

**GTR 7 Informal Working Group
September 10/11, 2013**

**Tentative Draft Proposal on Evaluation
of Injury Parameters and Injury Risk
Curve, a collaborative undertaking
between NHTSA and Japan**

Part II

**JAPAN
JMLIT/JASIC/JARI**

- Human Volunteer Test (~ 6km/h)
- 20 accident cases of FE Simulation (8 ~ 28km/h)

Injury Scale : WAD

Injury evaluation parameters : Strain

Correlation between WAD and Strain

Correlation among Strain and NIC, NFM

- PMHS Test (16 , 17.3 , 17.6 , 24km/h)

Injury Scale : AIS

Injury evaluation parameters : IV-NIC(R)

Correlation between AIS and IV-NIC(R)

Correlation among Intervertebral Rotation, NDC, IV-NIC, and NFM

Common injury evaluation parameter : IV-NIC(R) • Flexion

Injury Evaluation Parameters and Injury Criteria for GTR7 (Proposal)

- Human Volunteer/Accident Reconstruction
- Injury scale : WAD
- Injury Evaluation Parameters
- Neck Forces/Moment, NIC

- PMHS tests
- Injury scale : AIS
- Injury Evaluation Parameters
- Intervertebral Rotation, IV-NIC, NDC, NFM

Common injury evaluation parameters : IV-NIC(R) · Flexion

AIS 1+ = 50%

Common Indicator - IV-NIC(R) · Flexion value = 1.1

WAD 2+ = 82.9%

- Injury evaluation parameters for BioRID-II :
- NIC
 - UpperNeck-FX
 - UpperNeck-FZ
 - UpperNeck-MY(Ext)
 - UpperNeck-MY(Flx)
 - LowerNeck-FX
 - LowerNeck-FZ
 - LowerNeck-MY(Ext)
 - LowerNeck-MY(Flx)

- Injury evaluation parameters for BioRID-II :
- NIC
 - IV-NIC (R) · Flexion
 - Intervertebral Rotation · Flexion
 - NDCrot
 - NDCx

Harmonization
(Suggest Alternatives
Or Agree to a
Common Criteria)

Neck Forces/Moments In progress

Injury Evaluation Parameters and Injury Criteria for GTR7 (Proposal)

Setting methods of neck injury criteria

- Fig. 1 shows that IV-NIC value corresponding to the AIS1+ 50% on the risk curve obtained by the PMHS Tests (Production seat)
- The IV-NIC value 1.1 corresponds to the AIS1+50% on the risk curve obtained by the PMHS tests shown in Fig.1. This IV-NIC value 1.1 also corresponds to 82.9% of WAD2+ risk curve wrt the IV-NIC.
- The IC of NFM and NIC will be created by WAD2+82.9% based on the risk curve of WAD2+ wrt IV-NIC (see Table 1 on the next page).

