Comment for Height on Head Restraints GTR

Rev.2 September ‘06

September ’05

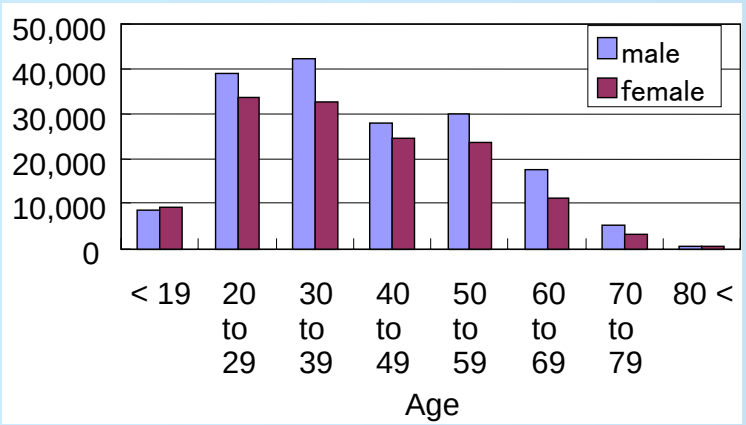
JAPAN MLIT

Number of Occupants Sustaining Neck Injuries in Rear-Impacted Vehicles by Gender, Age, and Seating Position (2004)

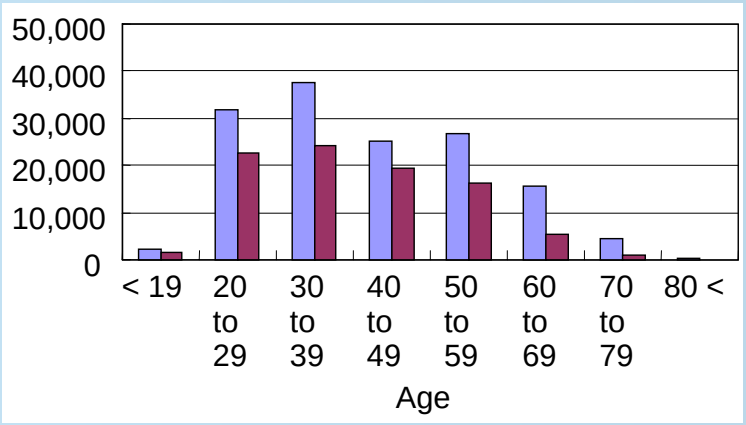
Drivers in their 30s make up the majority of the occupants sustaining neck injuries.

