Head Restraint Backset During Routine Automobile Driving: Drivers Usually Exceed the Recommended Guidelines

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FROM ABSTRACT:

Objective: The purpose of this study was to measure the head restraint distances during routine automobile driving and during individual driving tasks such as turning, stopping, starting, and lane changes.

Methods: Fourteen subjects drove around a specified route that included residential, thruway, and highway driving; additional driving tasks such as lane changes, were evaluated. The distance of head restraint to posterior aspect of the head was measured continuously throughout the drive using an ultrasonic measurement system.

Results: The average head-to-restraint distance throughout the driving route was 78.1 mm [3 inches]; this distance did not vary significantly between the global measures during various driving areas (residential, thruway, and highway).

The head restraint backsets during right turns (93.6 mm [3.7 in.]) were significantly larger compared to the other driving tasks.

Conclusions: Most subjects maintain a relatively consistent head-to-restraint distance throughout their driving route.

Two subjects adopted very large head restraint backset distances throughout their drive, apparently reflecting driver posture.

Twelve of 14 subjects [86%] had average backset distances that exceeded the National Highway Traffic Safety Administration and the Federal Motor Vehicle Safety Standard guidelines, indicating that most drivers may be at risk for whiplash-like disorders if exposed to a rear impact while driving.

Of the monitored driving tasks, turning, especially right turns, caused drivers to increase their head-to-restraint backset distance.

KEY POINTS FROM THIS STUDY:

1) "If an occupant's head is unsupported in a rear-end collision, then it lags behind and retracts posteriorly relative to the thorax, resulting in a S-shaped spinal curvature characterized by flexion in upper and extension in lower cervical regions."

2) "This S-shape is related to nonphysiologic extension of the lower cervical segments, pinching rather than gliding of the facets, capsular tissue strains, and transient compression of the neural tissues. Any of these nonphysiologic vertebral intersegmental deformations may account for symptoms experienced by victims of rear impact; all of these tissue-related strains result from abnormal kinematics of the cervical vertebrae." **[The primary whiplash rear-end collision injury is facet capsular ligament sprain and transient neural compression]**

3) Head restraints were introduced in the late 1960s to limit differential movement of the head and torso, in the hope of reducing spinal motion.

4) There have only been marginal decreases in neck injury claims for automobile collisions with head restraints installed because incorrect positioning does not constrain head–neck motions within the physiologic range.

5) "Properly adjusted head restraints reduce incidence of whiplash injuries."

6) "A reduction in cervical spine displacement substantially reduces head contact time, neck displacements, and loads."

7) Active head restraints that move upward and closer to drivers' heads during a rear impact reduce whiplash injury claims by 43%.

8) Better head restraint positioning also reduces the rebound chest-to-head forward motion, further decreasing risk of injury.

9) In 2007, the National Highway Traffic Safety Administration established that the distance between the back of the head and the head restraint should not exceed 55 mm [2inches].

10) During a rear-impact collision, a good head restraint will decreased rearward head displacement, reduce cervical spine extension, reduce head acceleration, reduce upper and lower neck shear forces, reduce intervertebral shear displacements, absorb head impact energy, and reduce rebound flexion.

11) This study used 14 subjects: 7 females, average age 24.1 years; 7 males, average age 27.7 years.

11A)) Male subjects adopted an average backset distance of 89.1 mm [3.5 inches].

11B)) Female subjects adopted an average backset distance of 71.68 mm [2.8 inches].

11C)) Two male subjects had extremely large head restraint backset distances (greater than 120 mm [4.7 inches]).

12) "The National Highway Traffic Safety Administration and the Federal Motor Vehicle Safety Standard governing head restraints states that the distance between the head restraint and head must not exceed 55 mm [2 inches] for front vehicle occupants."

13) "Women are more likely than men to suffer neck injuries in rear impacts."

14) "We found that the average head-to-restraint distance for 12 of 14 subjects [86%] exceeded the 55-mm [2 inch] head restraint backset requirement of the Federal Motor Vehicle Safety Standard; 2 male subjects were considerably higher (120 mm [4.7 in])."

15) "Improper positioning of head restraints appears to be an ongoing issue, because our overall average backset result was significantly higher than the National Highway Traffic Safety standard."

16) In another study of 1000 subjects, 50% had a head restraint backset distance that exceeded 151 mm [6 inches].
[This significantly greater distance may reflect an older average population with greater postural distortions while driving].

17) "We observed that individuals drive with consistent head restraint backsets (throughout the residential, thruway, and highway driving areas and through certain driving tasks including lane changes and stops)."

18) The relative amount of backset was significantly larger during right turns than in many other driving activities; left-hand turns also tended to be larger. **[This places turning individuals at greater risk of injury during collisions].** "The increased backset during turns is likely due in part to increased visual field required during turns; the drivers move away from the head restraint to gain an unobstructed view to the side."

19) The backset distance remained large when stopped; this is important because low-speed rear-end collisions often occur when the struck vehicle is stopped at a stop sign or stoplight.

20) "The risk of injury is likely greater when the head is held out of position because subjects with their heads rotated or inclined at the time of impact have more severe symptoms at presentation, and increased likelihood of being symptomatic at 2-year follow-up."

21) This study indicates "most drivers may be at risk for whiplash-like disorders if exposed to a rear impact while driving. Drivers do not appear to decrease their head restraint backset distance while performing specific tasks, such as intersections and stops, that are known to be particularly risky in terms of rear-end collisions."