



JP Research review of JASIC & BAST Flex-PLI Injury Reduction Estimate

GTR09 PH2 Informal Working Group

March 18th to 20th, 2013

Topics

1. Alliance Concerns
2. JP Research review of documents GTR9-5-14 & GTR9-5-19
3. PCDS Summary
4. Tibia Fractures versus impact speed
5. GIDAS injury pattern versus PCDS
6. Summary

Alliance Concerns

- Appropriateness and validity of the use of constant factor for all speed categories to estimate “Serious Tibia Injuries”
- The estimation of test speed as travel speed reduced by 5KPH.
- Appropriateness of estimating Tibia injury reduction by shifting the injury severity curves by “1” AIS level in the US dataset (AIS-2 is reduced to AIS-1) because of friendly bumper.

JP Research review of documents GTR9-5-14 & GTR9-5-19

Why JP Research

- Independent third party
- JP Research, Inc. is a worldwide research consulting firm specializing in statistical, mathematical, engineering and risk analysis, particularly with regard to motor vehicle safety.

Alliance Requested to JP Research:

- Examine the data and methodology used in the GTR9-5-14 and GTR9-5-19 documents
- Provide recommendations, if possible, on how the available field data could be used to estimate the number of serious injuries associated with tibia fractures

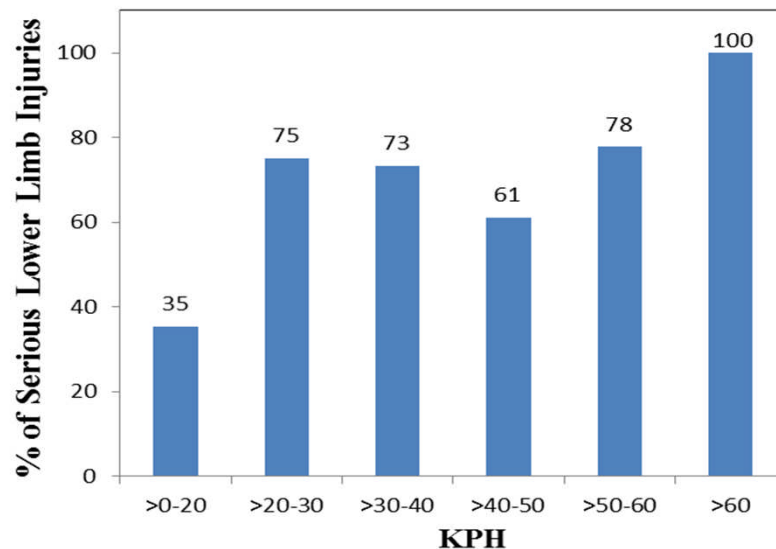
PCDS Summary

NASS Pedestrian Crash Data Study (PCDS):

- PCDS data is based on 6 major cities across the U.S.
 - PCDS is a small data set with only 404 pedestrians aged 16 years and older
- Vehicles are predominantly model years 1990 through 1996.
 - Over 60% Passenger cars
 - 20 – 25 % Sport utility vehicles, pick-up and vans
- The U.S. vehicle fleet has changed significantly in the last decade:
 - 40% of today's vehicle population are Sport utility, pickups and minivans
- This data is not representative of the current U.S. fleet mix and consequently the PCDS data may not be a statistically valid sample of pedestrian related crashes/fatalities/injuries.

Estimating “Serious Tibia Injury Numbers”

- JASIC used a factor of 66% to convert “Serious Lower Extremity Injuries” to “serious Tibia Injuries” (GTR9-5-14) . JPR’s analysis showed that this approach results is an over estimate of Tibia injuries.
 - JPR found 121 serious lower extremity injuries in the PCDC (MAIS2+, excluding fatalities), 75 (62%) were Tibia fractures and the % varies significantly across the impact speed, see figure-1 below.



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

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

- Because of the small sample size of PCDS it’s difficult to estimate an average conversion factor similar to the JASIC study. However, the Injury distribution versus speed, figure-1, can be used to check the potential tibia injury numbers.
- If the PCDS speed category distribution is used with the data in GTR-5-14 the serious tibia injuries would be 30% lower than the JASIC estimate.