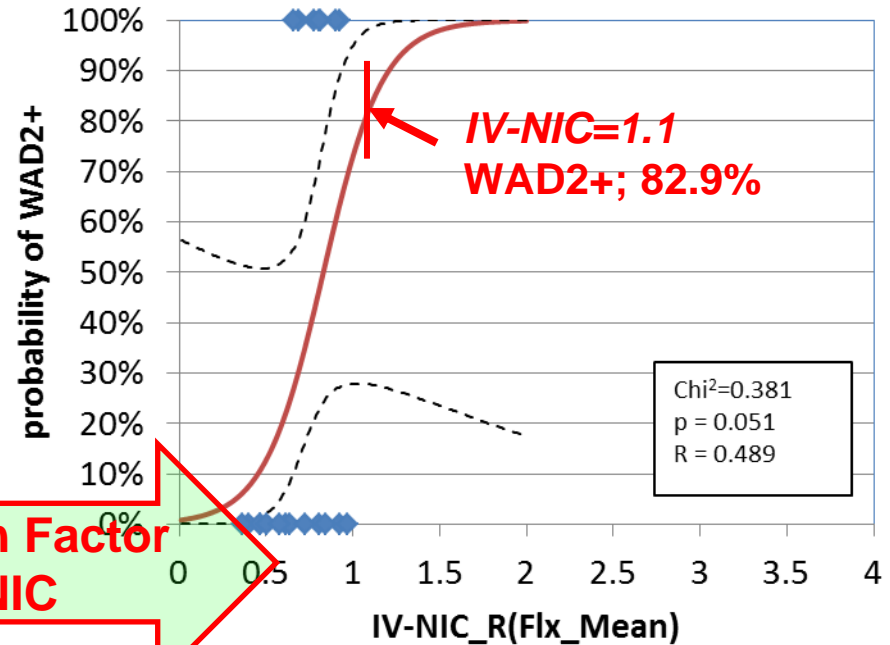
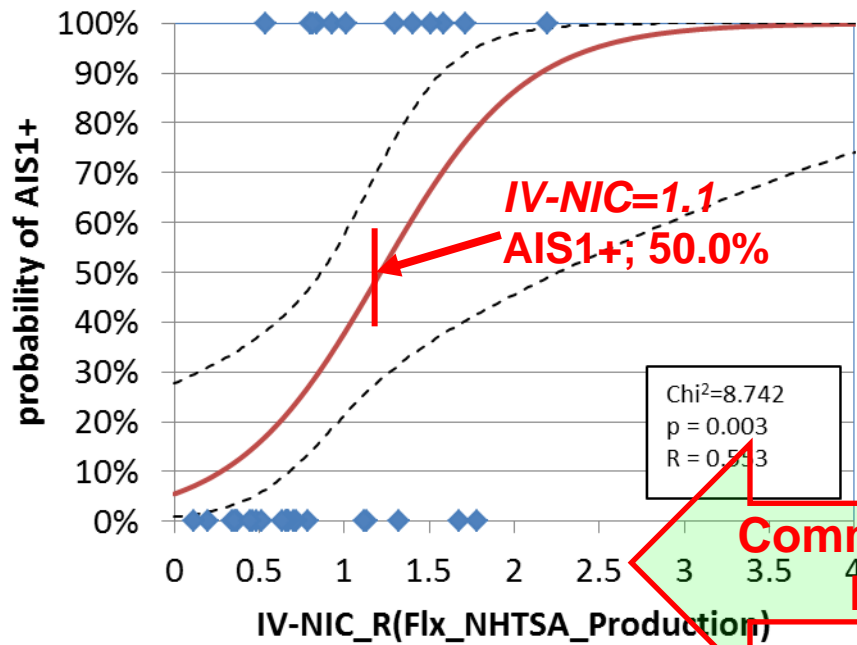


Fig. 1 Injury Risk Curve (AIS1+; PMHS: Production Seat)

Fig. 2 Injury Risk Curve (WAD2+; CAE: Accident Reconstruction)

**Common Factor
IV-NIC**

Table 1

Tentative Draft on Injury Evaluation Parameters and Injury Criteria

Injury Criteria		WAD2+	AIS1+	Literature Human Tolerance
		82.9% Value (IV-NIC=1.1)	50.0% Value (IV-NIC=1.1)	
IV Rotation		?	3.7 deg.	
NDCrot		12.0 deg	12.2 deg.	
NDCx		30.5 mm	117.8 mm	
NIC Max		23.2	29.7	-
Upper Neck	FX	636.5	?	845 ^{1), 2)}
	FZ	979.2	?	1134 ^{1), 2)}
	MY(Flx)	33.5	?	50.2 ²⁾
	MY(Ext)	33.5	?	20.3 ²⁾
Lower Neck	FX	636.5	?	600 ~ 800 ³⁾
	FZ	1135.9	?	-
	MY(Flx)	33.5	?	-
	MY(Ext)	33.5	?	-
		NHTSA works		Units:
		Japan works		Force (N)
				Moment (Nm)

References:

1) Mertz, 1971, Strength and Response of the Human Neck, 15th STAPP

2) SAE J885, 2003, Human Tolerance to Impact Condition as related to Motor Vehicle Design

3) Stemper, 2009, Verification of Lower Neck Shear Force as a Rear Impact Injury Criterion

Conclusion

Tentative draft proposal on injury evaluation of parameters and injury risk curve, a collaborative undertaking between NHTSA and Japan was reported.

Until the next meeting on December, 2013, it should be refined and reviewed carefully, and it should also be updated/revised as the final proposal on the neck injury evaluation parameters and the neck injury criteria for the informal GTR7.

Further discussion
(if needed)

Classification on WAD and AIS

- ◆ WAD is applied for HVT and CAE.
- ◆ AIS is applied for PMHS.
- ◆ As shown below, AIS & WAD are essentially different injury scales.
- ◆ Based on the proper different definitions of AIS and WAD, the conversion between AIS and WAD through IV-NIC as the common factor will be done.

WAD (for CAE)

WAD	
Grade	Clinical classification
0	The neck has no symptoms, and the physical finding is normal.
1	The neck has pain and stiffness, but the physical finding is normal.
2	In addition to neck symptoms, there is a limit of motion space of the cervical vertebra and a localized tender point, suggesting neck symptoms from the musculoskeletal system.
3	In addition to neck symptoms, there are neurological findings such as the tendon reflex disorder, adynamia, and perception disorder.
4	Dislocation and fracture of the cervical vertebra.

