sodium azide pellets. The filament heats the pellets to 300 degrees centigrade. The decomposing sodium azide produces a gas, mostly nitrogen gas, which inflates the air bags. Nitrogen gas is very friendly, non-flammable and non-toxic.

There is an ongoing debate about the some of the gases produced by decomposing sodium azide. When dissolved in water, sodium azide produces hydrazoic acid. The vapors from this acid are almost as toxic as cyanide gas. Whether or not the air bag exhaust contains sufficient amounts of this toxic vapor to present a viable hazard to a vehicle's occupants remains questionable.

Some air bags are constructed of neoprene coated nylon cloth. Very tough and capable of withstanding the rapidly increasing pressure generated by the expanding gas. The air bags are stowed tightly folded in a sealed compartment. The compartment cover, which has no welded seams, is opened by the expansion of the air bag. This is much like the old foil pan popcorn poppers that expanded as the kernels popped. There are no mechanical devices to open the container. Inflation is required for the air bag to break open the sealed compartment. An air bag will not "flop out" of the container into a driver's lap.

The total time for the system to function, from the moment the sensors detect a collision to the full deployment of the air bag, is about 160 milliseconds, or less than 3/10ths of one second. This is extremely fast and one reason occupants may contend the air bag did not deploy. They did not see it, as on television, so it must not have happened.

When deploying, the inflation of the air bag may sound like a gun shot, very loud in tight quarters and unexpected. The entire sequence may be over before you realize it happened. All a driver may find is the now limp and empty air bag in his lap with the mistaken impression it did not work.

An air bag has vent holes to allow the gas to escape and permit the occupant to ride down the collision. This is the action that prevents serious injuries. The driver is not suddenly stopped but his forward movement is slowed greatly through the collision before coming to a halt. For all of this to occur in the little time available, a gentle inflation of the air bag, as seen in television commercials, is not practical. The inflation must be rapid to protect belted and unbelted occupants in high severity crashes. In low severity collisions, this rapid deployment can result in injuries if the occupants strike the bag in the early stages of deployment.

Air bag induced injuries happen most often to people not using seat belts. They may be sitting close to the steering wheel. The Insurance Institute for Highway Safety has reviewed cases of air bag induced injuries in accidents where it was determined the injuries were caused solely by the air bags. Of 380 occupants with 436 injuries, ninety six percent were classified as minor (AIS 1) and the remaining four percent were classified moderate (AIS 3), according to the Abbreviated Injury Scale. This scale is an anatomically based system that classifies injuries by body region on a six point scale according to threat to life. A code of AIS 1 reflects minor injuries like cuts and bruises and AIS 6 represents injuries that are inevitably fatal.

An often heard complaint is the presence of smoke from the air bag, as though it was on fire or something had shorted out. When an air bag is manufactured and stowed in the compartment, the folds of the air bag are coated with talcum powder. Talcum powder aids in the necessarily rapid deployment by preventing the neoprene folds from sticking. The talcum powder will spread throughout the car's interior giving the impression of smoke. The powder is non-toxic and causes no permanent discomfort.

Some injuries can be expected from a collision even when the air bag was present and worked perfectly. An air bag does not restrain the lower torso so lower leg fractures can be found. As the air bag is coming towards the occupant at great speed, from 98 to more than 300 miles per hour, frontal blunt trauma is to be expected. Bruises to the face and chest and TMJ injuries may be presented. There have been reports of injuries from the hyper-extension of the neck but these have not been confirmed. Eye injuries are not frequent but there have been reported occurrences.

While nearly all air bag injuries are minor, a few have been serious. The New England Journal of Medicine reported a 33 year old woman suffered an atrial tear in a relatively minor crash. The injury is believed to have resulted from contact with the inflating air bag. The physicians reporting the case noted that in some circumstances "the velocity of the air bags may be sufficient to rupture the right atrium, since it is one of the thinnest vascular structures in the thorax."

In one instance investigated by the National Highway Traffic Safety Administration, the arm of an older female driver was splintered. Indications are her arm was resting across the air bag module, that is on the steering wheel, when the bag deployed.

Reports of gas burns from the air bag exhaust vents have been reported and recently found to be unsubstantiated. The exhaust gases are only slightly warmer than the air from a hair blow dryer as it leaves the vents. This is far below the temperatures required to inflict even the most minor burns in the time available for exposure. Close examination of some of the reported burns found they were abrasions from the friction of unprotected parts of the body, such as the forearms and thighs, passing over the expanding air bag.

As of September 1, 1996, there have been 33 adult deaths and 17 child deaths attributed to air bag function. Three deaths of short, elderly women, who were thought to be seated very

close to the steering wheel, have been reviewed. The investigations concluded the fatalities were caused by a combination of air bag and steering wheel loading. Similar patterns of fatal injuries have been identified in low severity crashes of cars without air bags. Two deaths involved motorists slumped over the steering wheel because of previously existing medical conditions. Two passenger deaths have been reported of children that were standing or sitting unrestrained in the front seats.

Several hard impact injuries with the vehicle's interior have been found even when an air bag deployed properly. Investigations into these collisions determined there was more than one impact, as when a car is struck by another car and then goes off the road to strike a tree. The serious impact injuries were caused by the secondary impact, the one with the tree after the air bag had done it's job, protecting the occupant in the first impact and then deflating. Without seat belts, no protection was available for the subsequent impacts. For maximum protection, in a variety of accident situations, the proper use of a seat belt and shoulder harness is required. The air bag systems, while they provide excellent protection in frontal impacts, are not as effective without seat belts and may be ineffective in other types of collisions.

Children in car seats, infant carriers, or children weighing less than 40 pounds using a seat belt, should not be placed in the front passenger seat of a car when there is an air bag system. Some auto manufacturers have begun to offer an on/off switch for the passenger side air bag system.

In any event, certain types of injuries are to be expected in real world collisions with air bags. Injuries alone may not mean the air bag system failed or was poorly designed, just that the laws of physics could not be influenced by the hype of Hollywood and Madison Avenue denizens.

UPDATE: The materials used to construct air bags is changing as the technology advances. Federal requirements for air bags are also changing rapidly.

On November 33, 1996, NHTSA announced new rules were in place allowing consumers to have passenger side air bags disconnected. Rules were also put in place allowing manufacturers to install passenger side air bag disabling switches and warning labels on new vehicles equipped with passenger side air bags.

As of November 33, 1996, NHTSA statistics inidicated 30 fatalities were attributable to air bags. Nineteen of these deaths were children under the age of 13.