



AUTO+ MEDICAL

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INTRODUCTION/

Much of the work undertaken by the FIA is not always immediately obvious and includes extensive research into safety as well as constantly reviewing and updating regulations and standards.

One example is our cover story and the partnership of the FIA with Holmatro, one of the most respected brands globally in the manufacture of rescue and cutting equipment. Over the last two years we have been working with Holmatro to look at equipment, cutting techniques and training, which will benefit everyone and be of interest to the extrication teams who have to work sometimes in difficult circumstances, while a trapped driver is extricated.

The video of Tommy Foster's unusual accident in F4 involving a pheasant hitting his helmet raises the issue of cockpit protection and highlights the importance of using FIA certified safety equipment.

It is not often we get to recommend a movie, but 'Rapid Response' documents the development of the motor sport medical teams in the USA following a young Steve Olvey who gives his views inside on how things have changed since his involvement as a medical student.

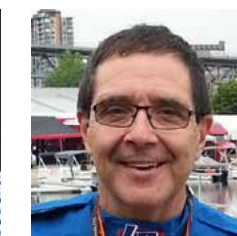
In a departure from our normal scientific feature, we are publishing a case report of an unusual injury. If any of you have case reports or want to share with us any interesting injuries you have seen, we would be delighted to receive them. We hope you enjoy the latest edition and as always let us know if you have any news or want us to include anything.

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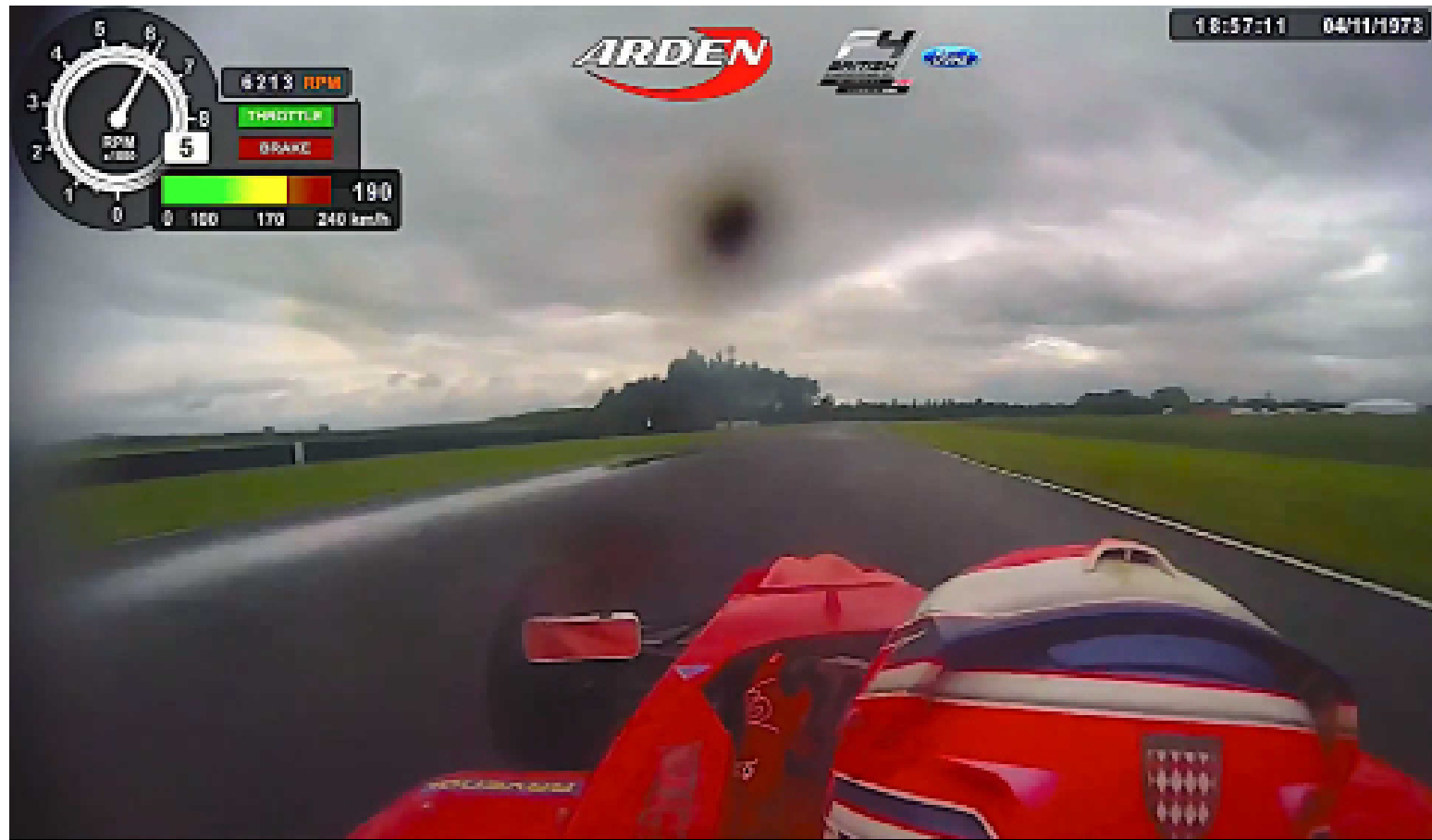


Dr Dino Altmann (Deputy President, FIA Medical Commission)

Editor: Marc Cutler
Deputy Editor: Rory Mitchell
Designer: Cara Mills

We welcome your feedback: automedical@fia.com

GLOBAL NEWS



Credit: YouTube/Tommy Foster Racing

ARAI HELMET PROTECTS F4 DRIVER STRUCK BY BIRD

A British F4 racer was struck by a pheasant at 105mph during a race at Croft in June.

Tommy Foster was struck by the bird when he was coming back to the pits at the end of a practice session, describing it as like being hit by a brick as it flew over him.

"I didn't even see it until it was inches away from my face, I had no time to react or avoid it," said Foster. "It felt like I was hit by a brick in the face. The visor buckled in but didn't fracture."

Foster was given the OK from the medical team before taking part in the race.

"I've seen animals on track before, but with the pheasant I didn't see it until it came over the car," said Foster. "Thanks to Arai Helmets UK for

making such a good quality product."

Foster drives for Arden Motorsport, which is part-owned by Red Bull Racing Formula One team boss Christian Horner. Following the incident, he explained the importance of drivers using helmets that are homologated to FIA standards.

"Lots of drivers and karters wear lesser quality helmets and visors - had I been wearing one then it would have been a very serious accident," explained Foster.

CAMS PARTNERS WITH MOTOR SPORT SAFETY AND RESCUE GROUP

The Confederation of Australian Motor Sport (CAMS) has formed a partnership with the Motorsport Safety and Rescue Group (MSR), to benefit the Ricciardo's Racers karting championship and Formula 4 categories.

Ricciardo's Racers was formed by six-time Formula One Grand Prix winner Daniel Ricciardo, and is a karting initiative aimed at helping kids aged 12-17 on the basics of motor sport before they progress to club level events.

The MSR Group will use its existing experience and resources to run the programme, while CAMS will continue to market and support the programme.

"With Ricciardo's Racers, the program is extremely popular, regularly running at capacity," said CAMS CEO Eugene Arocca. "This partnership will allow MSR to utilise its expertise to run the program more efficiently and effectively, while CAMS continue to own the program, as well as promote events and provide support."

"This will certainly be a cost-saving for CAMS, given MSR already have the right tools in place with their other projects and programs," added Arocca. "This means we don't have to seek out new contractors in every venue the program is run."

In addition, the MSR Group will be responsible for managing Formula 4 events, including the recruitment of teams and drivers in the category.



