Understanding injury biomechanics

High-resolution pressure imaging measures high-impact interfaces – providing new insight in injury biomechanics

It's surprising, but even in 2019 many car makers still design with data based on crash test dummies the size of the average male. That's why, based on real-world crash data collected since the 1970s, Volvo recently discovered that women are at higher risk of whiplash in an accident, due to their obviously different anatomy from the 'average male'. And as they are generally shorter than men, women tend to sit closer to the wheel and lower in the seat, meaning they are also more likely to suffer chest injuries and require different head protection.

A University of Virginia study set to be published in an upcoming issue of the journal *Traffic Injury Prevention* looked at 22,854 frontal crashes between 1998 and 2015 involving 31,254 occupants, ranging in age from 13 to 97, with a near equal proportion of males (49.4%) and females (50.6%). All were restrained by a three-point safety belt. Pregnant occupants past their first trimester were excluded. Researchers found the odds of a female sustaining a serious to fatal injury in a collision are 73% higher than they are for a male.

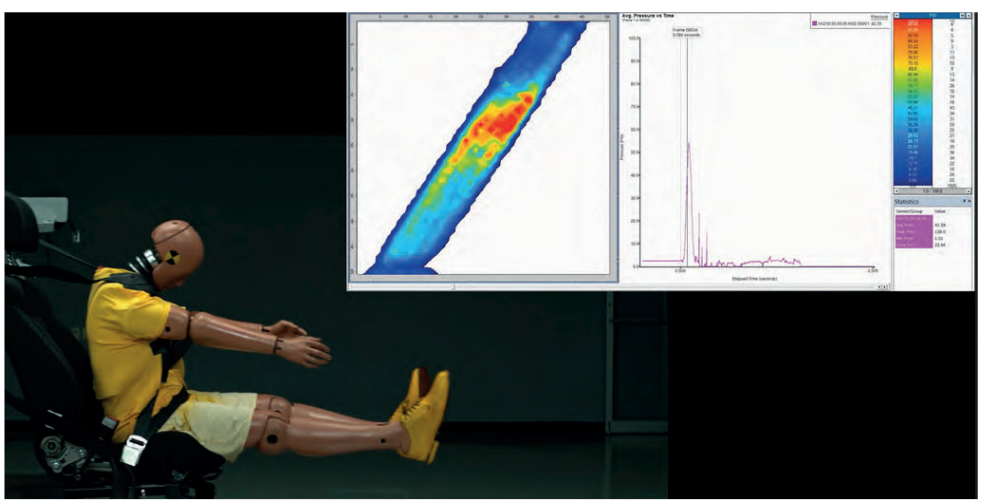
Regardless of occupants' gender, height, shape or weight, it seems obvious that cars must be designed to protect all people beyond the 'average man' represented by crash test dummies. Differences in fat distribution, muscle strength, bone alignment and the fact that the pelvis is different, for example, clearly suggest that females are not simply 'smaller males'. Those differences, along with many others, may contribute to why women are more vulnerable than men in car crashes.