AIS (for PMHS)

AIS	
Grade	Clinical classification
0	No Injury
1	<ul style="list-style-type: none"> • Strain, acute with no fracture or dislocation • Interspinous ligament laceration
2	<ul style="list-style-type: none"> • Dislocation (subluxation) without fracture facet unilateral • Disc injury
3	<ul style="list-style-type: none"> • Dislocation (subluxation) without fracture facet bilateral

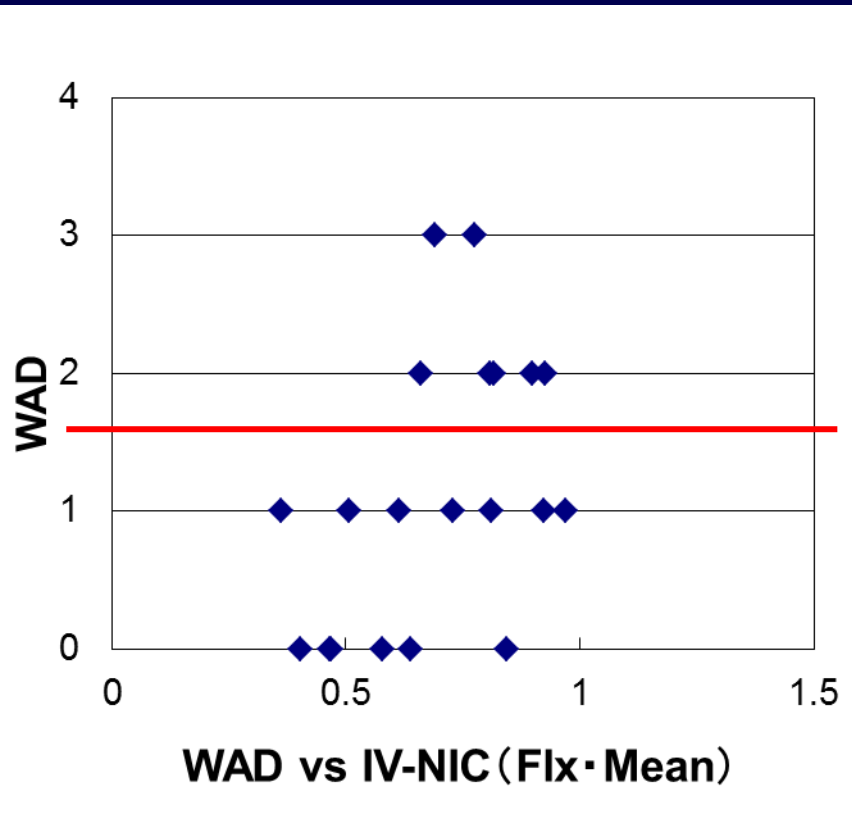