STUDY SHOWS FEMALE DRIVERS JUST AS FIT AS MALE

Research done by Michigan State University gives definitive proof that women racing drivers react and respond just as well as their male counterparts on a race track.

The study, conducted by David Ferguson, Assistant Professor, Department of Kinesiology, shows that heat stress is not a factor in the performance of female drivers, putting to rest a controversial aspect of the discussion involving the menstrual cycle.

"Heat strain is the primary stressor in racing. Women naturally have an elevated core temperature during a certain phase of their menstrual cycle. The misperception was that they would potentially fatigue faster and become a safety risk to other drivers," said Ferguson. "Based on our results, I'm here to say that's just not true."

Ferguson studied female drivers around two phases of their menstrual cycle; the follicular, which spans the first day of a period to ovulation, and the luteal,



which begins at ovulation.

In three similar races Ferguson tracked six male and six less-experienced female drivers in two classes of racing, closed and open cockpit. From there he looked at their heart and breathing rate, core body and skin temperature as well as heat-induced stress, which can lead to heat exhaustion.

"The luteal phase is when women can have higher heart rates, core body temperature and an increase in other physiological factors that are considered markers for fatigue," said Ferguson. "Yet even during this time, these factors still were no different than what male drivers exhibited."

DR NAOMI DEAKIN PRESENTS STUDIES AT MAJOR US CONCUSSION CONFERENCE

Watkins Scholarship winner Dr Naomi Deakin presented at the American Academy of Neurology Sports Concussion Conference in Indianapolis in July. The conference brings together clinicians and scientists involved in the prevention, diagnosis and management of sports-related concussion worldwide.

Deakin presented two posters at the event, the first entitled 'ImPACT in UK motor sport; is this the right concussion assessment for our drivers?' which focused on the use of ImPACT concussion testing in motor sport and the second which looked at sports-specific assessments in a UK

concussion clinic entitled 'Data from an emerging UK sports concussion clinic; should athlete assessment be sports-specific?'.

"These are the first motor sport medicine submissions to any American Academy of Neurology event, therefore significantly expanding the influence of motor sport concussion research outside of the UK to a major international audience," said Deakin.

The presentations come after the launch of Deakin's motor sport concussion survey RESCUE-RACER.

For more info: <http://rescueracer.org>

VIRGIN RACING FORMULA E TEAM HOSTS 'QUIET RACE' FOR KIDS WITH AUTISM

The Virgin Racing Formula E team created a unique racing experience for kids with autism spectrum disorder at this year's season finale in New York.

Teaming up with sponsor Stanley Black and Decker, the 'Quiet Race' event was held at the Brooklyn Circuit in Red Hook.

The experience was aimed to advance inclusion and support neurodiversity by giving kids and their families a special behind-the-scenes garage tour and race-day experience.

They were also given the opportunity to learn about STEM careers in motor sport, and driver Sam Bird auctioned off his racing suit with all proceeds benefitting Autism Speaks.

"Formula E is a unique form of motor sport and our electric engines showcase the best automotive



technology," said Bird.

Autism affects an estimated one in 59 children in the United States and 70 million people worldwide, and each person with autism has different strengths and challenges. For some people on the spectrum, sensory sensitivities can make motor sport difficult to enjoy. But with Formula E's distinct low-pitch noise compared to

other disciplines, it enables both Virgin and Stanley Black and Decker to create a more inclusive race day.

"I'm proud that this sport allows us to welcome new fans who may not be able to enjoy other types of motor sport," added Bird. "It was exciting to show how our series is unique and hopefully introduce these kids to a world of STEM careers within the sport."

MONTEIRO GETS FIRST WIN SINCE INJURY RETURN

Tiago Monteiro claimed a home victory at the World Touring Car Cup race at Vila Real, his first win since his comeback from serious injury.

Monteiro became the 11th different winner of WTCR in 2019, finishing over two seconds ahead of Yvan Muller after taking the lead in the early stages of the race.

"God knows how much we worked for that," said Monteiro. "We made the comeback after two years, and it was such a tough season so far. Of course, I always dreamt of making a huge comeback here, but to do it [this way] is unbelievable."

It is his first win since his testing crash at Barcelona almost two years ago, when his brakes failed at 160mph and his car was pitched into the barriers.

The impact left the 41-year-old with a series of serious injuries, including two broken vertebrae, blood clots on the brain, a badly twisted knee and a dislocated shoulder.

Monteiro made a full-time comeback with the KCMG squad at the first race in Marrakech earlier this year in April.



FIA BEGINS NEW ALCOHOL TESTING



The FIA began its new alcohol testing for both drivers and officials in Formula One support categories this year, as part of changes to the FIA International Sporting Code.

All FIA championships must now have alcohol testing as the presence of alcohol in a driver's body during an international competition is prohibited.

There will be testing for officials at as many championships as possible, although not all due to logistics. The FIA also encourages ASNs to implement anti-

alcohol regulations at the national level, which is already the case for some of them including the Confederation of Australian Motorsport.

Earlier this year alcohol testing was present in both Formula 2 and Formula 3 at the Circuit de Barcelona and in Austria for the Porsche Supercup round.

FIA Medical Coordinator Prisca Mauriello presented the test in Barcelona to around 40 drivers, which includes one breathalyser for the initial test and another for the confirmation test.

Drivers can be tested three hours before and until 30 minutes after a race, qualification or test session. The sanctions for breaching this rule include immediate disqualification from a race, or a fixed scale of additional sanctions including suspension and fine.

"With the addition of Appendix C to the FIA International Sporting Code, this ensures drivers are safe and competing fairly on track," said Adam Baker, FIA Safety Director. "Following the introduction to F3 and F2 in Barcelona, there will be a progressive introduction of the alcohol testing to other categories."

• More information on Appendix C can be found here: <https://www.fia.com/regulation/category/123>

FIRST AID KITS TO BE MANDATORY FOR ALL CROSS-COUNTRY AND BAJA EVENTS

First aid kits are to be mandatory for all Cross-Country and Baja events, as part of a proposed standard by the FIA.

The type of equipment contained in the first aid kit includes both medical and survival provisions, each of which are listed in Appendix III: Safety Crews of the Cross-Country Rally General Prescriptions.

The proposed standard states medical equipment must be in a fluorescent-coloured bag and should be easy to access. Its location should also be indicated by an orange arrow on the car.

For Cross-Country rallies all cars must carry both the Cross-Country kit and the Baja kit, with the weight of the complete survival kit being included in the minimum weight of the cars.

The idea is to facilitate competitor's preparation of the survival kit, alongside the Medical Training given by Dr Jean Duby. Any team that fails to bring the complete survival kit will be refused to start until it conforms with the regulations.



FIA LAUNCHES WORLD ACCIDENT DATABASE 2.0

The FIA has launched a new version of its World Accident DataBase (WADB), making it easier for National Sporting Authorities (ASNs) to report racing accidents worldwide.

WADB 2.0 features significant improvements to make it more user friendly, easier to access, and enhance data entry by allowing ASNs to upload information from PDFs.

This follows feedback from users of the platform, which has been running for the last five years, collecting accident data from around the world.

During that five-year period, WADB has enabled the FIA to come up with statistics

by discipline and analyse safety issues in motor sport.

One of the key areas it has highlighted is the number of spectator fatalities in rally-related disciplines, something the FIA is keen to decrease with the introduction of Rally Safety Guidelines.

"Considering the last four years, in the rally-related disciplines the number of spectator fatalities was higher than the number of driver fatalities," said FIA Safety Director Adam Baker speaking at the FIA Conference in Sun City, South Africa.

"For these reasons a major focus for us is rally safety, specifically spectator safety. A big part of this is ensuring operational best practice and this is the main motivation behind the publication of the Rally Safety Guidelines," added Baker.