Cited from presentation material for 4th GTR Meeting

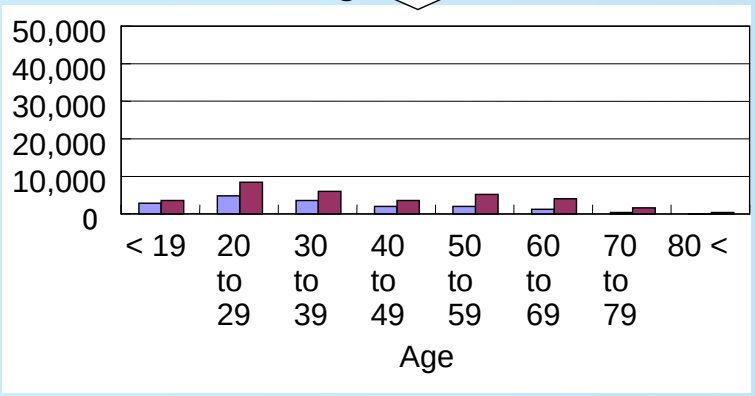
Occupant (Driver + Passenger) 309,939



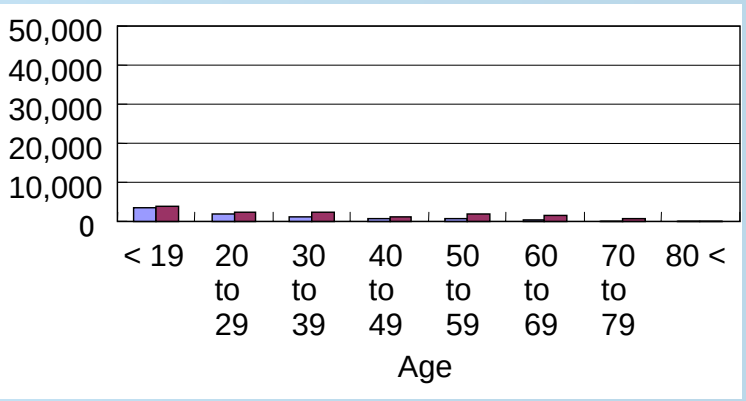
Driver 234,354



Front Seat Passenger 49,536

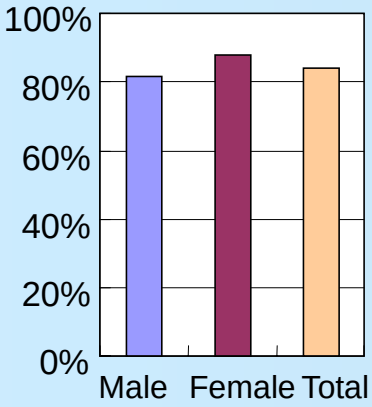


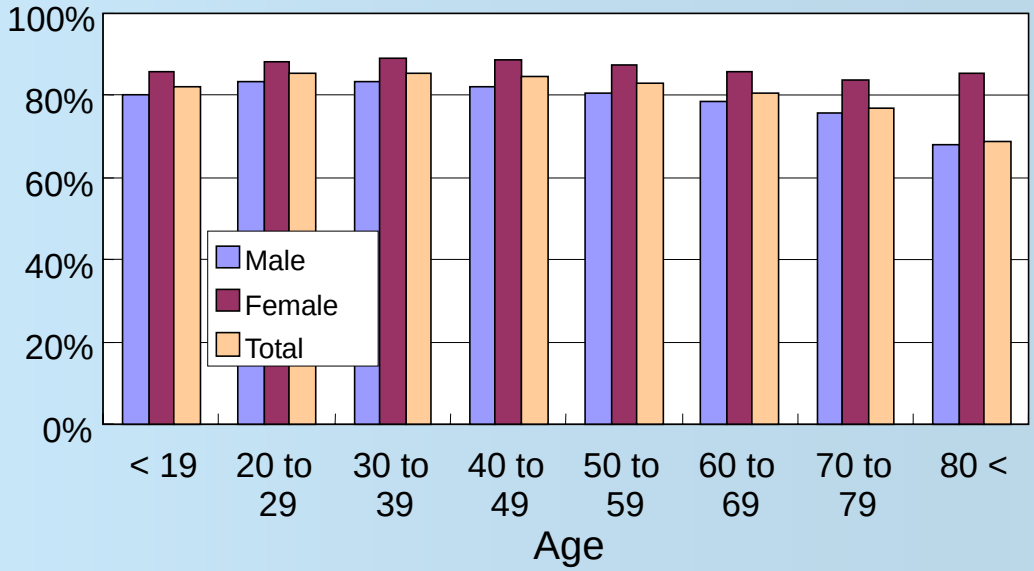
Rear Seat Passenger 26,049



Number of Occupants Sustaining Neck Injuries in Rear-Impacted Vehicles by Gender and Age

Among rear-impacts resulting in bodily injury, 81.7% of male and 88% of female drivers of the impacted vehicles sustained minor neck injuries.





Male	81.7%
Female	88.0%
Total	84.0%

Minor Neck Injury Ratio =
Minor Neck Injuries / (Deaths + Serious injuries + Minor Injuries + Not injured)

Subject: Rear impact resulting in bodily injury

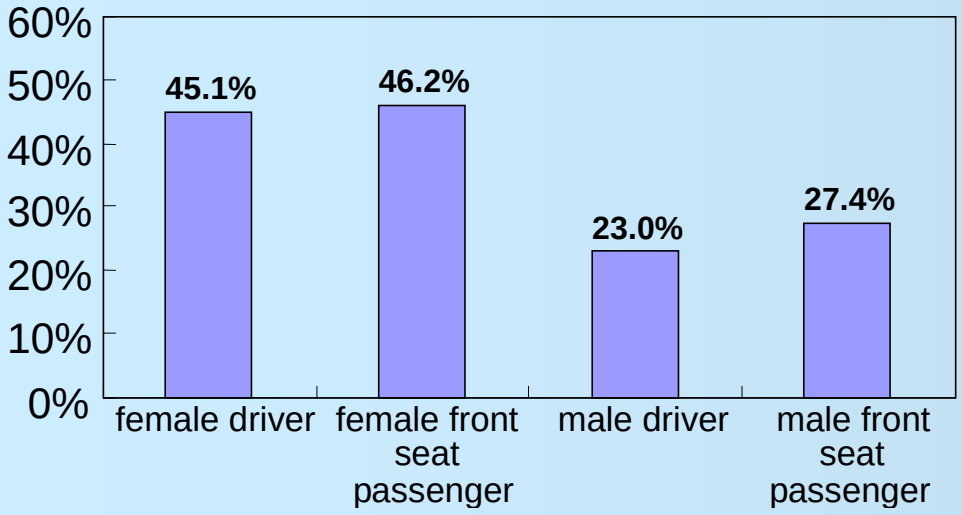
“Not injured” means the number of drivers who were not injured in the accident in which any passenger of rear-impacted vehicle was injured.

