Injury Threshold for the Flex-PLI Medial Collateral Ligament (MCL) (JAMA proposal)

The Japan Automobile Manufacturers Association Inc. Vehicle Safety subcommittee and Pedestrian Safety WG
Current Proposal

Review of Injury Criteria and Injury Thresholds for Flex-PLI
Based on the paper by Iversson et al. (2004) employed by IHRA, and the ESV paper by Konosu et al. (2001), the threshold values for MCL failure were set at 18 and 20 mm.
Injury risk curves for MCL failure from the IRCOBI paper by Iversson et al. (2004) employed by IHRA
Injury risk curves for MCL failure from the ESV paper by Konosu et al. (2001)
Parameter study was carried out using simplified car models.
Estimation of MCL Failure Threshold

Flex vs. Human model (not including high-bumper vehicles)

Flex-GT MCL elongation thresholds (18-20 mm) were deduced from the correlation obtained using the FE simulation results with simplified vehicle models not including those representing high-bumper vehicles.
Issues with Current MCL Threshold

1. Flex-GT MCL elongation thresholds (18-20 mm) were deduced from the correlation obtained using the FE simulation results with simplified vehicle models not including those representing high-bumper vehicles.

2. The effect of muscle tone on the knee joint tolerance taken into account in the current gtr has not been reflected in determining the MCL elongation thresholds.
Estimation of MCL Failure Threshold

Flex vs. Human model (INCLUDING high-bumper vehicles)

Flex-GT MCL elongation thresholds will be 19-22 mm when the correlation obtained using the FE simulation results with simplified vehicle models INCLUDING those representing high-bumper vehicles is used.
Effect of Muscle Tone

Lloyd and Buchanan (1996) – Muscles are activated to support about 15% of static varus-valgus loads. Muscular contribution increased with increasing magnitude of VV moments.

Lloyd and Buchanan (2001) – For volunteers, average contribution to varus is 17 ± 9.7% and to valgus is 10 ± 6.3% of externally applied moment.

The effect of muscle tone has been addressed in Lloyd and Buchanan (1996, 2001) from the Journal of Biomechanics.
Effect of Muscle Tone

- Flex-GT MCL elongation thresholds: 19.3-21.9 mm based on the correlation obtained using the FE simulation results with simplified vehicle models INCLUDING those representing high-bumper vehicles
- Effect of muscle tone: 10% in valgus bending
- Flex-GT MCL elongation thresholds taking into account the effect of muscle tone: 21.2-24.1 mm (average: 22.7 mm)

Proposed Flex-PLI MCL elongation threshold: 23 mm