

Impact case study (REF3)

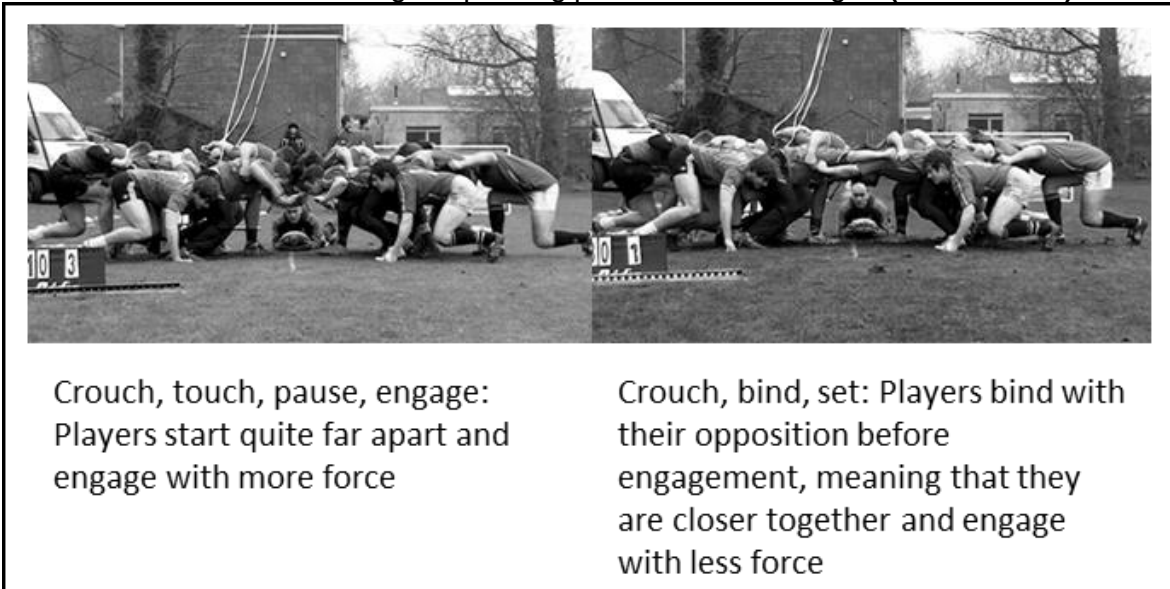
Institution: University of Bath		
Unit of Assessment: C24		
Title of case study: Reducing injuries in rugby union through global changes to make the scrum safer		
Period when the underpinning research was undertaken: 2010-2015		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Keith Stokes	Professor, previously Head of Department and Senior Lecturer	February 2002 - present
Grant Trewartha	Reader, previously Senior Lecturer	September 2001 – August 2016
Ezio Preatoni	Senior Lecturer, previously Lecturer and Research Associate	August 2010-present
Dario Cazzola	Senior Lecturer, previously Lecturer and Research Associate	November 2012-present
Elena Seminati	Lecturer, previously Research Associate	September 2014-present
Period when the claimed impact occurred: 2014 – present		
Is this case study continued from a case study submitted in 2014? No		
1. Summary of the impact		
<p>University of Bath research has had a significant impact on reducing the burden of injury in rugby union, with a specific focus on making the rugby scrum safer. Working in partnership with the international governing body, World Rugby (formerly the International Rugby Board) we carried out research showing a 25% reduction in scrum forces by changing technique. In 2014, World Rugby announced the global adoption of scrum laws based on our research to be used by all players at all levels of the game. The new laws have contributed to a reduction in injuries, including the most serious (catastrophic) spinal injuries, with associated economic benefit (reducing forecast care costs from GBP30,000,000 per year to GBP2,500,000 per year in England). This work has contributed to making rugby safer for over 9,000,000 players across the world.</p>		
2. Underpinning research		
<p>Rugby has relatively high injury risk, with a perception of a high risk of permanent neck/spine injuries. Historically about 40% of spinal injuries occurred in the scrum. These injuries are so life-changing, that individuals and their families and friends value preventing even one injury. In addition, there is a substantial cost implication. The lifetime cost of supporting each young individual in the UK with a permanent spinal injury is estimated at between GBP10,000,000 and GBP20,000,000.</p> <p>In the scrum, opposing sides collide together while vying for forward momentum, and players experience considerable forces. These collisions may cause acute injury, and repeated collisions in training/matches may lead to degenerative injuries, such as arthritis.</p>		

Trewartha and Stokes delivered a project funded by the global governing body for rugby (World Rugby, previously the International Rugby Board) from 2010 to 2014 with the hypothesis that de-emphasising initial engagement velocity could reduce magnitude of forces in the front row and consequently reduce the risk of injury (**Reference 1**). Working on this project in collaboration with the governing body for rugby in England (Rugby Football Union), we investigated scrums across a wide range of teams, from school to international level, to:

- establish the forces that front row players are subjected to when the scrum engages
- test alternative methods of engagement.

