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Prepared at the Request of Counsel

February 15, 2013

Scott Schmidt
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Washington, D.C. 20005

Dear Scott:

Enclosed, please find my report evaluating the methodology and assumptions made by the JASIC (Japan Automobile Standards Internationalization Center) group and the Federal Highway Research Institute on the estimation of cost reduction due to tibia fracture mitigation. In particular, the results presented in the documents GTR9-5-14 Phase 2 and GTR9-5-19 are evaluated for the validity of the assumptions and the statistical methodology used.
We do not address cost estimates and reduction in this report.

Background
The Alliance of Automobile Manufacturers, through OICA, is participating in Phase 2 of UNECE Global Technical Regulation No. 9 on Pedestrian Impact Protection (GTR9). An Informal Group on Pedestrian Safety Phase 2 (IG PS2) has been established to further develop proposals to replace the EEVC/TRL Legform with the Flexible Pedestrian Legform Impactor (Flex-PLI) as the pedestrian protection lower leg measurement tool of GTR 9 and the ECE Regulation (ECE/TRANS/WP.29/1091, para.36).

A benefits analysis of the FlexPLI Legform vs. the TRL Legform was conducted by Japan Automobile Standards Internationalization Center (JASIC) (GTR9-2-07r1 and GTR9-2-12). Alliance member companies support further developing Flex-PLI as a single harmonized test tool in order to enhance the safety level of lower leg pedestrian protection. The benefit analysis was examined by Alliance who expressed two major concerns: 1) The JASIC study did not consider vehicle speed effect appropriately, and 2): the number of tibia fractures should not be included in estimates of fatalities.
JASIC has purportedly addressed these concerns of Alliance and has subsequently presented a study (documents GTR9-5-14 Phase 2). BASt proposed another possible method for estimating Flex-PLI benefits (GTR9-5-19).

Methodology

JP Research examined the assumptions used by the JASIC group to perform the additional analysis on cost reduction due to Tibia fracture mitigation. (GTR 9-5-14)

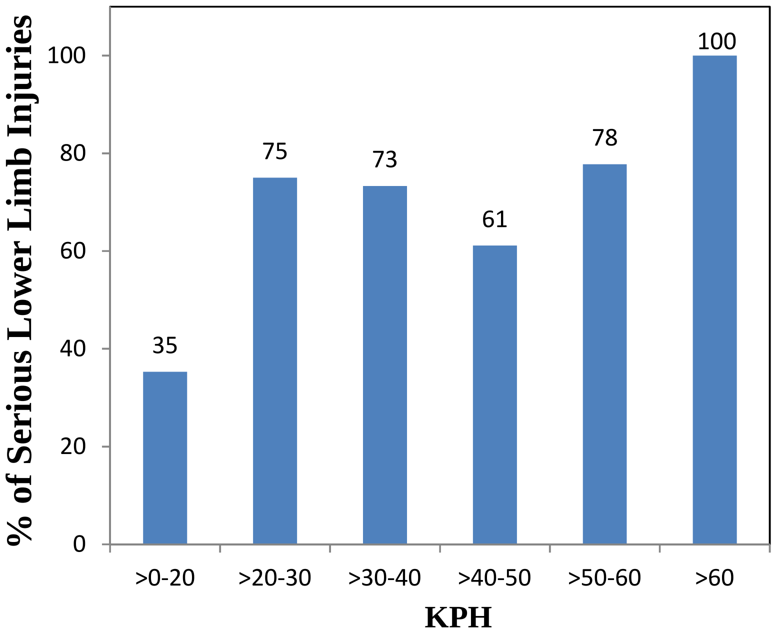
Assumption 1: Conversion of "Serious Lower Extremity Number" to "Serious Tibia Injury Number"

The Japan National Traffic Accident Data only contains "Serious Lower Extremity Number" and does not contain information on "Serious Tibia Injury Number". Consequently, JASIC used the following equation to estimate the number of serious tibia injuries:

> Serious Tibia Injury Number = Serious Lower Extremity Injury Number x 66%. (Appendix 2, GTR9-5-14).

JP Research used the PCDS (Pedestrian Crash Data System) for the years 1994-1998 to determine the percentage of serious lower extremity injuries that were serious tibia injuries. There were 121 pedestrians with serious lower limb injuries (MAIS 2+, excluding fatalities) and of these, 75 (62%) were tibia fractures. But this 62% varied significantly across impact speed categories as seen in Figure 1.

Figure 1. Percentage of Serious Lower Limb Injuries* that are Tibia Fractures



*Lower Limb Injuries include MAIS2+,
Source: Pedestrian Crash Data Study 1994-1998

For example, for the impact speed less than 20 KPH, 35% of serious lower limb injuries were tibia injuries, while for other speed categories over 60% of serious lower limb injuries were tibia injuries. The JASIC study used 66% across all vehicle speed groups which is not a valid assumption for converting lower extremity injuries to tibia injuries.

In addition, there were 69 pedestrians with MAIS 3-4 lower limb injuries, and of these, 56 (82%) were tibia fractures. Consequently, the percentage also varies based on injury severity and the JASIC study used 66% for all AIS 2+ injuries while making the conversion.