VIEW FROM THE GROUND:

THOMAS HEGGELUND

**CHIEF MEDICAL OFFICER, WORLD RALLYCROSS NORWAY,
NORWEGIAN MOTORSPORTS FEDERATION**

In the latest column from the frontlines of grassroots motor sport, Dr Thomas Heggelund gives his views from the ground in Norway.

“ I got into motor sport in 2006 when Norway was going to host a test year for Rally Norway before they were accepted, because the first Rally Norway wasn't until 2007. At that stage I asked a friend of mine to get some free tickets because they worked at the area where I was working and she's into motor sport, and her father was the president of the Norwegian Motorsport Federation. He turned up and said 'I can get you a job to be the CMO' so instead of getting a free ticket I got a job! Now that Rally Norway has finished, I do the WRX in Hell.

I am the doctor for the Norwegian Motorsport Federation as well, so for the last 10 years I've tried to increase the safety awareness and set standards for the CMOs of each of the different types of races in Norway. What I've done for the last eight years is try to get it to be obligatory for rally drivers to have a first aid course, specific to rally. At national level there is always an ambulance, but it can take 20-30 minutes before it comes at some stages, so the first responders are

always going to be the race drivers and the co-drivers. We are also teaching them extrication and we teach them about the kinetics of a crash and what to do if they have signs of an injury for spinal damage or those types of things.

To be able to be the CMO at a national level you can be a specialised nurse or a certified ambulance driver. For most of the races at national or at grassroots levels it is nurses or paramedics who supply the first aid. For a higher standard of race, say for example a world championship, they have their own doctor.

One of the things I would like to change at national level motor sport is to get everyone to use the HANS system. Currently it's not mandatory in all the different classes, so at lower levels they don't particularly use the HANS system. I also hope to get it in that more people, once they get their racing

licence, have to do a first aid course – so they're aware of the dangers specific to the race type they're doing. People who race take it really seriously, and they put a lot of money and effort into it and safety is always a part of what the finances go into, so part of that is trying to get them to invest in more safety equipment like the HANS system.

It's a challenge to serve the medical system that works for all levels and to set the level that drivers know of the risks of sports and high-speed accidents and all that. So it's a challenge to keep the sport going at a national level versus what qualification you need for medical personnel. It's different from what you do on a normal day of work so that makes it more interesting.”



FEATURES

POWER CUTS

A new partnership with the FIA is aiming to put the most powerful tools into the hands of safety teams across the world

Holmatro produces the most powerful hydraulic equipment for road rescue services worldwide. So it makes sense to put those into the hands of safety teams for the world's fastest championships.

This is at the crux of a new partnership agreement between the FIA and Holmatro. As an FIA Official Supplier, Holmatro is now working closely with the Safety and Medical departments on ambitious plans to bring its rescue equipment to circuits worldwide.

Harm Hermans, CEO of Holmatro, says the partnership fits perfectly with the FIA's ongoing work in race track safety and will help his company to further develop cutting-edge rescue tools based on the newest racing technologies.

"The FIA is an important partner for us," says Hermans. "We want to bring our expertise to all race series in the world and help to achieve the highest standard of care for drivers at all events."

Holmatro is the number one supplier of rescue equipment for the road but it also has a long history in motor sport. For over 25 years it has been the official rescue tool supplier for the IndyCar Series, and it also



Harm Hermans, CEO of Holmatro

supplies tools to the TOCA safety team for the British Touring Car Championship. But its partnership with the FIA takes its commitment to motor sport to a new global level.

QUICK RELEASE

Holmatro's cordless and powerful tools are ideal for the motor sport environment, where drivers need to be extricated from carbon fibre monocoques and high-strength roll-cage structures.

The company's tools were perhaps best exhibited in the aftermath of James Hinchcliffe's accident during practice for the 2015 Indy 500. When the Canadian driver crashed heavily at over 200mph, it caused a suspension component to penetrate the cockpit and sever an artery in his leg. Arriving at the scene the IndyCar safety team was able to use Holmatro's tools to quickly extricate him from the car, which ended up being a key factor in his survival.

But rather than sit back and revere in the work that its tools helped accomplish, Holmatro joined the IndyCar Safety Team for a post-incident evaluation of the response. This was followed by the joint development of new procedures to extricate the driver from the cockpit even faster in similar situations. Holmatro translated the learnings from these sessions into a new hydraulic tool that can cut out a section of a car's carbon fibre tub much quicker, enabling easier access to the driver.

It is this research culture that caught the eye of the FIA. After inviting Holmatro to help with methods of cutting through the strong titanium Halo in preparation for its introduction into Formula One, the FIA



Holmatro's tools can be used by one person rather than two



Holmatro has been involved in Indy-Car since 1991

started to talk about a more concrete partnership in safety research.

“The moment the FIA reached out to us I think we felt that we could be a strong partner in helping bring the safety of race tracks to a higher level,” says Hermans. “We started our relationship with the research department of the FIA by doing tests on monocoque cockpits. We did a lot of testing on desincarceration at the end of 2017 and beginning of 2018, and now here we are. After that we felt that if we work together we can bring it to a new level.”

STANDARD BEARER

Bringing that standard to a higher level is something that Holmatro is keen to do. It will build on the FIA’s existing safety training programme with rescue workshops where teams will be trained to the top standard.

“THE PLAN, DEVELOPED TOGETHER WITH THE FIA, IS TO BRING MORE INNOVATION TO THE EXTRICATION PROCESS”

“There are still examples all around the world where rescue goes wrong because people are not trained or not ready, so you have to be prepared and in race mode as a trackside safety team,” explains Hermans. “The only way to do that is through the highest standards of training and the willingness to improve in safety and equipment services.”

Holmatro also plans to get involved with some of the FIA’s research projects, the latest of which involves further improving the time it takes to cut through a carbon fibre monocoque. The company is currently



Holmatro plans to get involved with the FIA’s research

developing specific sets of tools to help with different racing scenarios.

“The plan, which was developed together with the FIA, is to get more innovation into the extrication process, and so we have defined a specific set of tools for open and closed cockpit racing, rally racing, and a set of tools for cars with the titanium Halo safety device,” says Hermans.

These pre-defined sets will be made available for purchase by National Sporting Authorities through the FIA website, at a special price.

Buyers can also be assured that they will get the right service and support during every race from Holmatro’s local resellers,

who can take care of the necessary service and maintenance of the tools.

“This is where we can bring real value to the racing world,” adds Hermans. “Holmatro’s authorized distributor network includes sales and service points in more than 160 countries in the world, so we can provide direct service to all local track safety teams who are responsible for the biggest races in the world.”

KNOWLEDGE TRANSFER

The bigger picture for Holmatro, and the FIA, is transferring what they learn from the racing environment to first responders such as firefighters and medical professionals on public roads. The preparation that safety teams have when immediately confronted with an incident on track and knowing how to use the tools from training is something Holmatro believes it can benefit from in the longer term.

Using its knowledge from IndyCar the company was able to come up with solutions for its blade design, as well as easy access for crews to get inside of a car that has sustained a heavy side impact where the driver is trapped.

“If someone has an accident with a heavy side impact and the driver is locked in his seat in the monocoque, then you need to



Holmatro’s hydraulic tool can be used to tackle complex extrication calls

have the particular tools that can remove him safely," says Hermans. "We learned in IndyCar how to design our arms for spreading tools and we also have spreader arms which are really, really small to make them fit between the inside of the monocoque and the spot above the capacitor. We bring that kind of knowledge back to the road safety environment, where we apply these learnings."

