

Innovative research striking back at concussion in rugby

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Two innovative new research projects by academics in Trinity College Dublin in collaboration with Leinster Rugby are opening up unique avenues to improve the diagnosis and analysis of concussion in rugby.

The research has the potential to provide a whole new system to more accurately identify potential incidences of [concussion](#) in rugby and help predict when a player should be removed from play and when they should return. It involves diverse disciplines including physiotherapy and bio-engineering and innovative approaches such as the analysis of head kinematics, bio markers and neurocognitive assessments.

Concussion is a form of mild traumatic [brain injury](#) and in rugby it is the subject of regular debate and scrutiny. One of the challenges that sports medical teams and players face is measuring how severe an injury may be and when it is safe to return to play. Current tests for concussion in rugby involve a cognitive test called the ImPACT, or CogSport assessment, and, on occasion, an MRI scan.

Recognising the need to find new methods for more comprehensive player assessment, Trinity researchers and Leinster Rugby are working to develop a suite of new and innovative techniques to more accurately detect incidences of concussion, diagnose the extent of injuries, and determine how damage is healing. This would facilitate early management and triage decisions regarding concussion and brain injury and create a more objective measure to assist a medical team in determining when a concussed player can return to play.

Blood biomarkers

One of the projects, which is being led by Assistant Professor in Physiotherapy at Trinity, Fiona Wilson, and Associate Professor and Head of Physiology in Trinity, Aine Kelly, involves examining specific blood biomarkers that may be present as a measure of brain injury in rugby players. Certain biomarkers have been shown to correlate with brain injury severity and can help identify cellular damage in a brain injury.

Trinity PhD student and Leinster Rugby Physiotherapist, Brendan O'Connell along with Leinster Rugby Physiotherapist, Karl Denvir, take blood samples from participating professional players at the club, firstly after a 14-day period free of contact and again over three consecutive games. Where a player has a suspected concussion, neurological examinations, neurophysiological and cognitive tests are also performed. The blood samples from the players are then analysed by a metabolomics laboratory in Steno Diabetes Center in Denmark, the largest diabetes clinic in the Nordic region focused on high-quality diabetes care and translational research.

Speaking about the project and the initial findings, Dr Wilson said: "Concussion is one of the most complex injuries that any sports medicine team will need to manage. We ultimately require a reliable and comprehensive battery of tests that will help clinicians decide when to remove a player from the field and then when it is safe to return to sport. Our initial findings indicate that we have made significant progress in identifying a blood test that will add to the armoury of tests for sports medicine clinicians managing concussion. Furthermore, collaboration with a world-leading diabetes centre means that progress can be made towards development of a simple finger prick blood test, which is already so familiar in diabetes management. This has great potential for simplifying the management of concussion."

Funding for the blood sample analysis comes from the GE-NFL Head Health Challenge Program led by Dr Matej Oresic.

The kinematics of concussion

A second project taking place at Trinity and Leinster Rugby marries pedestrian crash research on the application of forces to the human body and new research into [movement patterns](#) in a sports collision. The team uses multi-angle video footage of a player collision and a system called Model Based Image Matching to map skeleton models of the player to the video footage to create an accurate reconstruction of a player's movement patterns in a specific collision.

They can then run analyses on these kinematic movement patterns and, using their research on pedestrian accidents, can apply their knowledge about the kinematic limits that the body can stand to these specific sports collision events. From this they can start to estimate from a particular collision if the player is likely to have been injured, in what way, and to what extent. They are also undertaking detailed analysis of the kinematic events leading to a concussion to find kinematic trends, which distinguish concussion from non-concussion head impact cases. These data may help establish tolerance thresholds for concussion injuries in rugby. The project is being led by Associate Professor Ciaran Simms from the Trinity Centre for Bioengineering with PhD student Gregory Tierney and physiotherapists from Leinster Rugby and the IRFU as well as sports scientists from the Oslo Trauma Centre.

Speaking about the future application of this work in rugby matches and the possibilities for assisting accurate and real time diagnoses of potential incidences of concussion Professor Simms said: "This method was developed to assess knee and ankle joint injuries, and has high potential to provide new insights into head injury mechanisms in contact sport. It will not replace other methods, but can provide an additional

tool for clinical decision-making."

Professor Simms continued: "If you can understand a player's movement patterns clearly in a specific collision incident, you have a very good starting point for developing counter measures, for example by taking a player off the pitch if the movement patterns suggest certain injuries or concussion is likely. In addition, different playing strategies could be developed to avoid getting into particular movement patterns that are more likely to cause concussion-type injuries. Future phases of our research would look to speed up this kind of analysis to allow it to be used in real time. This would have the potential to provide feedback to a referee in a TMO sense to say that a particular collision was problematic, and that the player may need to come off the pitch for further assessment."

Speaking on behalf of Leinster Rugby, Physiotherapist Brendan O'Connell said: "Concussion is obviously front and centre at the moment in rugby and in sport in general, and rightly so. The IRFU in particular have been doing great work from the ground up, educating and informing everyone involved in the game of [rugby](#)."

"With that in mind, we at Leinster Rugby were very keen to explore different avenues for us to contribute to the debate in a positive manner and to hopefully make a difference."

"Leinster Rugby is very committed to research and Karl and I in the physiotherapy department were delighted to play our part and to use the excellent facilities in Trinity College as part of this research."

"The opportunity to develop another objective test to add to the existing range of tests already available was one that we were very keen to explore further with the ultimate aim of making the management, assessment and return to play of players more objective."

"At Leinster Rugby we want the players to perform to the best of their abilities on the pitch. We try to achieve this while at the same time always having the best interests and welfare of those same players front of mind. I hope that this research can make a difference and that again, it is the players that benefit both on and off the pitch."

Provided by Trinity College Dublin

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