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# AUTO

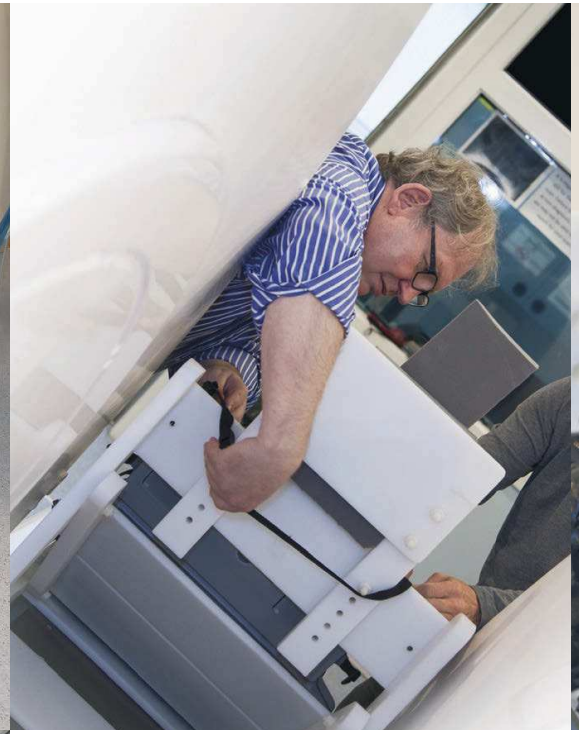



P43

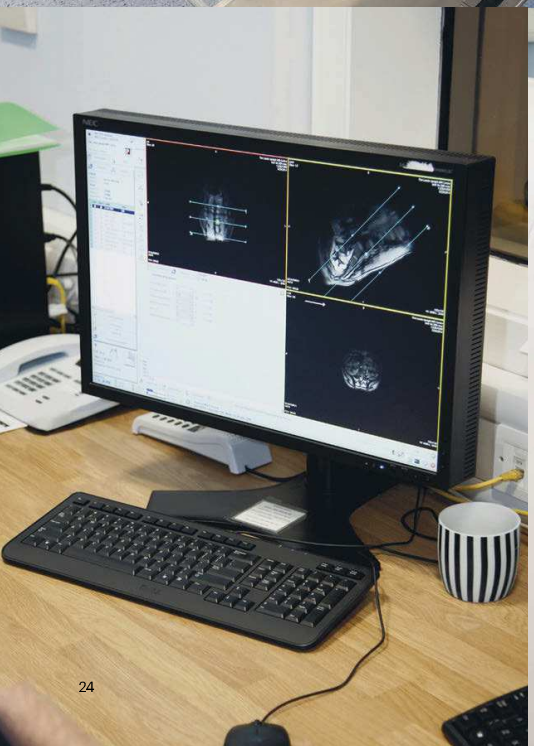
## RACING'S ELECTRIC DAWN

BEHIND THE SCENES AT FORMULA E AS IT PREPARES TO LIGHT UP MOTOR SPORT

The scanner at the Upright MRI Centre in Leeds in the UK is big enough to take Formula Ford driver Jack Barlow as he would be seated in his race car. The FIA Institute's Dr Paul Trafford (right) can then see how Barlow's seating position affected the back injury he suffered in testing at Thruxton.



Formula Ford driver Jack Barlow is scanned with the same helmet and overalls he was wearing during his accident.



Motor sport safety

# THE BIG PICTURE

*The FIA and Toyota are using Europe's largest MRI scanner and a ground-breaking computer model to determine how drivers' seating positions might affect their chances of sustaining a spinal injury in a race accident*

TEXT: MARC CUTLER PHOTOGRAPHY: WILL THOM

What do you get when you combine Europe's largest Magnetic Resonance Imaging (MRI) scanner with one of the world's most powerful computer simulations of the human body? A major leap forward in motor sport safety.

At least that is the hope of FIA Institute researchers, who have brought these two worlds together to help understand what happens to a driver's body in a crash and how injury can be minimised.

To do this they are using the latest in scanning technology at the Upright MRI Centre in Leeds, England, which boasts a machine that is much wider and more open than the usual cylindrical MRI scanner. This means that, for the first time, a scan can be taken of a driver while he is sitting in a full-size race seat.