The work was carried out in two phases. Phase one was carried out by Trewartha, Stokes and Preatoni in 2011-12, with teams scrummaging against a modified scrum machine that measures forces. Phase two was carried out by Trewartha, Stokes, Preatoni, Cazzola and Seminati in 2012-14, with teams scrummaging against each other while wearing sensors to determine forces.

In phase one we tested 34 teams in 6 different levels (international to schoolboy). The force across the front row on initial contact in machine scrummaging was 16.5 kN in international men’s and elite men’s teams, ranging across other levels to 8.7 kN in elite women (**Reference 2**). We also asked the teams to engage (come together at the start of the scrum) using five different sequences including the standard engagement at the time (“Crouch, Touch, Pause, Engage”), a variation of the verbal instructions (“Crouch, Touch, Engage”), variations of adding players (seven players plus one or five players plus 3) and a fold-in engagement (that became “Crouch, Bind, Set”; see Figure below). “Crouch, Bind, Set” emerged as the technique that most clearly reduced peak forces during engagement. There was approximately a 50% decrease in force at all levels, including 16.5kN to 8.6kN in international men’s and elite men’s teams, and 8.7kN to 4.4kN in elite women’s teams. The levels of sustained force during the pushing phase were unchanged (**Reference 3**).



In phase two, we tested 27 teams in 5 levels (international men, elite men, elite women, community men, university men) during live scrummaging and took forward the standard engagement at the time (“Crouch, Touch, Pause, Engage”) and the sequence that had most benefit in phase one (“Crouch, Bind, Set”). Live trials demonstrated a 14-25% reduction in the peak forces on engagement with our new method, across all levels tested (**References 4 and 5**).

Overall, using a scrum engagement process that involves binding with the opposition prior to engagement improved loading conditions for front row players in contested rugby union scrums, with the clear potential to reduce injury risk.

3. References to the research

Research project schedule

1. World Rugby Player Welfare web pages:
<https://www.playerwelfare.worldrugby.org/?documentid=29>

Peer reviewed Journal Articles

2. Preatoni, E, Stokes, KA, England, ME & Trewartha, G 2013, 'The influence of playing level on the biomechanical demands experienced by rugby union forwards during machine scrummaging', *Scandinavian Journal of Medicine and Science in Sports*, vol. 23, no. 3, pp. 178-184. <https://doi.org/10.1111/sms.12048>
3. Preatoni, E, Stokes, KA, England, ME & Trewartha, G 2015, 'Engagement techniques and playing level impact the biomechanical demands on rugby forwards during machine-based scrummaging', *British Journal of Sports Medicine*, vol. 49, no. 8, pp. 520-528. <https://doi.org/10.1136/bjsports-2013-092938>
4. Cazzola, D, Preatoni, E, Stokes, KA, England, ME & Trewartha, G 2015, 'A modified prebind engagement process reduces biomechanical loading on front row players during scrummaging: a cross-sectional study of 11 elite teams', *British Journal of Sports Medicine*, vol. 49, no. 8, 092904 , pp. 541-546. <https://doi.org/10.1136/bjsports-2013-092904>
5. Preatoni, E, Cazzola, D, Stokes, K, England, M & Trewartha, G 2016, 'Pre-binding prior to full engagement improves loading conditions for front-row players in contested rugby union scrums', *Scandinavian Journal of Medicine and Science in Sports*, vol. 26, no. 12, pp. 1398-1407. <https://doi.org/10.1111/sms.12592>

Grants

Grant Trewartha (Principal Investigator), Keith Stokes.
Biomechanics of the rugby scrum. International Rugby Board. 2010-2013. GBP540,000.
<https://www.playerwelfare.worldrugby.org/?documentid=29>

4. Details of the impact

"In 2014 ... a new scrum engagement sequence was adopted in the Laws of Rugby Union that was based on the evidence generated in the University of Bath study. The law change was applied to all levels of rugby across the globe and has subsequently been observed to reduce injuries in the scrum in a range of settings." Head of Technical Services, World Rugby" (**Supporting Evidence 1**).

