Difference of TRL legform impactor/injury criteria and Flex pedestrian legform impactor/injury criteria
Difference of Structure

**TRL Legform Impactor**

- **Structure**
  - **Main unit**
  - **Femur**
    - RIGID
  - **Tibia**
    - RIGID
  - **Knee**
    - Steel Plate
  - Knee Ligaments (Steel plate)

**Flexible Pedestrian Legform Impactor**

- **Structure**
  - **Main unit**
  - **Femur**
    - Flexible like human bone
  - **Tibia**
    - Flexible like human bone
  - **Knee**
    - Ligaments like human knee
  - MCL: Medial Collateral Ligament
  - ACL: Anterior Cruciate Ligament
  - PCL: Posterior Cruciate Ligament
  - LCL: Lateral Collateral Ligament

MCL, ACL, PCL, LCL are the names of the ligaments in the knee.
Difference of Instrumentation/Injury Criteria

**TRL Legform Impactor**

- **Instrumentation**
  - Injury Criteria

- **Real-world Accident Analysis**
  - Otte et al, 2007

- **Knee Shearing Displacement**
- **Knee Bending Angle**
- **Upper Tibia Acceleration**

- **No instrumentation**

**Flexible Pedestrian Legform Impactor**

- **Instrumentation**
  - Injury Criteria

- **Knee-ACL Elongation**
- **Knee-PCL Elongation**
- **Knee-MCL Elongation**

- **BM: Bending Moment**

- **Femur-1 BM**
- **Femur-2 BM**
- **Femur-3 BM**
- **Femur-4 BM**

- **Tibia-1 BM**
- **Tibia-2 BM**
- **Tibia-3 BM**
- **Tibia-4 BM**

- **Upper end of tibia**

- **64 mm**

- **297 mm**

- **217 mm**

- **137 mm**

- **134 mm**

- **214 mm**

- **294 mm**

- **374 mm**
Difference of Tibia Injury Assessment

Instrumentation

- Knee Shearing Displacement
- Knee Bending Angle
- Upper Tibia Acceleration
- No instrumentation

- Basically, TRL acceleration and Flex bending moment has low relationship.
- TRL acceleration tends to show higher value especially when bumper bottoming out happened, however it is because of lack of biofidelity of long bone and using acceleration as for injury criterion.
- Beside, Flex has bending stopper cable especially to avoid high bending, so its influence also shall be considered.

Injury Assessment Items

- Instrumentation

(1) Tibia fracture risk assessment
Difference of Tibia Injury Assessment

- TRL tends to show higher value when bottoming out happened.
- However, except those cases, not always either impactor is higher than other.

Instrumentation

- Knee Shearing Displacement
- Knee Bending Angle
- Upper Tibia Acceleration

No instrumentation

BM: Bending Moment
In this research, Flex MCL elongation is slightly higher values than TRL bending angle. However, it has a chance that the relationship can be changed by car stiffness and/or geometry.
Difference of Knee MCL Injury Assessment

Instrumentation

- Injury Assessment Items
- Knee Shearing Displacement
- Knee Bending Angle
- Upper Tibia Acceleration
- No instrumentation

- Not always either impactor is higher than other.

Instrumentation

- Injury Assessment Items
- Femur-3 BM
- Femur-2 BM
- Femur-3 BM
- Knee-ACL Elongation
- Knee-PCL Elongation
- Knee-MCL Elongation
- Tibia-1 BM
- Tibia-2 BM
- Tibia-3 BM
- Tibia-4 BM

BM: Bending Moment
Difference of Knee ACL Injury Assessment

- Basically, Flex ACL elongation and TRL shearing displacement has not clear relationship.
- It has a chance that the relationship can be changed by car stiffness and/or geometry.

Injury Assessment Items
- Knee Shearing Displacement
- Knee Bending Angle
- Upper Tibia Acceleration

No instrumentation

Instrumentation Items
- Knee-PCL Elongation
- Knee-MCL Elongation
- Femur-2 BM
- Femur-3 BM
- Tibia-1 BM
- Tibia-2 BM
- Tibia-3 BM
- Tibia-4 BM

BM: Bending Moment
Difference of Knee ACL Injury Assessment

- Not always either impactor is higher than other.
Comments from Japan

- Basically, **TRL legform impactor** and **Flex pedestrian legform impactor** have **totally different structure and injury criteria**.
- Therefore, **direct comparison tends to lead not clear relationship**.
- Basically, to make a regulation using impactor, following items are needed.
  - **Impactor shall have high biofidelity**.
  - **Injury criteria shall have good relationship with human one**.
- Otherwise, some **misunderstandings and/or misleading results will be obtained**.