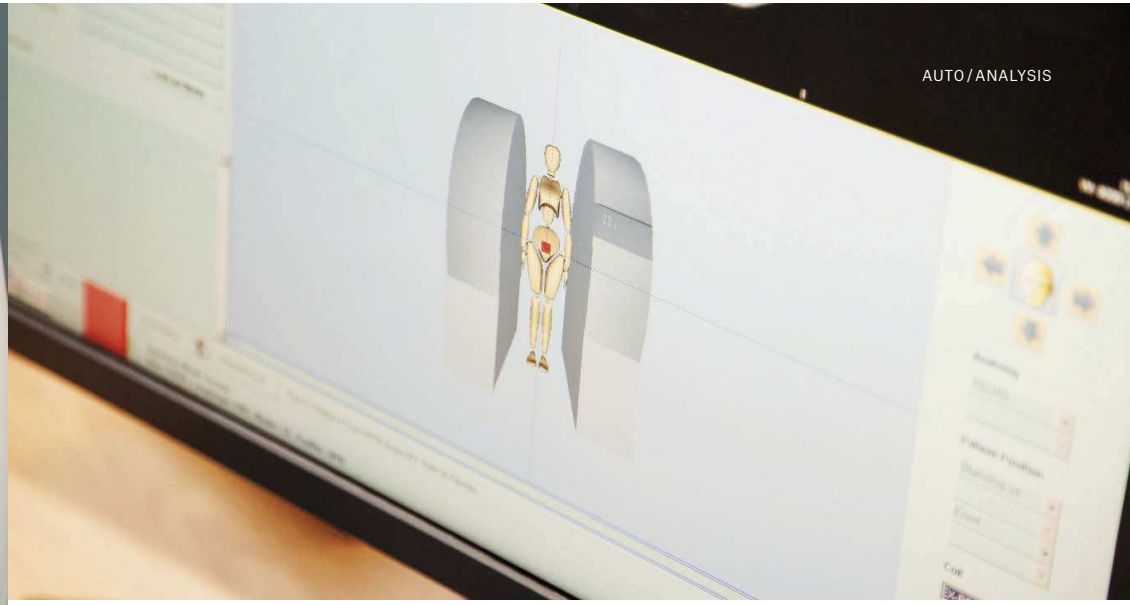
The results of these scans are then sent to Toyota, which has developed a computer model of the human body that it uses for virtual crash testing. Called the Total Human Model for Safety (THUMS), it is made up of almost two million elements that accurately reproduce the human form, from precise bone strength to the structure of organs.

Naturally, this project requires both safety research and medical expertise, which is why FIA Institute medical advisor Dr Paul Trafford and research consultant Andy Mellor have teamed up in Leeds to test the process on the first driver.

That driver is Formula Ford GB racer Jack Barlow, who suffered a high-speed crash while testing at Thruxton. Barlow went off the track at a fast right-hander, rolled his car and came to rest upside down. The 18-year-old was able to climb out once the car had been righted, but was taken to Southampton General Hospital for checks where it was found he'd cracked a vertebra in his back. This scan is aiming to help further diagnose the injury and aid his recovery.

In fact, it will help all drivers in the sport. As Mellor says: "We are seeing a significant number of spinal injuries in motor sport at the moment and they seem to be caused by frontal impacts as ▶



Barlow's time in the MRI scanner – and the results (above) – will be used to help him continue to recover from his back injury.

well as vertical impacts. We've done as much research as we can with crash test dummies, but the dummies don't simulate body architecture very well. So we are working with Toyota to get a much better understanding of the way in which the skeleton behaves in impact conditions."

The MRI scans will especially help researchers to get a better understanding of spinal geometry when drivers are in a race seat. The theory is that injury could be minimised by ensuring that a driver's spine is not loaded in an undesirable way, by enhancing seat design.

The scans will enable Mellor and his team to provide accurate environments and seating positions – including F1, rallying and Le Mans – for Toyota to test in its THUMS programme. That programme can provide detail far beyond normal medical simulations.

"The processing power of THUMS is off the scale compared to anything we use on our desks," says Mellor. "There are almost two million detailed elements and it takes over a full day to do one run. It provides lots of detail."

One of the areas Mellor and Trafford will be focusing on with the MRI study is the pelvic position that drivers naturally adopt. They will then view the response from that position as it is forced into different postures to see if that is more or less painful in a number of outcomes.

"There are two things that we think might be relevant for our studies," says Mellor. "First of all, you have the geometry that the driver is forced to sit in by seat design, but also you have the posture that the driver chooses to adopt when he is seated and we think one interesting element of that is pelvic rotation. Pre-position of the pelvis at the start of an accident or before it has developed might be significant in the injury outcome."

Both Mellor and Trafford agree that the position of the vertebrae directly influences the potential for spinal injury in an accident.

"The THUMS system can simulate the position of every vertebra," adds Trafford. "So if we could measure where the vertebrae are in the first place, where the driver is sitting and where his pelvis is, we can give that information to Toyota to use in the simulation."

For Barlow they already have a lot of information that will help. They have the data from his crashed car, his seat, his HANS device, his helmet and himself. All were put into the scanner along with a model of a steering wheel and pedals so he was in exactly the same position as in the car.

Following the successful scan of Barlow, the next aim in the project is to work with Toyota World Endurance Championship drivers Anthony Davidson and Alex Wurz. During the 2012 Le Mans 24 Hours, Davidson was involved in an accident where his car somersaulted and landed in a crash barrier, injuring his back in the process.

"Toyota can run their simulation to see if the model gets the injury in the same place as Davidson suffered it in real life," says Trafford. "Then we can start moving the seat, altering the foams and changing the geometry to see what happens and whether we can reduce this injury."

Then they will measure Wurz's seating geometry and put that into the programme.

"Wurz is 10 inches taller than Davidson so we should get a much better feel of how different their orientations are when sat in the same car. That is then going to be the key data that will be fed into the THUMS model, so when we are simulating identical accident events for those two drivers we can see whether either one of them is in a better or worse position for the G-loads they sustain."

That is where the programme can really make great strides in improving driver safety.

"It is exciting and interesting work," agrees Trafford. "It's quite complicated getting data to feed into a computer to simulate crashes and predict injuries, but we are trying to build a crash programme on a simulator where we can then change the parameters such as the seating angle to predict and solve problems before they occur."

This is where the potential for safety improvement is huge. "We can then look at whether certain drivers are getting injuries because they are sitting at an angle that puts more pressure on their spines. That is what we are trying to understand." ■