Example of Consideration in Europe

A DETAILED ANALYSIS OF THE CHARACTERISTICS OF EUROPEAN REAR IMPACTS

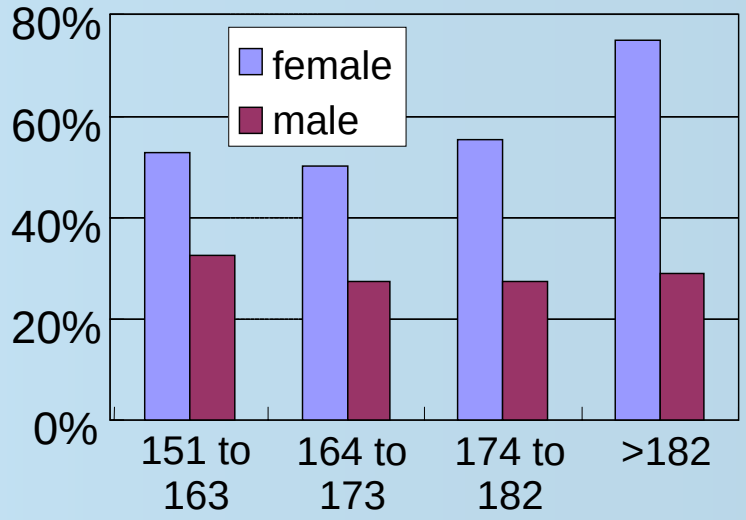
Volker Eis, Raimondo Sferco, Paul Fay/Ford Motor Company, Germany and UK #19ESV 05-0385

Female front seat occupants are at higher risk of receiving an STNI（Soft tissue neck injuries）.



STNI risk of front seat occupants in single rear impacts by **gender and seating position**

The taller the women are, the higher is their risk of receiving a soft tissue neck injury.



STNI risk of front seat occupants in single rear impacts by **gender and body height**

Comparison of Seated Height of Japanese, Netherlanders, and Americans

Since the seated heights of Japanese females and males are shorter than those of Americans in all age groups, head restraints with a height of 800 mm will cover all occupants.

<Netherlands> <Japan> <USA>

female (age:20-60) n = 635			female (age:18-29) n = 203	female (age:60-88) n = 50		female 2000CY
%ile	Sitting hight	%ile	Sitting hight	Sitting hight	%ile	Sitting hight
5	827	5	824.1	737.8	5	810
10	840	10	833.0	758.8	10	---
25	864	25	850.5	771.3	25	---
50	890	50	864.0	796.5	50	865
75	915	75	885.0	822.5	75	---
90	936	90	902.8	840.2	90	---
95	947	95	918.9	852.8	95	925

male (age:20-60) n = 495			male (age:18-29) n = 217	male (age:61-81) n = 47		male 2000CY
%ile	Sitting hight	%ile	Sitting hight	Sitting hight	%ile	Sitting hight
5	882	5	873.0	812.6	5	862
10	896	10	887.0	829.2	10	---
25	916	25	903.0	841.0	25	---
50	949	50	926.0	867.0	50	928
75	976	75	945.0	880.0	75	---
90	1001	90	969.4	887.6	90	---
95	1016	95	985.2	896.5	95	994

Source : (Netherlands) NL Calculation of needed head restraint height (informal group 3rd meeting)
(Japan) *Human Body Dimensions Data for Designs* (1994) by Life Engineering and Industrial Technology Research Institute, Agency of Industrial Science and Technology