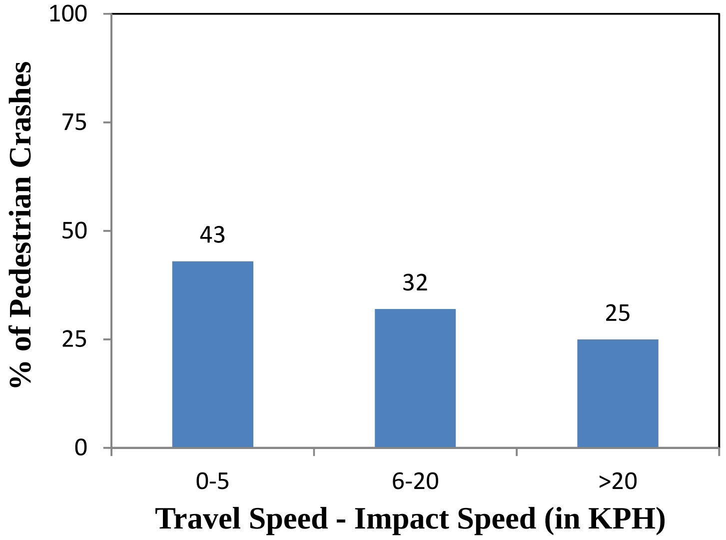
Assumption 2: The Conversion of "Travel Speed" into "Impact Speed"

The JASIC study also made an assumption to convert "travel speed" into "impact speed". The following conversion equation was used in the JASIC study:

Impact speed= travel speed-5 kph

PCDS data was used to validate this assumption.

Figure 2. Percentage of Pedestrian Crashes by Difference between Travel Speed and Impact Speed



Source: Pedestrian Crash Data Study 1994-1998

Figure 2 shows that in PCDS, only for 43% of crashes, the difference between impact speed and travel speed was less than 5 kph. For 32% of crashes the difference was 6-20 kph and for 25% of crashes, the difference was more than 20 kph.

Again, assuming a difference of 5kph between travel speed and impact speed is not valid and consequently, using travel speed to estimate impact speed is not a valid approach to estimate number of serious tibia injuries.

Assumption 3: Estimation of Serious Tibia Injury Ratio by Impact Speed

The JASIC study estimated the serious tibia injury ratio using the following formula (GTR9-5-14, page 5):

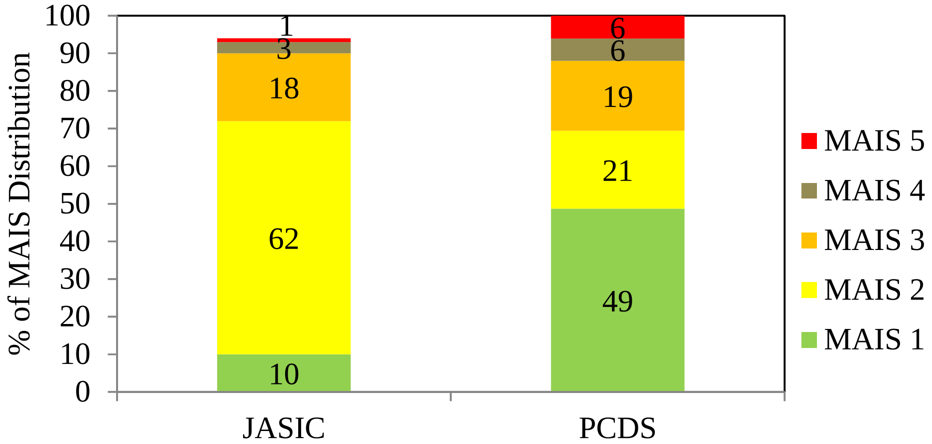
> "Serious Tibia Injury Number" / ("Serious Lower Extremity Number" + "Minor Lower Extremity Number")

JP Research repeated the study using PCDS data to estimate serious tibia injury by impact speed and Japan National Traffic Accident Data for lower extremity injury estimates. Appendix A presents the results and comparisons between JP Research and JASIC study. Even assuming their national data and assuming reduction percentages proposed by JASIC, the number of serious tibia injuries by year was estimated as 568 (compared to 806, estimated by JASIC). Even with changing just one assumption of 66%, the revised estimates were 30% (806-(568/806)) less than JASIC study estimates. This finding clearly indicates the sensitivity of assuming serious tibia injuries are 66% of serious lower extremity injuries.