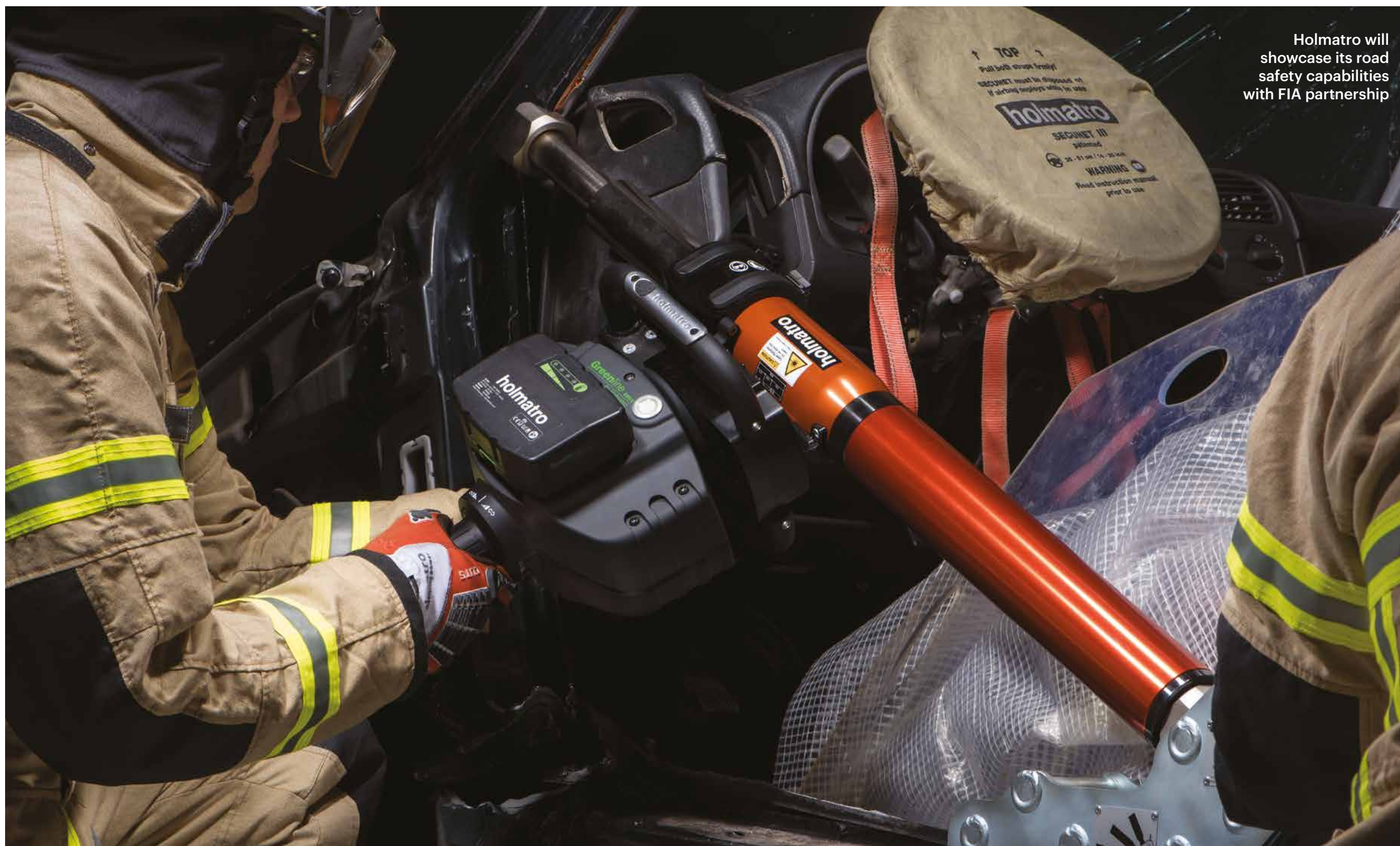
With the changing landscape of the automotive industry heading towards electric-powered cars, that also poses challenges that Holmatro will have to face when cutting into a car in the future.

"There are a lot of things to take into account but we learn how to deal with them; how do you cut through an electric car safely? Is there any danger for the first responder or the victim? Is there still electrical current in the car? This is all related to our research and development," explains Hermans.

Holmatro's growth as a company gives it a prime position to be at the forefront of accident rescue worldwide, with it dealing in more than 160 countries and having three separate divisions in the Netherlands, USA and China.

Bringing the message alive into the road safety environment from the high-octane world of motor sport is perhaps where it becomes more than just a marketing exercise for Holmatro. This is why the company is organising events and taking part in exhibitions all around the world; to not only show its partnership with the FIA, but also its capabilities as a rescue tool supplier on public roads.

"I think what you really notice in a race



Holmatro will showcase its road safety capabilities with FIA partnership

environment is the operational readiness of race track safety teams, they are extremely prepared," says Hermans. "That's why we use the slogan 'When the Race is for Life'. As a firefighter you are also involved in a race when you need to save a person's life by

“WHAT YOU REALLY NOTICE IN A RACE ENVIRONMENT IS THE OPERATIONAL READINESS OF SAFETY TEAMS”

extricating them from a crashed car; a race against the clock. If you want to win the race – that's how we translate the message to our customers in the world – you have to be prepared; you have to know how to use the tools and how the team is organised.”

DR STEPHEN E. OLVEY, M.D.

**Medical Consultant, IndyCar Series
Motor Sports Director, University of Miami Concussion Program**

Dr Steve Olvey has been involved in motor sport for more than 50 years, primarily in his role as Medical Director for CART (now IndyCar) in the US between 1979 and 2003. During that period he was responsible for a number of safety advances in motor sport, including improvements to trackside rescue equipment which helped saved the lives of countless drivers thereafter. His extensive experience as a motor sport doctor is documented in an upcoming film based on his best-seller book 'Rapid Response'.

AUTO+ Medical: The film 'Rapid Response' based on your best-selling book will be released this year, can you tell us a bit about it?

Steve Olvey: The movie 'Rapid Response' is a documentary produced by two gentlemen with connections to the film business in California, Mike Miles and Roger Hinze. Miles had bought my book, liked it, talked to some people in the movie business, and decided to take on the task of producing a movie.

The film follows my career in motor sport medicine that started in 1966 when I volunteered to work at the Indianapolis Motor Speedway after graduating from

Indiana University Medical School. It was the month of May in Indianapolis and the track was open for practice. At first, I was relegated to the infield taking care of spectators. Soon I was stationed on the race track itself. In those days there were no emergency physicians, no paramedics, and the only ambulance was a disguised hearse from the local funeral home. I actually was the first physician to be placed in this situation, I had to learn fast. At that time, one in seven drivers were killed every year in the major forms of motor sport. The sport was on thin ice as politicians around the world introduced legislation to ban it.

By the mid-seventies, the drivers themselves began to question risking their lives when the odds of survival were so poor. In 1975, I was approached by the head of the United States Auto Club and asked if I would be interested in traveling the entire circuit and attempt to improve the medical care that drivers were given. The idea had originated from the drivers themselves and was presented to the sanctioning body by Wally Dallenbach. Ironically, during that same time period, Professor Sid Watkins was approached by Bernie Ecclestone to do the same thing in Formula 1.

The movie goes into vivid detail showing what we; physicians, medics, scientists, engineers, nurses, organizers, and drivers

Dr Steve Olvey was Medical Director for CART (now IndyCar) between 1979 and 2003



went through to make motor sport as safe as it is today. My good friend and esteemed colleague Dr Terry Trammell, a superb spine surgeon, had joined forces. No punches were pulled in documenting this history, actual footage is used throughout the movie and shows the carnage that occurred. In CART, with the help of many others, I was able to assemble a team of dedicated and talented individuals. We studied each crash in detail, dissecting each injury-producing crash, and enlisting companies and individuals as necessary. The ending of the film shows in detail the horrific crash and the subsequent phenomenal survival of Alex Zanardi, which signified the progress we had made. The film is due in theatres September this year.