Series Tibia Fractures Estimates from JASIC & JPR Analysis

| Travel Speed | Impact Speed | Serious Lower Extremity Injury Number | JASIC Conversion | Serious tibia Injury Number | Minor Lower Extremity Injury number | Serious Tibia Injury Ratio | Reduction | Reduction Ratio | Flex-Impactor effect |
|---------------|--------------|---------------------------------------|------------------|-----------------------------|-------------------------------------|----------------------------|-----------|-----------------|----------------------|
| 0-20 | 5 | 4,478 | 66% | 2,955 | 27,190 | 9.3% | 0.30% | 9.10% | 2,870 |
| 21-30 | 20 | 1,100 | 66% | 726 | 2,580 | 19.7% | 4.50% | 15.20% | 560 |
| 31-40 | 30 | 1,372 | 66% | 906 | 1,695 | 29.5% | 14.90% | 14.60% | 449 |
| 41-50 | 40 | 927 | 66% | 612 | 731 | 36.9% | 29.20% | 7.70% | 128 |
| 51-60 | 50 | 355 | 66% | 234 | 224 | 40.5% | 36.60% | 3.90% | 22 |
| 61-70 | 60 | 82 | 66% | 54 | 47 | | | | |
| 71-80 | 70 | 21 | 66% | 14 | 10 | | | | |
| 81-90 | 80 | 4 | 66% | 3 | 4 | | | | |
| 91+ | 90 | 10 | 66% | 7 | 8 | | | | |
| Estimate/Year | | | | | | | | | 806 |

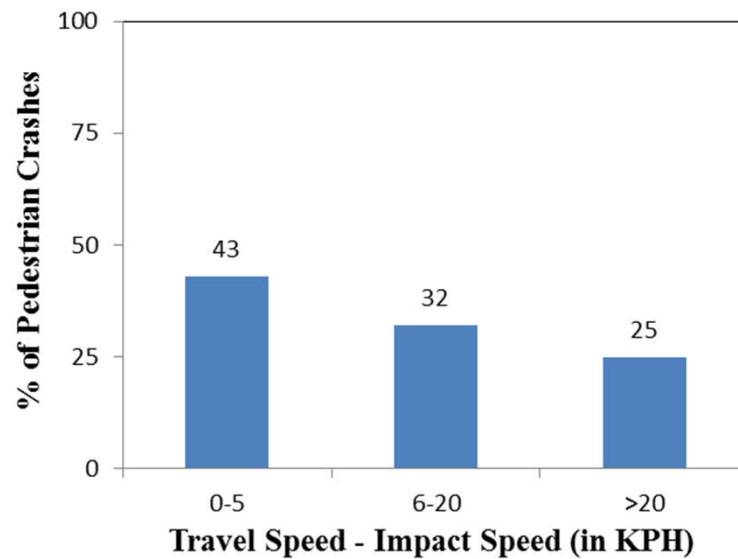
Source: GTR9-8-14, page 5

| Travel Speed | Impact Speed | Serious Lower Extremity Injury Number | PCDS speed categories | Serious tibia Injury Number | Minor Lower Extremity Injury number | Serious Tibia Injury Ratio | Reduction | Reduction Ratio | Flex-Impactor effect |
|---------------|--------------|---------------------------------------|-----------------------|-----------------------------|-------------------------------------|----------------------------|-----------|-----------------|----------------------|
| 0-20 | 5 | 4,478 | 35% | 1,580 | 27,190 | 5.0% | 0.30% | 4.70% | 1485 |
| 21-30 | 20 | 1,100 | 75% | 825 | 2,580 | 22.4% | 4.50% | 17.90% | 659 |
| 31-40 | 30 | 1,372 | 73% | 1,006 | 1,695 | 32.8% | 14.90% | 17.90% | 549 |
| 41-50 | 40 | 927 | 61% | 566 | 731 | 34.1% | 29.20% | 5.00% | 82 |
| 51-60 | 50 | 355 | 78% | 276 | 224 | 47.7% | 36.60% | 11.10% | 64 |
| 61-70 | 60 | 82 | 100% | 82 | 47 | | | | |
| 71-80 | 70 | 21 | 100% | 21 | 10 | | | | |
| 81-90 | 80 | 4 | 100% | 4 | 4 | | | | |
| 91+ | 90 | 10 | 100% | 10 | 8 | | | | |
| Estimate/Year | | | | | | | | | 568 |

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

PCDS Speed categories result in 30% lower tibia injury estimate
Average conversion factor is ~47%

Impact Speed estimate from travel speed



Source: Pedestrian Crash Data Study 1994-1998

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

JASIC study converts the travel speed into impact speed as

“impact Speed= Travel speed – 5KPH”