Effects of Straightening and Ramping-up on the Height of the Head Restraints

Rev.1

Straightening and Ramping-up of the test subject in the past

Cited from presentation material for 5h GTR Meeting

＜Points of Examination ＞

1) Straightening

Amount of change due to the straightening of the spine

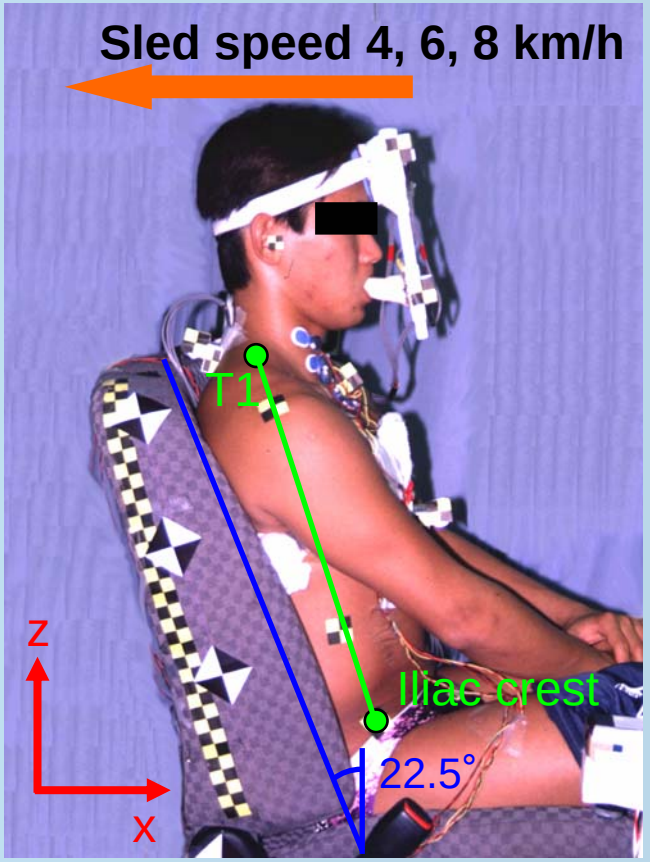
→ Amount of change in distance between T1-IC

2) Ramping-up

Amount of elevation of the trunk

→ Displacement of IC along the seat back

Standard seat: 22.5˚



The above points were examined until just before the torso rebounds from the seat back

↓

Check them at the moment T1 is closest to the seat back

Seat used: Standard seat

Test subjects: 4 to 5 males

Effects of Straightening and Ramping-up on the Height of the Head Restraints

Rev.1

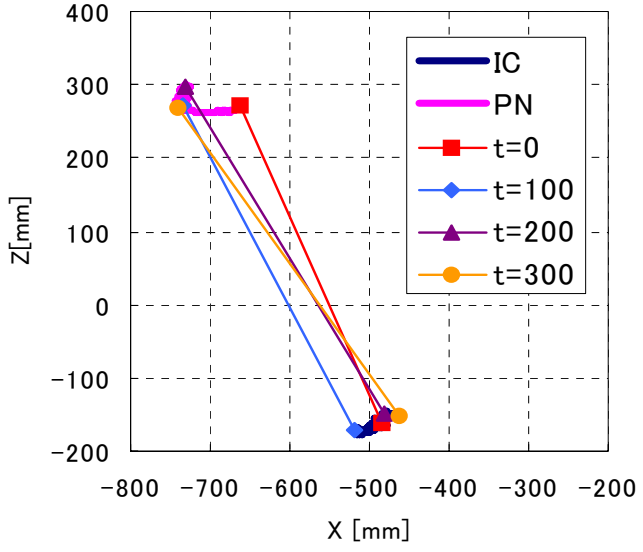
Straightening and Ramping-up at the moment T1 is closest to the seat back

Straightening : About 38 mm in average(up to 6km/h)

Ramping-up : About 10 mm in average (8 km/h)