A+M: During the early years of your career in CART (now IndyCar), what were the biggest challenges you faced while trying to make motor sport safe?

SO: When I was Director of Medical Affairs for CART I faced many obstacles trying to make the sport safer. The promoters themselves were the biggest detriment to adequate care, as they did not want to spend money on safety. Rescue helicopters were non-existent, or poor substitutes like news or corporate helicopters might be available at times. I remember trying to shove A.J. Foyt into a corporate helicopter without being allowed to take the executive seats out of the craft to make adequate room.

Infield care centers were often inadequately equipped and supplied; the prevailing idea was to get the driver off the grounds as soon as possible. Ambulances were ill equipped, the personnel inept, and fire equipment was



Olvey is a world expert in trauma and rescue in motor sport

often lacking. The only answer was to bring our own vehicles, personnel, and equipment. We started with our own super-equipped ambulance. This vehicle gradually evolved into an 850 square foot expandable semi-trailer that could adequately take care of two critically injured patients simultaneously. We had the ability to do minor surgery and every immediate life-saving procedure. We even had a section for the physios to do their thing. Our rescue vehicles included fire control equipment, extrication tools and supportive items, and we had the initial clean-

up materials on board. We could reach any part of the circuit within 60 seconds, usually less. I also made hospital arrangements prior to an event, securing the routes to the trauma center and assuring the availability of adequate air and ground transport teams.

A+M: What do you think has been the most significant safety innovation that has been introduced into motor sport?

SO: I think the most significant safety innovation in recent years has been the HANS device. It has virtually eliminated

“THE MOST SIGNIFICANT SAFETY INNOVATION IN MOTOR SPORT IN RECENT YEARS HAS BEEN THE HANS DEVICE”

basilar skull fracture as an injury. A close second is the Safer Wall, a joint effort by the Indianapolis Motor Speedway and NASCAR. The wall has decreased the forces involved on impact by 40% to 60%. Other innovations include making the cockpit a total system rather than a container full of individual components. The seat, the restraint system, the head surround, well placed protective padding, and the HANS all have to work in concert to adequately protect a driver. The Halo will likely turn out to be a life-saving addition as will the space-age shield device being developed by IndyCar.

A+M: You were involved with the first response to Alex Zanardi’s crash in 2001, how did that incident influence the response times of medical teams in motor sport?

SO: Alex Zanardi’s crash in Germany involved an injury that before was considered to be 100% fatal. No one had ever survived a traumatic, bilateral, above the knee amputation. Alex survived because the Safety Team arrived in 19 seconds and these men were trained to improvise and react. The team fashioned tourniquets to quell the massive hemorrhage, maintained his airway, and

they got him out of the car quickly. At the heliport, we started multiple IV's to replace lost blood, he was so depleted he suffered a full-blown cardiac arrest and had to be resuscitated. Once his volume reached an acceptable level, he stabilized. Before the race even happened, I had made the decision to send anyone critically injured to Berlin rather than the closer hospital in Dresden. Dresden was only 10 minutes away, Berlin was 35. But Dresden did not have a massive blood bank or the same imaging capabilities, and they did not have a full battery of specialty surgeons in house. Alex was in the operating suite in Berlin 59 minutes after the crash, barely within the famous "Golden Hour". These are the requirements necessary for survival in such a horrific crash. This is what I tried to make available everywhere we raced.

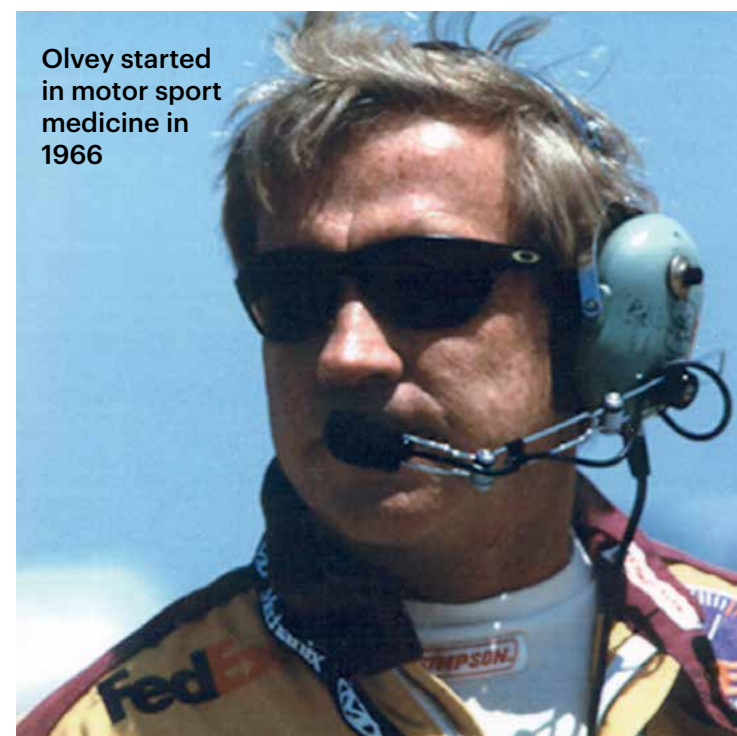
A+M: Do you think there is a correlation between response times from medical teams at race tracks and first responders on public roads? If so, what can they learn from motor sport?

SO: Motor sport provides a template for adequate highway safety. To achieve on the highway what we have at our circuit races would take a massive overhaul in most parts of the world and would not be possible at this time. It would require an elaborate system of coverage with the properly trained individuals, vehicles, and equipment. Some Scandinavian countries almost have this type of system in place. Many of the world's larger and wealthier cities have accomplished much in the way of trauma treatment. To truly stem the tide of highway fatalities is going to take much, much more. The FIA is a real leader in this effort.

“ WITHOUT THE FIA MEDICAL COMMISSION, THE WHOLE STATE OF MOTOR SPORT MEDICINE WOULD LAG PRECARIOUSLY ”

A+M: Alongside your work in IndyCar you are also Motor Sports Director for the University of Miami Concussion Programme. How important is continued research into concussion in motor sport?

SO: One of the largest feathers in the cap of motor sport has been the management and prevention of concussion. In both Formula 1 and IndyCar we have had concussion protocols for a long time. Since the mid 90s, any driver in IndyCar and F1, who was thought to have had a concussion, was taken out of the event for the weekend. He or she was then watched closely and only allowed to return to competition when asymptomatic. Many popular traditional sports still wrestle with establishing a true concussion protocol. We were the first sports organization to use ImPACT with annual baseline testing and follow up testing until stable, then in 2002 I made the test mandatory. In IndyCar, there have been no concussions in three and a half years. Many athletes in traditional sports are unfortunately suffering from the long-term effects of too many concussions throughout their careers. Worldwide there is still a paucity of good concussion clinics or centers, research is still ongoing and soon concussion will hopefully be recognized and universally dealt with by accomplished medical personnel. Centers like Cambridge,



with Professor Hutchinson and Naomi Deakin and the University of Miami in the US are continuing to find all the answers.

A+M: What do you think is the key issue in motor sport medicine at the moment?

SO: I think the key issue in motor sport medicine currently is how to get the word down to all the small, poorly equipped, and inadequately staffed events to shape up their operations. We have wrestled with this problem in the ICMS (International Council of Motorsport Sciences) for years. The top series have all attempted to make racing safer using modern techniques and facilities. There are still many small tracks whose drivers don't have a fighting chance. Also, even though great strides have been made, it is still very difficult to cover events that cover vast amounts of land. The efforts made in the FIA to surmount this issue are phenomenal and much has been accomplished although much still needs to be done in order to reach the success that circuit racing enjoys.

