CIREN Public Meeting May 2000
"Lower Extremities Injuries"

Seattle/Harborview CIREN Team
"Knee bolster contacts and leg fractures"

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Abstract for Presentation

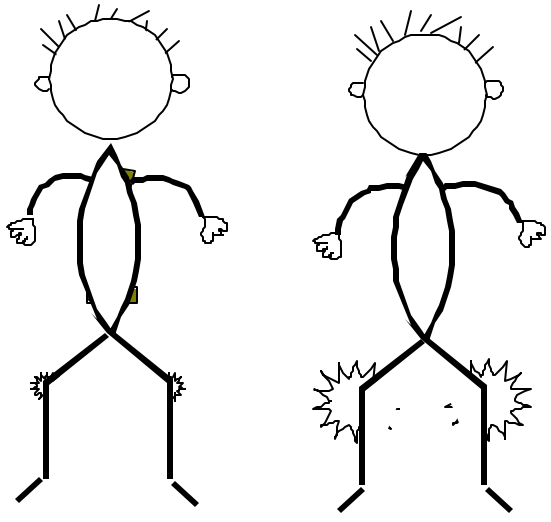
The forces that cause lower extremity fractures frequently are the result of intrusion. Also, in a recent research paper, our center estimated that the muscle forces acting on the upper legs can also increase the risk of femur fracture. Some lower extremity fractures may also be the result of the lower extremity striking very stiff areas around the bolster systems. There are various types of bolster systems and many allow only a narrow area for the right leg. Hence, during a braking moment the right knee may tend to strike the stiff area of the steering column and miss the provided bolster. An examination of knee impacts to the various types of knee bolster systems found some did cushion the knee without fracture. However, some knees completely missed the system. The resultant force of impact was thus transferred elsewhere to the body, with associated severe injuries. Some knee bolster systems might tend to be too stiff, and may increase the risk of lower extremity fracture on impact. Three cases will be conducted examining lower extremity fractures that were associated with impact to stiff knee bolster areas.

Presentation Outline

Title: Knee bolster contacts and leg fractures

Occupant energy distribution discussion

-An unrestrained occupant will take more impact loads to the lower extremities than a restrained occupant. Lower leg impacts are needed to distribute the energy in both cases, and also allow the passenger to remain upright for impacts with the air bag.



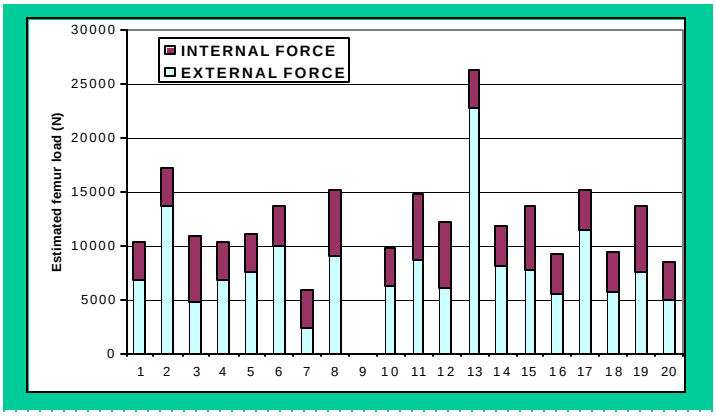
What Forces contribute to Lower Extremity Injuries?

- Muscles forces and direct contact forces, or intrusions

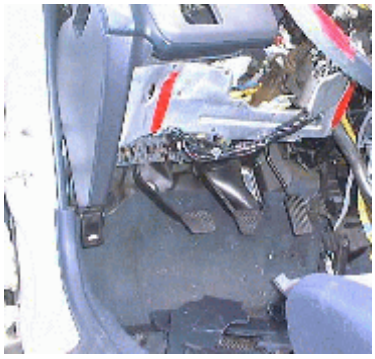
Recent Research done by the Harborview CIREN team:

"Estimating the loads in femurs of occupants in motor vehicle crashes", Tencer, Kaufman - CIREN Annual Conference, San Diego, 10/99"

- Examined 20 crashes
- Only injury - isolated mid-shaft femur fracture
- Calculated the distribution of the energy for each occupant based on belt use systems and crash test data from the same vehicle.
- Determine the force acting on the lower legs
- Simple, clean calculation of force
- No other forces or intrusions were acting on body besides the restraint use
- 15 of the 18 drivers fractured the right leg and most were braking
- About 30% more force is added to the femur bone by the muscles in the leg



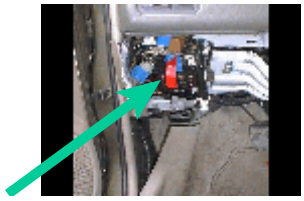
Deformed bolster areas from direct impact by the knee, did not cause any fractures in moderate crashes.



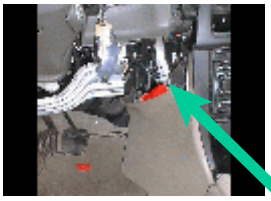
Intrusion is an acceleration or force, and generally is the result of most leg fractures

Some knee contacts struck very rigid areas around the steering column, and caused the leg to fracture.

Some systems were completely missed by the legs, thus the resultant force was distributed elsewhere resulting in serious injuries to an unrestrained driver.



Left Knee



Right knee

NASS coding for Knee Bolsters

- Current coding options are limited to the following:
  - Types
    - Padded
    - Rigid plastic
    - other specify,
  - Deformation, yes or no.

Possible new variables for coding knee bolster systems may be needed

1. Full or split systems
2. Width of both left and right bolster areas
3. Actual deformation measurements
4. Direct contact or partial contact
5. Include sketches of area or the actual shapes of the metal hidden behind panels

Case Reviews (presented at the public meeting only)