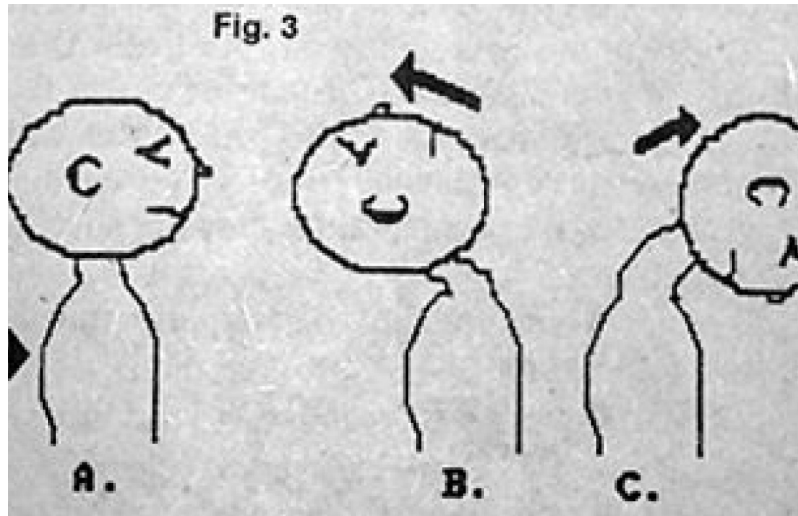


Dynamic Chiropractic



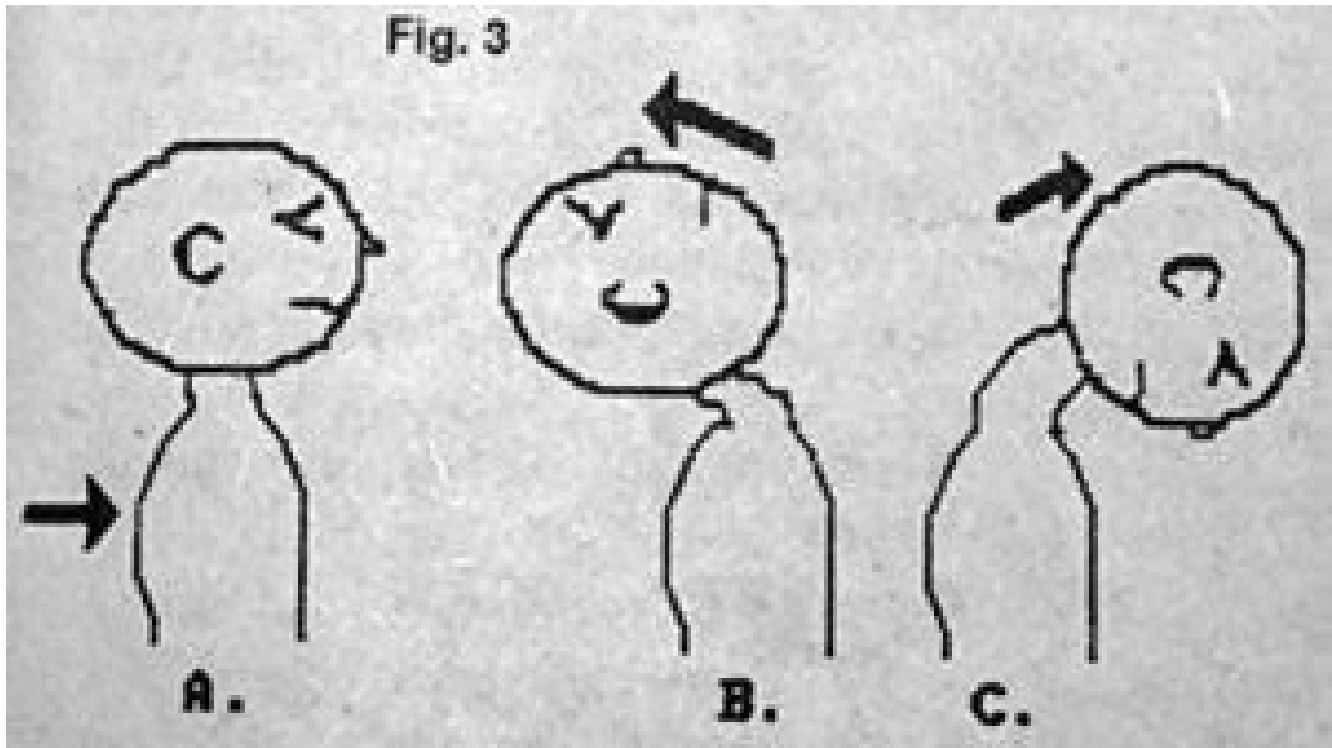
WHIPLASH / NECK PAIN

Are Vehicle Damage and Occupant Injury Always Proportional? -- Part II

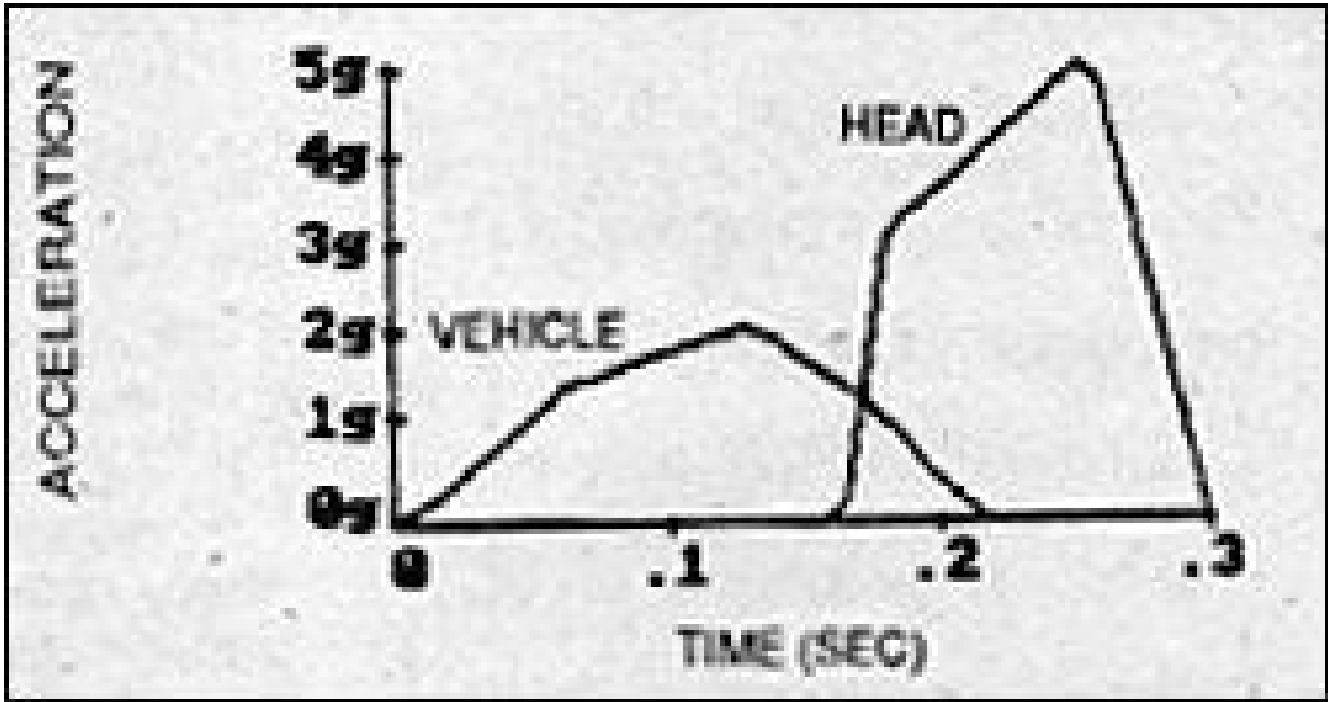
ACCELERATION OF THE HEAD AND NECK OF THE LEAD VEHICLE'S OCCUPANTS

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When the lead vehicle is struck from the rear and is easily accelerated, the inertia of the head of the occupant of the lead vehicle resists acceleration and the neck snaps back with tremendous force.⁶ (Figure 3) This overextended position then induces a reflex contraction of the occupant's neck musculature, causing the head and neck of the occupant to be catapulted forward with rotational and translational accelerations higher than those of the vehicle itself.³



McKenzie⁴ has indicated that a definite relationship exists between the rate of acceleration of the lead vehicle and the rate of acceleration of the occupant's head. Due to the reflex musculature contraction, the head and neck of the occupant of the lead vehicle will attain accelerations of some two to two and one-half times greater than the vehicle itself. (Figure 4) Thus, because the head and trunk experience magnitudes of accelerations not nearly reached by the vehicle itself, we are dealing with a unique phenomenon termed the magnification of accelerations.⁴ Martinez³ reports that an eight mile per hour rear-end collision of two vehicles of the same mass produces a 2g (gravity) acceleration of the vehicle and a 5g acceleration of the occupant's head. McNab¹ states that in a 15 mile per hour collision, the vehicle will accelerate 10g; and consequently, the head of the occupant would be accelerated to 20-25g. Since g is the acceleration of gravity (32 feet/sec²), one can understand that accidents between 10 to 15 miles per hour do not cause small insignificant traumas to the neck. McNab¹ states further that injury in rear-end collisions results from the relative acceleration of the head and trunk