A+M: Can you tell us a bit about your role in the FIA Medical Commission and what you get involved in?

SO: I have been very fortunate to be involved in the FIA Medical Commission. The membership of the committee constitutes some of the most accomplished individuals, not only in motor sport's medicine, but in the provision of state-of-the art medicine all over the world. Information is often presented by one member who has recognized a specific problem and then the entire committee gets involved to achieve a solution. Examples abound, but drivers racing competitively with disabling injuries, and women being equally accepted in all forms of motor sport are just a couple. Rather than working on issues in isolation, we are able to join forces to obtain the best-case scenarios. Professor Gérard Saillant's leadership encourages this and the addition of Pau Mota, FIA Head of Medical and Rescue makes all the above more cohesive and proactive. Without the Commission, the whole state of motor sport medicine would lag precariously. My interest is to make trauma rescue the most efficient and effective it can be all over the world and to continue to study concussion, and do what is necessary to minimize the effects of having one.

A+M: What has been the most rewarding part of your job working in motor sport medicine?

SO: The most rewarding part of my job has been to see the sport that I grew up loving continue to thrive, to see drivers, many of who have become friends, survive what not too long ago were fatal injuries, and to share the exploration of trauma management with so many other experts of similar heritage.

MIND CONTROL

How a tech start-up is improving race driver safety and performance through a unique partnership with McLaren.

It's May at Indianapolis Motor Speedway and the familiar sound of cars racing around its famous oval circuit is blaring as drivers attempt to qualify for the Indy 500.

The McLaren team, which is entering the Indy 500 as a standalone project in 2019, is on the back foot, after crashing in practice and failing to make the top 30. The team has one last chance to prove itself in Sunday's Last Row Shootout. After three runs it looked to be through provisionally, only for fellow rookies Juncos Racing to post a faster time with minutes to spare.

It was a gutting blow for McLaren but the event was not a complete loss. It also proved to be the start of a new groundbreaking partnership to carry out neurological research in conjunction with a tech start-up called MindMaze.

Although there was no opportunity to test MindMaze's technology in race conditions, the two companies rigorously tested its functionality during the team's preparations for the world-famous event and this has formed the basis of a wider research partnership.

MindMaze is best known for developing

MindMaze uses brain sensing technology to monitor a driver's neuro signatures



technology to help stroke victims during their rehabilitation, by regaining movement in their muscles through using a combination of virtual reality, motion capture, and electroencephalographic (EEG) scans. Now it has turned its attention to motor sport, and more specifically in using brain-sensing technology to help gather data and insight on overall driver safety and performance.

The technology is the brain child of CEO Tej Tadi, who set up the company during his PhD and Doctorial work six years ago. Since then it has received investment from Hinduja Group, who valued the business at over \$1 billion. In the last two years the company has focused on the development of its 'MindDrive' platform, which Tadi explains is how it can look at factors such as driver fatigue and gathering data on performance.

"It's a classic, non-invasive method of EEG technology, but built with our own hardware and our customised software," says Tadi. "You have a certain number of electrodes covering the scalp and combined with our ability to decode certain metrics. It goes into the helmet, then that gives us insight into the driver's fatigue and eventually that extrapolates into performance.

"Given that these guys drive in such stringent conditions, there's not much that's been done about monitoring drivers from a neuro perspective."

TESTING GROUND

So far, the company's VR technology has made its way into hospitals across Europe and Asia, helping more than 1,300 patients through its MindMotion Pro and MindMotion Go programmes. In 2017 it also received FDA approval which is how the partnership with McLaren came about, as it looks to break into

the North American market while also utilising its technology infrastructure beyond Formula One and other motor racing programmes.

MindMaze had plans to run its brain-sensing technology on Fernando Alonso during the race, to transmit key neural signatures from Alonso to the track-side medical team in real-time in the event of an incident. But after the team failed to qualify, it has since run it on McLaren's simulators, a few of the team's recent Formula One cars and even an old car from 1981.

"That's really the beauty of the partnership with McLaren," explains MindMaze Business Development Director, Owain Walbyoff. "They're providing all of the infrastructure when it comes to the racing environments for us to then test and then we're supplying all of the technology around the device and the brain monitoring."

The initial results have been encouraging for the company, with positive responses from their stakeholders having proved it can work in a live track environment in all different sorts of cars.

"We've been the first in what we've pioneered," says Tadi. "We're the first ones to get high quality active data from multiple channels that make sense, which give you the basic setting of looking at brain data.

"A lot of people can get away claiming artefacts as brain activity, there is a lot of hype around neurosensing and devices. The first thing that we have done correctly is, if you think of the amount of electrical noise and

“GIVEN THEY DRIVE IN SUCH STRINGENT CONDITIONS, NOT MUCH IS DONE ABOUT MONITORING THEM FROM A NEURO PERSPECTIVE”



movement and rest that happens in a race car, we've been able to see there is continual neuroactivity and that's a big step."

This is where the partnership with McLaren culminates into something beyond exposure into new markets, as MindMaze wants to use motor sport as a place to validate its technology and ultimately help benefit road car users and other sports where issues like concussion are prevalent.

"If you look at the NFL where there are huge problems with concussion, or cycling, there are so many other helmet-wearing sports where they have huge issues with head trauma," says Walbyoff. "We also acquired a company called GAITUP, which is focused on movement and motion analysis.

"They use sensors and algorithms to record and measure movement, and we supplied a lot of the data to the elite sport sectors whether that be trainer brands that want to

embed sensors in their footwear or clothing manufacturers that want to put sensors inside their textiles.

"Outside of sport we felt there are some really exciting avenues for the technology in consumer cars as well and embedding sensors in cars which can generate biometric data."

One of those avenues of exploration could potentially be in the crash test safety tests, and working with organisations such as Euro NCAP to help how they understand the way the brain reacts in a heavy-duty test environment.

"This will be part of the spectrum of tests," explains Tadi. "We obviously know how to do it and we have protocols in place, but crash testing and other tests to improve robustness are part of the paradigm and protocols. And that's why we partner with teams like McLaren, their access to engineering, their access to testing. It's not just about putting a sticker on a car; it truly has been a very organic relationship."



THE ROAD BACK:

THIERRY NEUVILLE

The WRC title contender reveals the extent of his injuries after crashing out of Rally Chile earlier this year in his Hyundai i20 Coupé.

During this year's World Rally Championship round in Chile, Hyundai's Thierry Neuville was 1.6s seconds behind reigning champion Sébastien Ogier and pushing to take second place away from the Citroën driver. Midway through Stage 8 in the Maria Las Cruces, Neuville suffered a dramatic accident as his Hyundai i20 Coupé WRC went over a fast crest and landed into a ditch, pitching it into a violent roll across the gravel. The car eventually landed on its side but in a heavily damaged state, and it caused the stage to be red flagged.

Neuville described it as one of the biggest accidents of his career, with air assistance called as a precaution by the team. He and his co-driver Nicolas Gilsoul were taken to a nearby hospital in Concepción, where they were checked over by doctors. While Gilsoul was cleared, Neuville suffered injuries to his left foot which needed stitches and later found out that he had torn the ligaments in his ankle.

A week after the accident Neuville was

back in the car for a pre-event test before Rally Portugal at the end of May. He managed to get himself back into shape and up to speed for the rally and is still in the three-way battle for the championship heading into Rally Germany. AUTO+ Medical spoke to him about the incident and his continued recovery.

AUTO+ Medical: Can you talk us through the crash and what happened from your perspective?