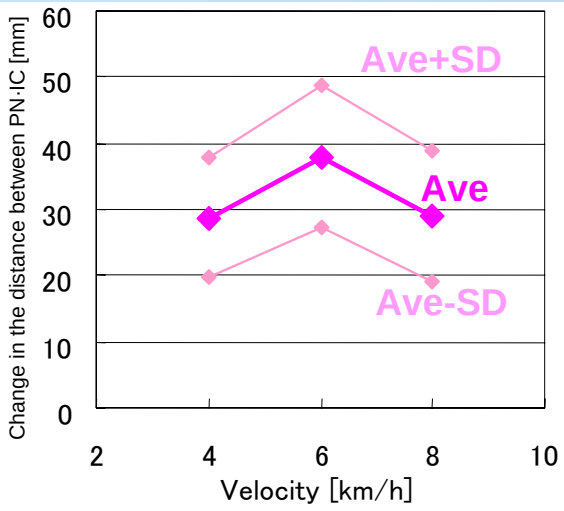
Orbit of T1· IC

Sled speed: 8 km/h



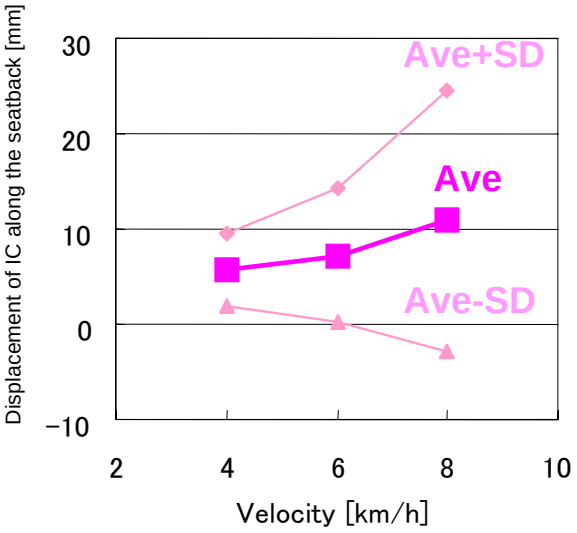
Straightening

Change in the distance between PN·IC



Ramping-up

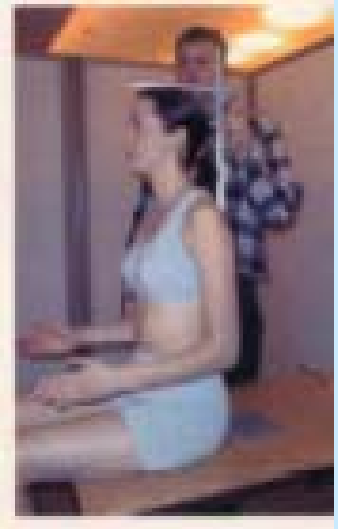
Displacement of IC along the seatback



Effects of Straightening and Ramping-up on the Height of the Head Restraints

Rev.1

Measuring Seating Height and Seating Position
At CEASAR and in Japan, the seating height is measured with the subject sitting up straight and includes extension due to the the straightening of the spine that occurs at the moment the occupant sustains a rear impact.

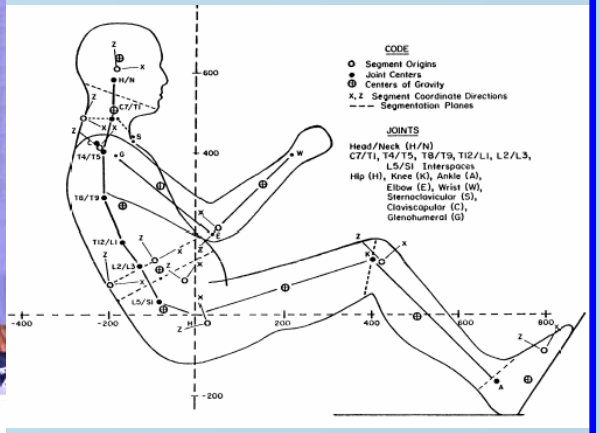


CEASAR : Sitting Height

Same method used in Japan

Position of the subject's when her/his sitting height is measured

Mini sled test



UMTRI method

Example of the sitting position

Effects of Straightening and Ramping-up on the Height of the Head Restraints

Rev.1

Summary

- **Upward move during a mini-sled test simulating a rear impact**

  Ramping-up : About 10 mm (8 km/h)

  Straightening : About 38 mm (6 km/h)