- Impact speed is an important contributor to injury severity for pedestrians interacting with motor vehicles.
- The PCDS data was used to identify the distribution of impact speeds for pedestrian accidents
 - Figure 2: Only 43% of the crashes show up to a 5KPH difference between impact speed and travel speed
 - Thus using the “Travel speed – 5KPH” to estimate the pedestrian impact speed is not a valid approach to estimating the number of serious tibia injuries

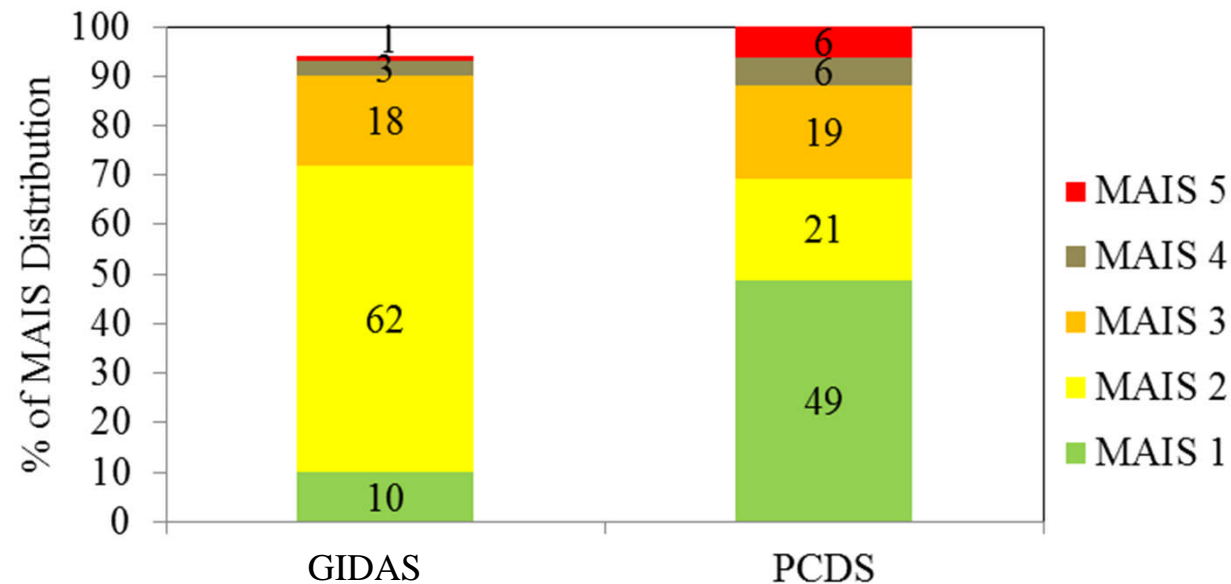
Note: Counts for speeds are up to and including the right end points. E.g. “10 to 20” means speeds greater than 10 and up to and including 20 KPH.

BASt Approach for Estimating Lower Extremity Injury Reduction

BASt tried to estimate the potential pedestrian injury reduction by taking the Pedestrian injury pattern in GIDAS database and shifting the risk curves by one AIS level.

- This would not be valid for the US case because there are significant differences in the distribution of Injuries.
- The study assumes a relationship between the MAIS level in GIDAS and injury classification by police reports, this is not the case in the US.

Figure 3. MAIS Injury Distribution for all Pedestrians



Source: GTR9-5-19, slide 5

Summary

- JASIC's method of converting serious lower limb injuries uniformly across all accident speeds to serious tibia injuries (*"Serious Tibia Injuries = 66% x Serious Lower Extremity Injuries"*) results in a potential 30% over estimate of pedestrian Tibia injury reduction.
- JASIC's assumption of the relationship between travel speed and impact speed (*Impact speed = Travel Speed – 5KPH*) cannot be used in general. As seen in the PCDS data only ~43% of the accident have a 5KPH difference between travel speed and estimated impact speed.
- The injury distributions of pedestrians involved in crashes are markedly different between Germany and US, ex. GIDAS has 62% of the pedestrian injuries as MAIS-2 versus only 21% in the US. Therefore, estimating injury reduction by shifting MAIS-2 to MAIS-1 would result in a significant overestimate of injury reduction in the US.
- The methods used in GTR9-5-14 and GTR9-5-19 for estimating serious fracture injuries would lead to potentially unrealistic national projections in the US.