International impact on policy through the Laws of the game

Based on our research, the international governing body for rugby union, World Rugby, permanently changed the scrum laws in 2014, and now players at all levels, in all countries play under this law. The revised law means that props now pre-bind with their opposition player prior to the engagement of the forward packs, which reduces force upon impact, and reduces scrum collapses. This law-change required revisions to the law book (**Supporting Evidence 2**), and development of game-wide education resources were developed for coaches and match officials (**Supporting Evidence 3**). With over 9,000,000 rugby players worldwide, reducing scrum impact forces reaches a large population and has a positive impact on the long-term health of many of the world's rugby players.

The law change was achieved through collaborative partnerships with both World Rugby and the Rugby Football Union. Soon after the project had been completed, Prof Stokes presented the outcomes at a meeting of rugby policymakers and an international panel of referees. The involvement of referees was key in developing the law change, given their role

as delivery agents and the need for them to have input into law revisions. The outcome of this meeting was a change to Law 19 relating to the scrum (**Supporting Evidence 3**).

International impact on injury prevention

Limited data are available regarding rugby injuries; however, South Africa, New Zealand and England are all high-level rugby playing nations that have good-quality longitudinal injury data. Robust data on rugby injuries resulting in permanent impairment has been collected in South Africa since 2008 and in England since 2011.

Influenced by our research findings, South Africa trialled the revised scrum law from 2012 (prior to the global roll-out). Since the adoption of the revised scrum law there has been a reduction in the number of scrum-related catastrophic spinal injuries that resulted in permanent impairment. In the 4 years prior to the law change in South Africa (between 2008 and 2011), 14 catastrophic spinal injuries occurred in the scrum, corresponding to a rate of 3.5 per year. Since the global adoption of the new scrum laws in 2014, there have been 3 catastrophic spinal injuries in the scrum in South Africa over 6 seasons (between 2014 and 2019), corresponding to a rate of 0.5 per year (**Supporting Evidence 4**).

In England, in the 2 seasons prior to a pilot law trial and subsequent global law change in 2014, there were 4 scrum-related catastrophic spinal injuries that resulted in permanent impairment, corresponding to a rate of 2 per year. In the 6 seasons since the revised law was introduced, there has been 1 such injury, corresponding to a rate of 0.17 per year (**Supporting Evidence 5**). Taking GBP15,000,000 (the middle value of GBP10,000,000 and GBP20,000,000) as an estimated lifetime cost of supporting a young individual in the UK who sustains a spinal injury that result in permanent impairment, 2 injuries per season (before the law change) equates to a forecast cost of GBP30,000,000 per season, compared with GBP2,500,000 per season for 1 injury over 6 seasons. Director of the RFU Injured Players' Foundation states:

“The work that was carried out at the University of Bath, resulting in a change in the scrum laws (in 2014), has reduced the number of players that have suffered life-changing injuries and the impact these have on individuals and society as a whole” (**Supporting Evidence 5**).

Evidence from New Zealand in the first season after the law change was introduced (2014) demonstrated a reduction in scrum-related injuries of all types that lead to claims from the national insurer (ACC) from 52 per 100,000 forwards per year prior to the law change, to 24 per 100,000 forwards per year after the law change (**Supporting Evidence 6**). In professional rugby in England there has been a 40% reduction in scrum-related injuries that lead to players missing training or playing time when comparing pre- to post-law change (**Supporting Evidence 7**).

5. Sources to corroborate the impact

1. Letter from Head of Technical Services, World Rugby. 12 January 2021
2. Laws of the game: Rugby Union, Law 19: The Scrum – Publicly available. Accessed 27 February 2020
3. Screenshot of World Rugby Press release regarding the change in the scrum laws, citing the University of Bath research – Publicly available. 8 May 2013
4. Data from South Africa relating to the scrum-related catastrophic injuries that result in permanent impairment – Publicly available (used in education materials in South Africa). Accessed 27 February 2020
5. Letter from Director of the RFU Injured Players' Foundation. 13 January 2021

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6. Letter to World Rugby from the ACC regarding injury data in New Zealand. 29 April 2015
7. Professional Rugby Injury Surveillance Project report, including scrum injury data for professional teams in England - Publicly available. 9 January 2019