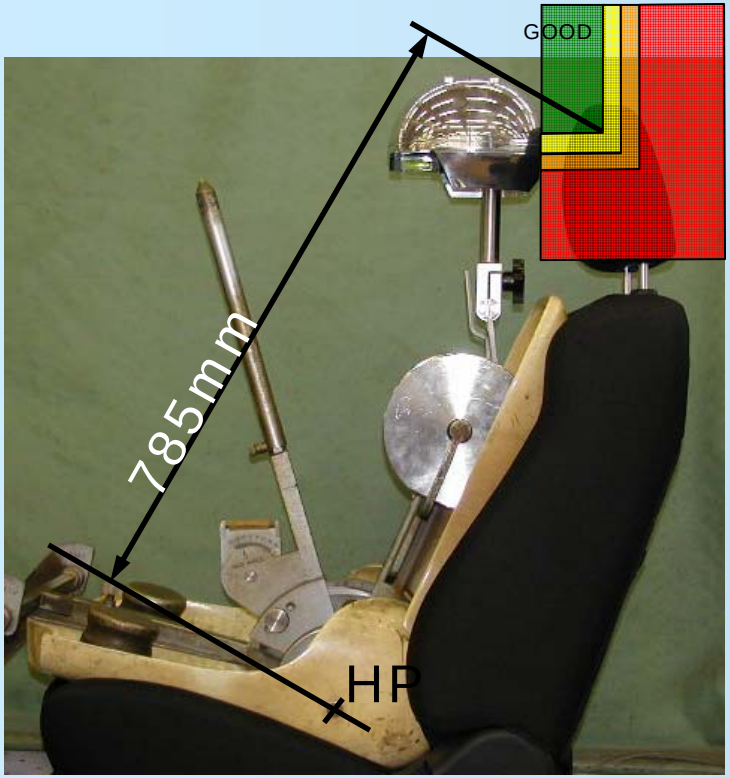
- **Of the above amount, the “Straightening ” is included in the sitting height measured.**

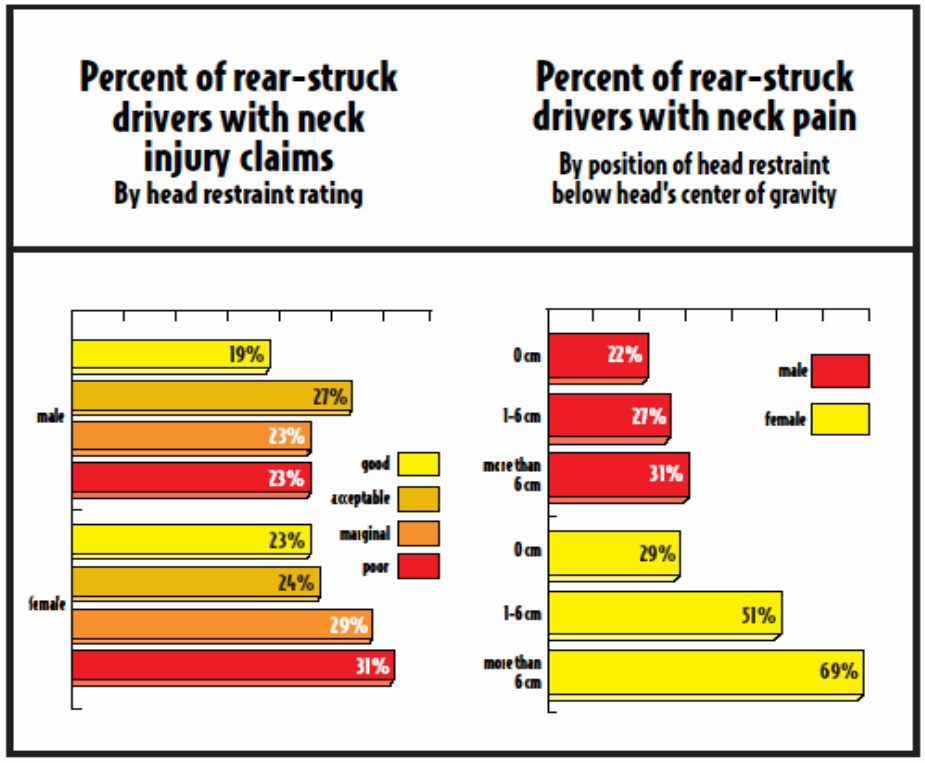
⇒ **The factors we have to consider in determining the head restraint height are only**

“the straight sitting height + Ramping-up”.

Confirmation of relation between headrest height and injury

- According to examination based on insurance record of IIHS、when ***headrest height is 785mm for occupant AM50%ile (HRMD), "GOOD" can be achieved***、resulting in effect of reducing injury（in particular, large effect of reducing it on female）
- Researchers found ***no further benefit for restraints higher than the head's center of gravity.***