Thierry Neuville: From our side it was quite a heavy impact, quite a heavy crash, basically we rolled the car and we got a few big hits. It was measured as 22Gs by the FIA. The first people to reach the car were spectators, they helped us get out of the car ourselves. The only exit out of the car was the front window, I was a little bit blocked by the steering wheel and had to jump over the handbrake. After realising that I couldn't use my feet to walk, the spectators were pulling me out. By that time, I didn't realise Nicolas was already out and when we got together he did some assisting with the spectators when I laid

down. So there were spectators trying to take care of us before the medical team was able to arrive. Obviously it was a difficult situation, nobody was speaking English. When the medical team arrived, we got all the necessary checks, then I went through into a helicopter to go as fast as possible to the hospital in the city of Concepción.

A+M: What were the injuries you sustained?

TN: Nicolas was ok after a proper check-up, I was mainly injured on the left foot, swollen left calf and my left ankle on the ligament. I had an open wound on my ankle which had to have stiches, but they were basically the main injuries. I got a standard body check-up where they looked at the spine, so the scanner by radio and all that stuff. We only realised that some of the ligaments were torn when I came back to Europe and I went to my doctor in Monaco.

A+M: What did the doctor advise in terms of your recovery?

TN: Obviously I was walking on crutches already but when I arrived in Europe I had another proper check, which showed that two ligaments in the left ankle were torn. And I lost some sensitivity on the left side of the foot, but they basically said that the sensitivity will come back in one year's time and for the ankle it is getting better. They told me that it will take six to eight weeks for it to heal, and the swollen calf will be gone in the next month.



Photo courtesy of @World / WRC Promoter.



Credit: YouTube/WRC

A+M: Were there any adjustments that you had to do when you got back into the car?

TN: No I was quickly back in the car, it was only eight days between the crash and the next test in Europe. The feeling was good, obviously I feel very safe in my car, it's not like you have a crash like this very often. We got the speed back pretty quickly and at the next competition in Rally Portugal we were already on the podium again, so no issues on that side.

A+M: How much of a priority was it for you to get back into the car?

TN: I mean it was the only priority so it

was no question for me that I couldn't achieve that, and I was pretty sure that no matter what happened I was able to get into the car again. That was priority number one after the incident.

A+M: How does your accident on a rally stage compare to ones on circuits?

TN: I think we can't compare WRC with Formula 1 for example, where the whole structure and circuit racing is different. The marshals are closer to the car and arrive within 10 seconds to the drivers. In WRC we are dependent on the spectators, the marshals and then also on the time that they need to arrive. I would say that the only goal for me was to get back into the car as soon as possible.

A+M: Is there anything else you would like to add?

TN: The only thing I would like to add is that the FIA and WRC do a lot of work on safety and it is important that safety for drivers has improved in the car.



Neuville was in hospital for a week recovering

Photo Courtesy of Thierry Neuville and Hyundai Motorsport

ACCIDENT CASE REPORT:

KART ACCIDENT BLUNT CAROTID INJURY

Authors: Dr Dino Altmann –
Deputy President of FIA Medical
Commission, Chief Medical Officer
of Brazilian Grand Prix

Dr Fernando Unterpertinger –
Member of Brazilian GP Medical Team



ABSTRACT

Although blunt carotid injuries are not common, knowledge of trauma mechanisms and associated injuries is important in order to help recognize such injuries. This case discusses these topics particularly in reference to karting trauma.

Karting is a sport that involves high speeds as well as the lowest levels of protection in motorsport. It exposes drivers to the risk of several traumas. This case report studies a Blunt Cerebrovascular Injury (BCVI) and related secondary injuries in a kart driver resulting from a rollover accident during competition.

BCVI are defined as injuries to the carotid or vertebral arteries. They are usually rare, representing less than 1% of blunt traumas [1] and are associated with high levels of energy transfer. Further, blunt carotid injuries do not occur alone and are associated with cerebral and cervical injuries such as complex skull fractures, intracranial haemorrhaging, cervical spine and facial fractures [2].

Carotid artery injuries can be caused by several mechanisms: cervical hyperextension or hyperflexion with rotation or stretching, direct cervical trauma, intraoral trauma or skull fracture involving the carotid canal [3,4].

CASE PRESENTATION

A.F. 46, male, victim of a kart accident with rollover and ejection from the vehicle, was attended by the medical team on the track and presented a short time of unconsciousness followed by a GCS of 11; he was removed from the track with cervical collar, rigid board and O2 and sent to the track technical medical centre (TMC). His helmet presented a great deal of



Figure 1

“ KARTING IS A SPORT THAT INVOLVES HIGH SPEEDS AS WELL AS THE LOWEST LEVELS OF PROTECTION IN MOTOR SPORT FOR DRIVERS ”

damage on the left side (Fig.1).

During the physical exam at the TMC, he presented a GCS of 14, blood pressure of 150x100 mmHg, HR of 126 bpm, O2 saturation of 98%, pain in the cervical posterior midline, a right periorbital edema and a swollen left wrist.

The driver was transported by ambulance to the reference trauma hospital where he was admitted to the emergency room with lacunar amnesia. He underwent a SCAT 2 test for concussion assessment, a whole-body CT-scan and a left arm X-ray. The SCAT 2 showed excellent performance of the cognitive functions tested, while the CT-scan

was positive for an intracranial haemorrhage and a brain contusion (Fig. 2), a C7 right lamina fracture (Fig. 3), fractures to the right tubercle of C4 and C5 (Fig. 4 and 5), a right orbital fracture and additionally a suspected left internal carotid artery pseudoaneurysm. An X-ray showed a left distal radius fracture.

In view of these findings and the high energy of the trauma, the patient underwent a cervical angio-CT (Fig. 6 and 7) with diagnosis of the left internal carotid artery pseudoaneurysm, in other words a BCVI Grade 3 on the Denver Grading Scale for BCVI (Table 1). [5]

Grade I:	irregularity of the vessel wall or a dissection/ intramural hematoma with < 25% luminal stenosis
Grade II:	intraluminal thrombus or raised intimal flap is visualized, or dissection/ intramural hematoma with 25% or more luminal narrowing
Grade III:	pseudoaneurysm
Grade IV:	vessel occlusion
Grade V:	vessel transection