Evaluation of GTR9-5-19 Presentation

The cost reduction due to introduction of FlexPLI within GTR9 analysis was reviewed to compare the injury distribution for pedestrians involved in crashes in the US versus Germany. The injury distribution presented in this document used GIDAS. JP Research used PCDS data to compare the corresponding injury distributions to pedestrians in US crashes. As seen in Figure 3, the injury distributions were markedly different between GIDAS (German experience) and PCDS (US experience) and the results from Europe on pedestrian crashes and injuries may not be transferrable to US. In addition, the BASt (GIDAS data) study shifts injuries by AIS-1 (ex: AIS-2 is reduced to AIS-1,due to friendly bumper design) using GIDAS data and recalculates the national estimates of annual number of "slightly" injured and "severely injured" tibia injuries. This method assumes a relationship between AIS injury severity levels based on in-depth investigations and injury classifications reported by police reports which contribute to the German national accident data. For example, in the US, these two injury classification schemes (police reports versus NASS/CDS) are based on significantly different criteria and a simple transformation across these two distinctly different data bases is not done unless a probabilistic method of data linkage is used.

Figure 3. MAIS Injury Distribution for all Pedestrians



Source: GTR9-5-19, slide 5

PCDS Data Analysis

The PCDS data is based on 6 major cities across the U.S. and includes vehicles which are predominantly model years 1990 through 1996. The 6 cities selected to participate in the PCDS are: Buffalo, New York; Chicago, Illinois; Dallas, Texas; Fort Lauderdale, Florida; San Antonio, Texas and Seattle, Washington. Appendix B presents the number of cases by city in the PCDS data.

The vehicle must be a late-model-year passenger car, light truck or van. Late-model-year was defined as being manufactured in the last 5 years of data collection. It also includes some non-late-model-year vehicles where the exterior design was the same as late model-year-vehicles (e.g. Ford Taurus 1988-1994). Due to the time period of data collection, over 60% of vehicles in PCDS are passenger cars, 10% are sport utility vehicles and 10-15% are pickups and vans.

Conclusions

Based on the available data on the JASIC and BASt studies, the following conclusions were reached:

- JASIC's method of assuming that 66% of serious lower limb injuries result in serious tibia injuries leads to potentially over estimated projections. In fact, the percentage varies significantly across impact speeds and injury severity. Consequently, the number of serious tibia injuries by impact speed presented in GTR9-5-14 (page 7) is not reliable.
- JASIC's assumption of the relationship between travel speed and impact speed results in over estimation of the serious lower limb injuries, as seen in PCDS data. Over 50% of pedestrian crashes in the US have a difference of more than 5 kph between travel speed and impact speed.
- The final estimate of 806 pedestrian tibia injuries per year is highly sensitive to the assumption of 66% of serious lower limb injuries are serious tibia injuries. Even

changing that one assumption leads to significantly different conclusions.

- The nature of injury distributions among pedestrians involved in crashes is markedly different between Germany and US.
- The assumption “reduction of lower extremity related AIS1-3 injuries by 1 when vehicle designed with pedestrian friendly bumper (AIS1shifting)” (slide3, GTR9-5-19) is not based on field data on pedestrian injuries. No technical literature/pedestrian injury data bases were found nationally or internationally to validate this assumption.

The fact remains that estimating the annual number of serious tibia injuries with the available databases is problematic.

Sincerely,

Jeya Padmanaban
President

Appendix A

Travel Speed	Impact Speed	Serious Lower Extremity Injury Number	Serious tibia Injury Number	Minor Lower Extremity Injury number	Serious Tibia Injury Ratio	Reduction	Reduction Ratio	
0-20	5	4,478	2,955	27,190	9.3%	0.3%	9.1%	2,870
21-30	20	1,100	726	2,580	19.7%	4.5%	15.2%	560
31-40	30	1,372	906	1,695	29.5%	14.9%	14.6%	449
41-50	40	927	612	731	36.9%	29.2%	7.7%	128
51-60	50	355	234	224	40.5%	36.6%	3.9%	22
61-70	60	82	54	47	42.0%	50.6%		-
71-80	70	21	14	10	44.7%	72.3%		-
81-90	80	4	3	4	33.0%	89.3%		-
91+	90	10	7	8	36.7%	99.4%		
								806

Source: GTR9-8-14, page 5

Travel Speed	Impact Speed	Serious Lower Extremity Injury Number	Serious tibia Injury Number	Minor Lower Extremity Injury number	Serious Tibia Injury Ratio	Reduction	Reduction Ratio	
0-20	5	4,478	1,580	27,190	5.0%	0.3%	4.7%	1,485
21-30	20	1,100	825	2,580	22.4%	4.5%	17.9%	659
31-40	30	1,372	1,006	1,695	32.8%	14.9%	17.9%	549
41-50	40	927	566	731	34.2%	29.2%	5.0%	82
51-60	50	355	276	224	47.7%	36.6%	11.1%	64
61-70	60	82	82	47	63.6%	50.6%	13.0%	-
71-80	70	21	21	10	67.7%	72.3%	-4.6%	-
81-90	80	4	4	4	50.0%	89.3%	-39.3%	-
91+	90	10	10	8	55.6%	99.4%	-43.8%	
								568

Source: PCDS Data for Serious Tibia Injury Numbers by Impact Speed

Appendix B

Table A. Number of Cases by City in PCDS Data

City	Number of Cases
Buffalo, NY	21
Chicago, IL	10
Dallas, TX	15
Ft. Lauderdale & Hollywood, FL	1
San Antonio, TX	23
Seattle, WA	28