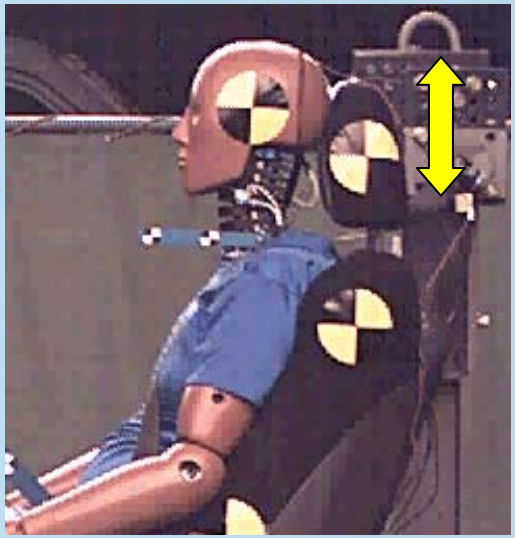
Confirmation of relation between headrest height and injury

Test method

- IIWPG dynamic test method（dummy：Bio RID2)

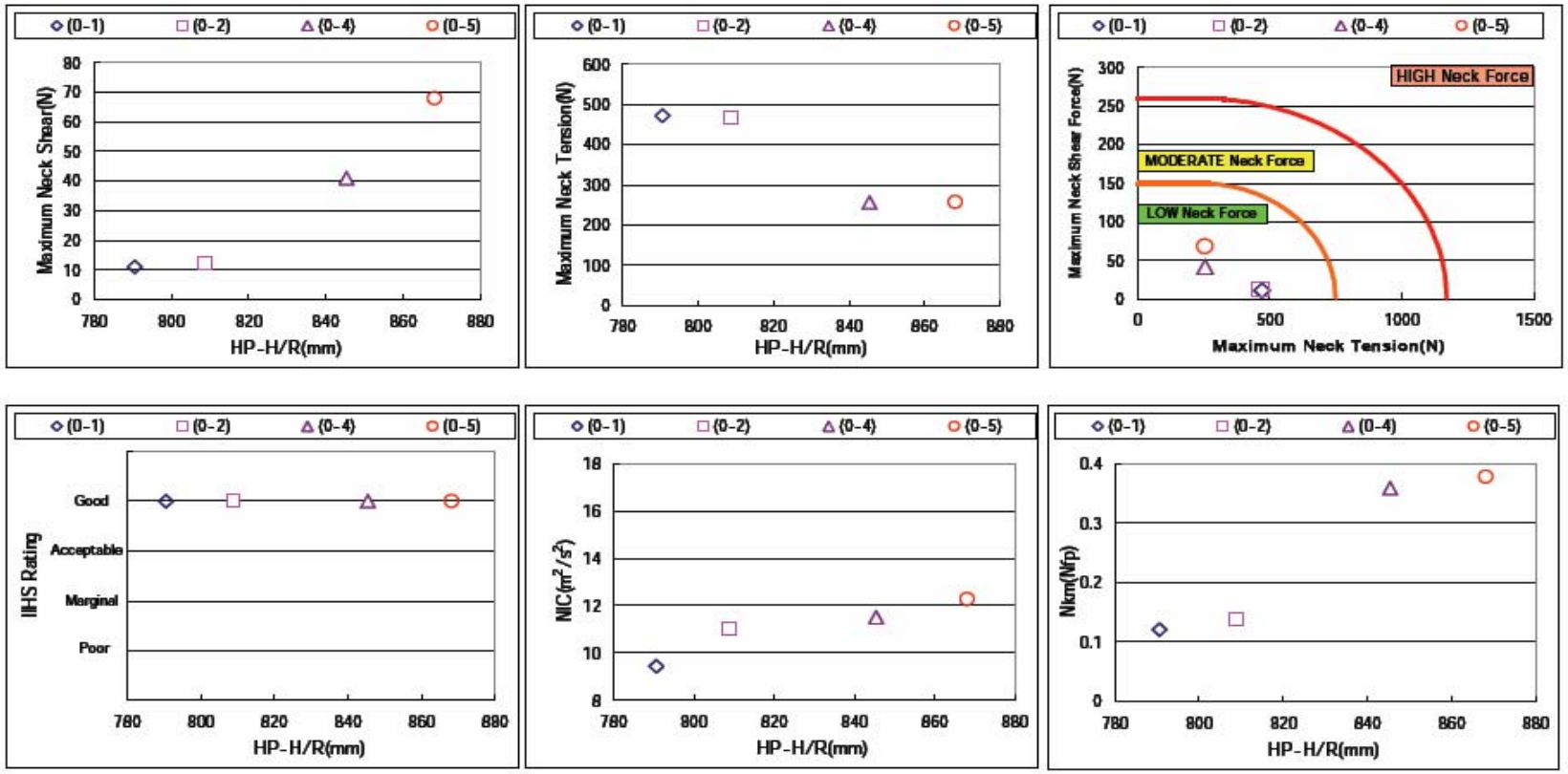
Sample

- Assess by changing headrest height of Passive typed whiplash reduction seat into 4 phases (790～850mm)