Table 1 – DENVER GRADING SCALE FOR BCVI

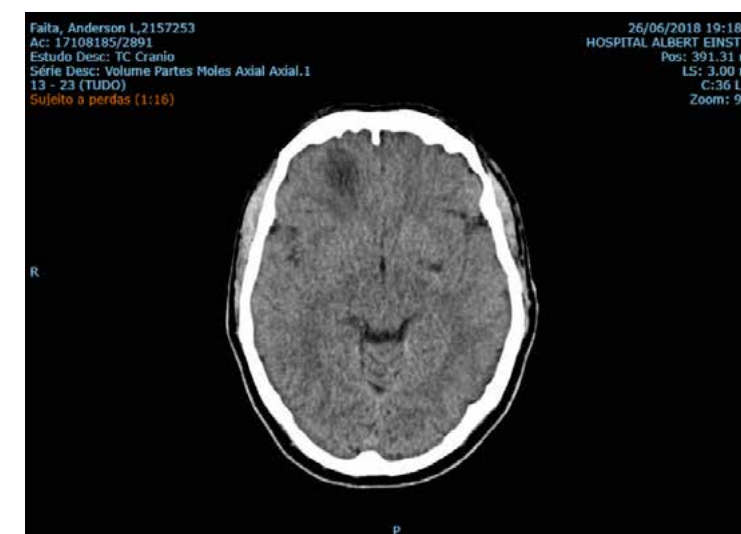


Figure 2

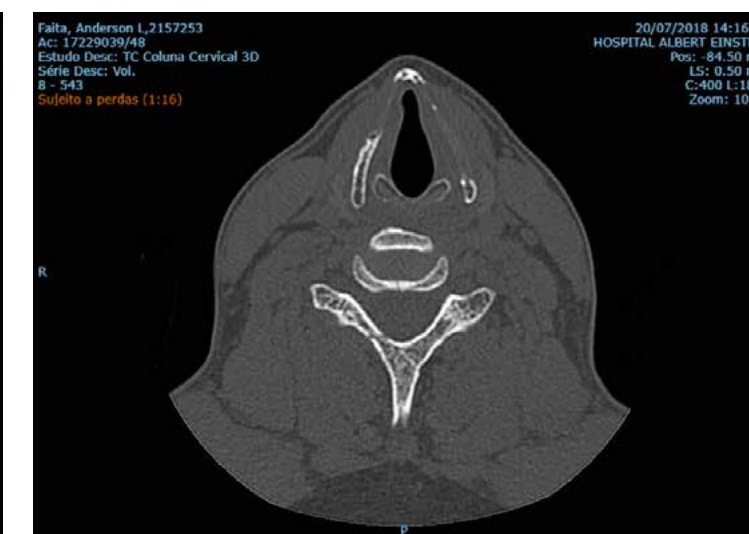


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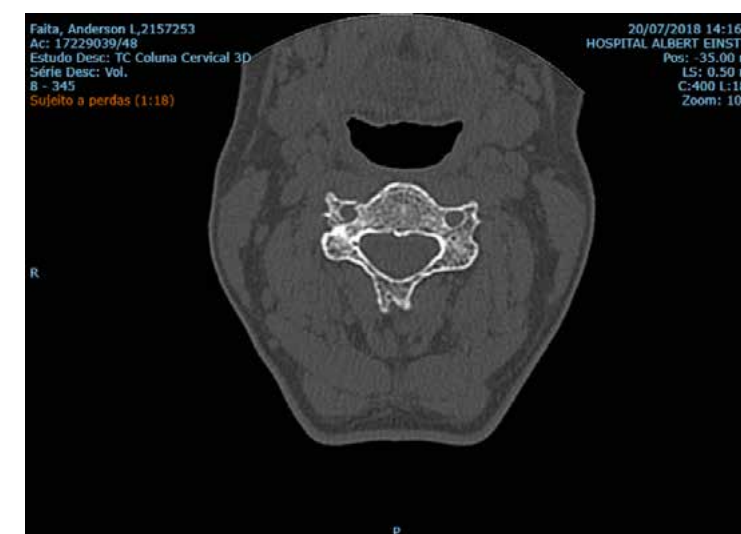


Figure 4



Figure 5

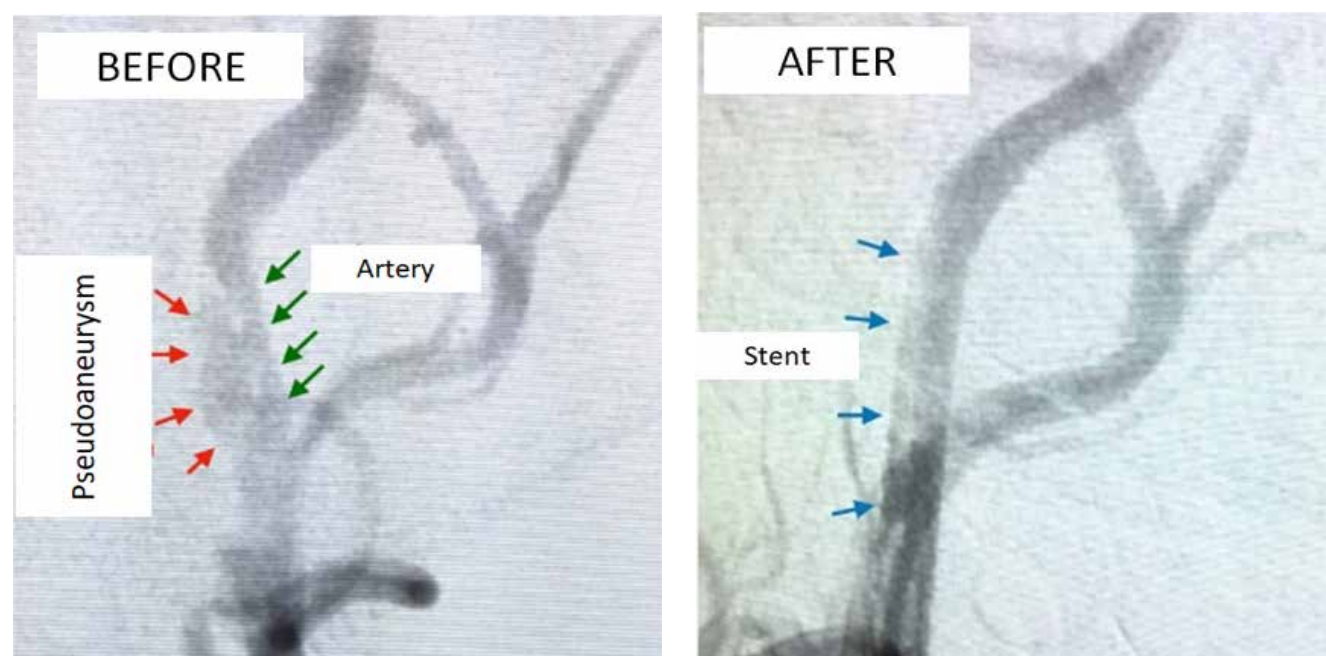


Figure 8

Initially a conservative management approach was proposed for the internal carotid artery pseudoaneurysm; however, 72 hours following the trauma, a new angio-CT showed an increase in the pseudoaneurysm associated with artery dissection. At this time an endovascular approach was considered in order to treat the carotid artery pseudoaneurysm with the placement of a stent^[6,7].

Control exams showed improvement of the traumatic injuries with regression of the intracranial haemorrhage and contusion area allowing for a safe endovascular intervention. A stent graft was successfully placed in the left internal carotid artery (Fig. 8).

Twelve days after the trauma the patient was released from hospital. The left distal radius fracture was surgically treated in a second hospitalization.

DISCUSSION

The accident occurred after the start at approximately 80 km/h and presented 3 important factors associated with severe

injuries: high energy transfer; rollover; and ejection of the pilot.

Examining the driver's helmet, which was severely damaged on the left side, we may infer that the association of these factors may have produced a mechanism of hyperextension of the left lateral cervical spine resulting in the vertebra flexion fractures of C4, C5 and C7 at the right side and a left internal carotid distraction injury.

In situations of this severity, safe and rapid removal from the track, followed by evaluation by the medical team and transfer to the hospital are of utmost importance in order to start first care and not aggravate existing injuries.

In the hospital, the medical team should be aware of the presence of secondary lesions such as fractures of long bones and cervical and facial fractures, since these are risk factors for BCVI. In the presence of these types of fracture the BCVI search should be led with significantly higher levels of attention.

Traumatic internal carotid artery pseudoaneurysms are the most common cause of stroke in young adults. While open surgery poses excess risk, endovascular treatment strategies have been applied during the last decade and have proven to be an effective option for the treatment of traumatic internal carotid artery pseudoaneurysms with low morbidity and mortality rates.

CONCLUSION

Although rare, not only in kart but in all of motorsport, drivers are regularly subject to BCVI, thus knowledge of these injuries, their mechanisms and risk factors are important for correct diagnosis and treatment.

Unfortunately, there is no research on BCVI aimed specifically at motorsport; as a result, this is a field which we must study further in order to increase driver safety in motorsport.

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