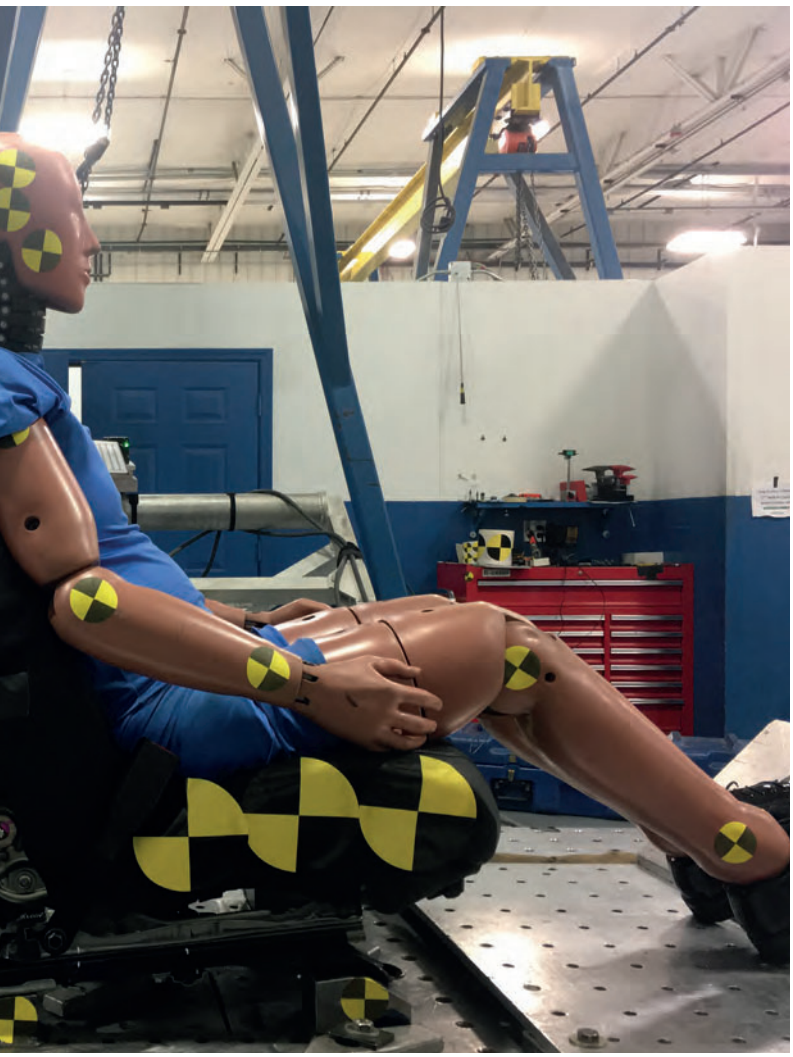
In response to demand from safety engineers for superior tools to solve precisely this problem, XSensor has developed state-of-the-art pressure imaging sensors that provide a level of high-speed impact data that has never been available before.

High-resolution measurement of loads on crash test dummies during impact tests provides valuable information in understanding injury biomechanics.

XSensor's high-speed pressure tools enable engineers to visualize the complete and precise interaction between passenger, seat, airbags and restraints in consistent and repeatable ways. These new insights will mean improved passenger safety for everyone.

XSensor's new platform for high-speed pressure imaging can be used in automotive impact testing for seats, airbags, seatbelts and child seats, as well as dynamic tire testing for speeds in excess of 120km/h (75mph). With respect to seating, for instance, the impact system enables designers and safety evaluators to understand





ABOVE: An ATD ready for a high-speed impact test

LEFT: High-speed seatbelt test showing interface pressure at impact

where the body makes contact with the seat in a crash situation, the effect of the pressures applied, and what the consequences are for seat design. XSensor's ability to measure comfort, ingress and egress, vibration and transmissibility, and the effect of both rear impact (whiplash) and front impact (seatbelts and airbags) in multiple accurate and repeatable ways is unparalleled.

It used to be that engineers relied on dummy sensors and data from high-speed cameras to determine what happened to the dummies during a crash. With XSensor's technology, engineers can see what's happening to the subject on the seat surface in unprecedented detail.

As XSensor COO Bruce Malkinson says, "For the first time, data shows how the subject compresses onto the surface and how the safety designs in the seat respond to the impact. The combination of the sensor properties, the data transmission rates and the software functionality means that safety engineers can now see pressure images from the entire impact scenario at speeds that are similar to other measurement tools. Pressure imaging now provides data that's fast enough to visualize the effect of car seats, airbags and seatbelts."

XSensor's technology offers a new approach to the challenges of acquiring sufficient and qualified occupant safety data in impact testing. For example, when testing for whiplash using various sized dummies, engineers get detailed maps of impact distribution on the surface for each dummy's size. With XSensor's product, that is more than 3,000 sensing points on the back of the seat alone. A superior ability to evaluate what parts of each dummy make contact with the seat, and when it makes contact, means vehicle seat design that takes the safety of all bodies into account. ❮

ABOVE LEFT: Custom vest equipped with XSensor technology

ABOVE: A crash dummy wearing a vest ready for a seatbelt test

ABOVE: XSensor pressure mapping technology used for headrest impact tests