Confirmation of relation between headrest height and injury

- **When headrest height is 790mm or more、overall assessment is nearly equivalent (higher headrest, better Fz, but worse Fx). *There is no further benefit to increase the height, consequently, achieving consistency with IIHS analysis results*.**

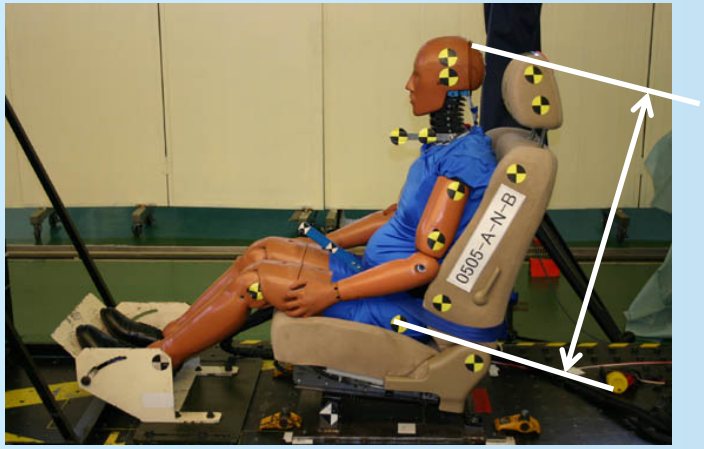


Confirmation of relation between headrest height and injury

Headrest height for AM95%ile.

From IIHS analyses and test results with Bio-RID2, it's estimated that *headrest height of approx. 820mm is sufficient to cover up to AM95%ile*.

Body size	HP−height of head top	Required headrest height
Bio−RID2	794mm	約785mm
HY−III　AM50%ile	797.5mm	約785mm
HY−III　AM95%ile*	828mm	約820mm



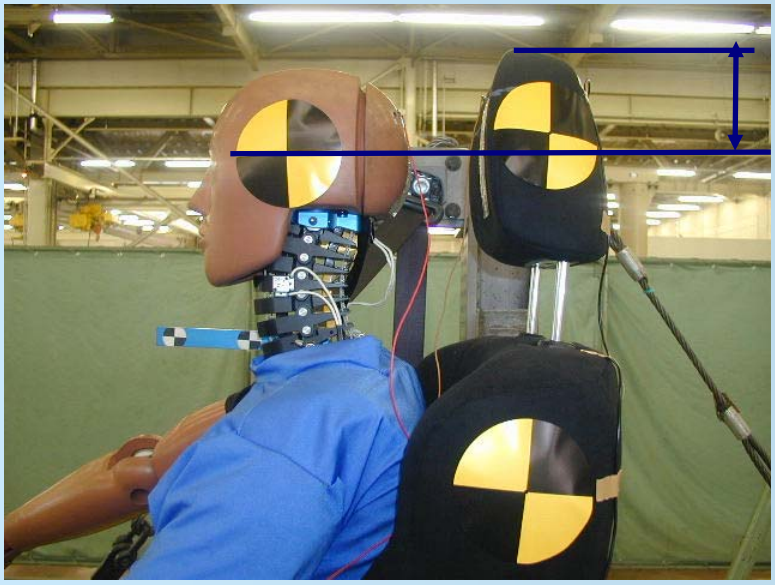
*equivalent to

Dutch Female 95%ile

Study for requirement of head restraint height

In case of 800mm regulation requirement, almost every production seats are more than 820mm height for keeping margin.

Therefore, most of existing seats are capable to protect AM95%ile. It will be difficult to expect more benefit, even if regulation requirement will be increased more than 800mm.



Conclusion

- It was found that females are more susceptible to neck injury than males in Japan. However, there is no data supporting the relationship between seated height and susceptibility.

- According to the research in Europe & IIHS, females with high seated height are the most susceptible.

- In case of current 800mm Height requirement, most of production seats height are sufficient to protect AM95%ile (Dutchwoman 95%ile). It is difficult expect further benefit by increasing height requirement. ***Therefore, 800 mm Height requirement could be acceptable.***