of the occupant, and the degree of injury is dependent upon the rate of acceleration. Neck injuries reported in the medical literature as a result of acceleration/deceleration collisions include: muscular tears and avulsions; ligamentous tears and ruptures; intervertebral disc disruptions; hemorrhages of the muscular coats of the esophagus; avulsion fractures; and vertebral dislocations,^{1,6,7,8,9} as well as a wide variety of neurological syndromes. In addition, Ommaya and Hirsch¹⁰ report that a collision with an acceleration of five times the force of gravity (5g) carries with it a 50 percent chance of brain concussion for the vehicle's occupants.



Conclusion:

In conclusion, it has been shown that a lead vehicle that is easily accelerated forward when struck from the rear will sustain less damage than one that is not easily accelerated. In addition, it has been shown that when the lead vehicle is accelerated the head and neck of the occupants reach accelerations with magnitudes two to two and one-half times greater than that of the vehicle, due to the phenomenon of magnification of accelerations. Furthermore, it has been reported that injury in acceleration/deceleration collisions is the result of the acceleration differences as a result of inertial differences of the occupant's head and the vehicle.

Finally, it should be obvious that those factors that limit or minimize the damage to the lead vehicle are precisely the same factors that result in greater damage to its occupants. McNab¹ describes this paradox in the following fashion: "The amount of damage sustained by the car bears little relationship to the forces applied. To take an extreme example: If the car was stuck in concrete, the damage sustained might be very great to the car, but the occupants would not be injured because the car would not move forward; whereas, on ice, the damage to the car could be slight, but the injuries sustained might be severe because of the rapid acceleration permitted."

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