Fig. A Scattering Diagram on WAD wrt IV-NIC

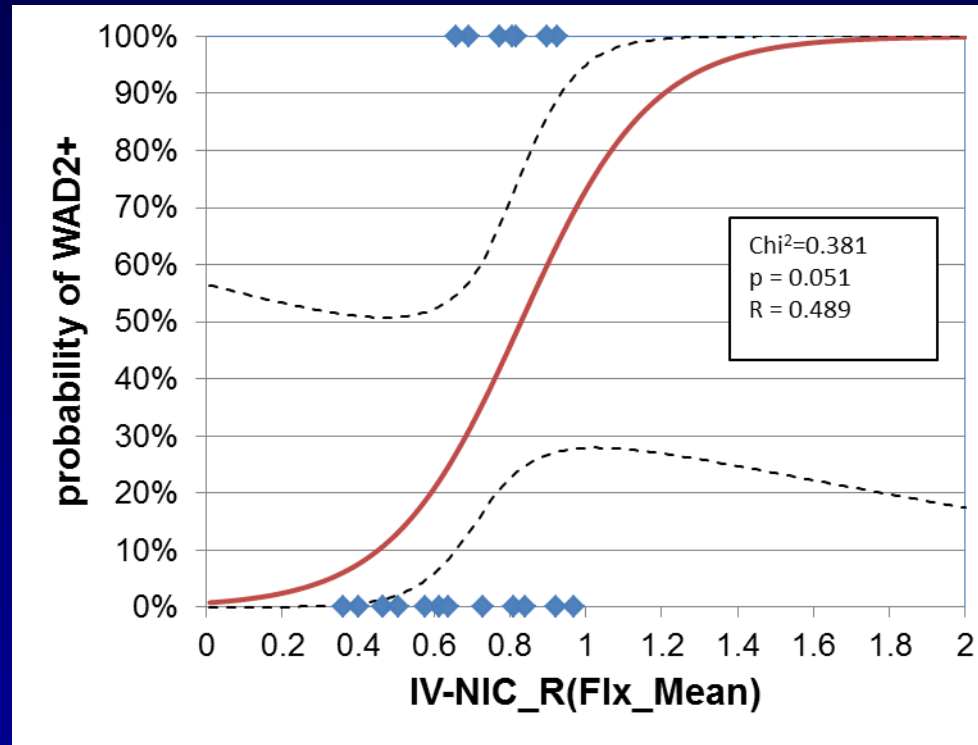
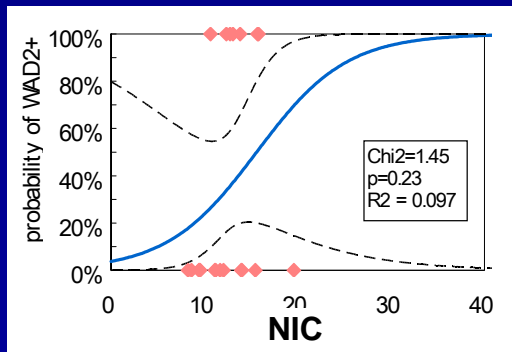
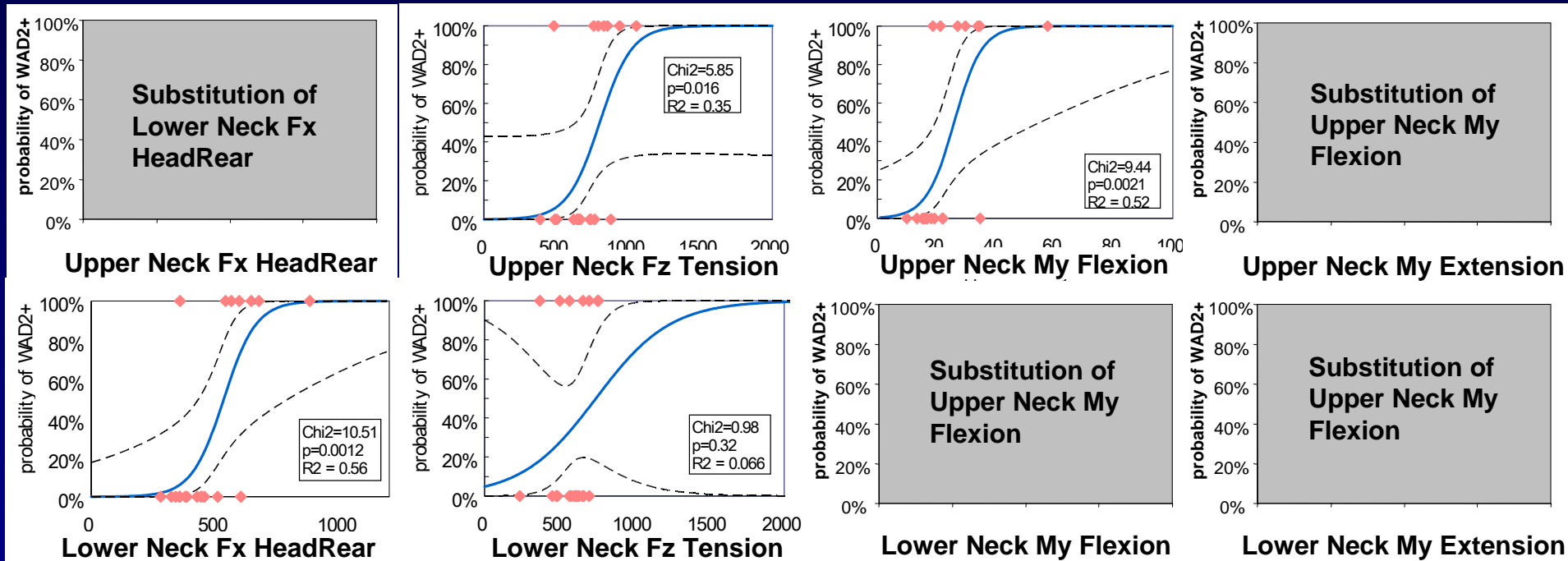


Fig. B WAD2+ risk curve wrt IV-NIC

JNCAP

Risk Curve of NIC/Neck Force/Moment and reference values in Japan



Injury Criteria		WAD2+	
		5%Value	95%Value
NIC Max		8	30
Upper Neck	FX	340	730
	FZ	475	1130
	MY(Fix)	12	40
	MY(Ext)	12	40
Lower Neck	FX	340	730
	FZ	257	1480
	MY(Fix)	12	40
	MY(Ext)	12	40