C4 Excessive Seat Belt Webbing Slack in a Low Speed Frontal Collision Resulting in Orbital Blow-Out Fracture

Robert D. Anderson, MS, Biomechanics Analysis, PO Box 7669, Tempe, AZ 85281-0023*

The goal of this presentation is to demonstrate seat belt inspection techniques and methodology and relate them to a case study in which a mechanism for introducing excessive seat belt slack into the restraints

This presentation will impact the forensic science community by presenting a potential mechanism for seat belt failure by which excessive slack is introduced into the seat belt. This can assist in the explanation of the disparity between the evidence of seat belt use with unrestrained occupant injuries in some instances.

A mechanism for the inadvertent introduction of excessive slack into the seatbelt webbing is presented. As a result of the additional slack, a face-to-steering wheel strike was allowed to occur in spite of seat belt use in a low speed frontal collision. This facial strike produced an orbital fracture with blindness from a direct blow to the eye from the steering wheel.

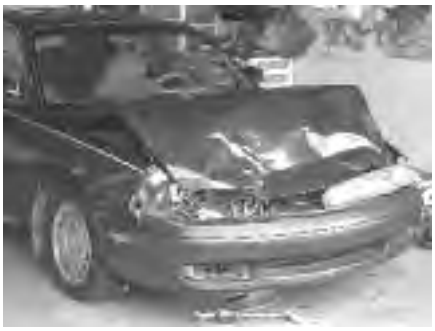

Figure 1, Frontal Under-ride Damage.

The extent of frontal damage is shown in figure 1 above. The sedan under-rode a full-sized pickup in a rear-end type collision orientation. It

sustained a little more than six inches crush across approximately 80% of its front, which is generally consistent with a Delta V as high as the 13 to 14 mph range. The airbags did not deploy presumably due to the “soft” contact with a longer than usual crash pulse.

The driver would have ordinarily had sufficient clearance for the lap and shoulder belt to prevent any face to steering wheel strikes during the collision. However, the extra lap belt webbing slack that passed through the latch plate compromised the seat belt’s effectiveness. This allowed the driver to travel forward with little restraint so that they suffered a facial strike on the steering wheel. The direct blow to the eye from the steering wheel rim caused an orbital blow out fracture with blindness.

Inspection of the driver seat belt revealed scratching on the latch plate consistent with habitual use. Loading marks consistent with seat belt use were found on the driver’s latch plate and D-ring. Transfers on the seat belt webbing revealed evidence that a little more than half a foot of webbing (excess slack) had been pulled through the latch plate.

Near the seat belt anchor, there was a plastic cover for the belt fuse, which is also known as a webbing tuck, energy loop or rip stitch,. As seen in figure 2, the plastic cover had a tendency to become caught beneath the seat. Unlike other fuse covers which are integral with the anchor bolt cover, this cover had a gap of exposed webbing that allowed it to twist relative to the anchor thereby allowing it to catch under the seat when

Since only modest seat belt forces consistent with restraining an occupant in a low speed frontal collision were sufficient to free the belt fuse cover, this served to introduce excessive webbing slack.

 ** Presenting Author*

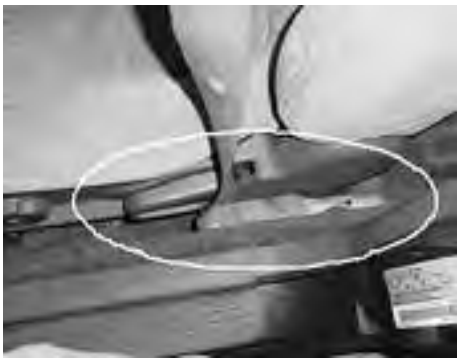

Figure 2, Belt Fuse Caught Beneath Seat

In addition, as seen above, because catching of the belt fuse cover effectively moved the anchor point forward, it also increased the likelihood of creating even more slack when the lap belt gets inadvertently caught on the recliner lever. This is consistent with the webbing transfers which showed more than half a foot of webbing forcefully passed through the latch plate in the collision.

Certainly, this seat belt configuration is dangerous since it introduces excessive slack into the seat belt, which directly undermines the seat belt's efficacy in a collision. In addition it is problematic and dangerous as it also provides a mechanism to inadvertently recline the seat back, which could cause a loss of vehicle control while driving.

Interestingly, review of NHTSA consumer complaints revealed descriptions of the seat belt catching the reclining lever and/or inadvertent reclining of the seat back, while driving in some cases. There were also complaints of the seat belt getting caught under the seat, on the reclining lever and/or extra slack, as well as complaints that the seat belts did not restrain in frontal impacts. These complaints are consistent with a pattern of the catching of the seat belt fuse cover under the seat, as occurred in the described collision.

Seatbelt, Slack, Ocular Injury

 ** Presenting Author*