Concussion: where are we now?

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Disclosures of interest

• Medical Services Director, Rugby Football Union

• Concussion advisor to World Rugby and Football Association
Challenges of the role

• Responsibility
• Honest, balanced, evidenced based and effective

• Keeping abreast of the science
• Making decisions with limited evidence
• Implementing projects to help build the evidence

• Variations in what is deemed to be an acceptable risk

• Communicating nuanced messages clearly
• Promoting the net health benefits of rugby whilst monitoring the emerging science around the positive and negative long term consequences

• Keeping a sense of perspective
THE PILLARS OF CONCUSSION RISK MANAGEMENT

- Surveillance
- Awareness & Education
- Management
- Research
- Prevention
- Communication
Premiership reported match concussion incidence 2002-2017

2016-17: 20.9/1000 hours  
Mean: 7.6/1000 hours  
@ 1 concussion per match
Men’s Community game reported match concussion incidence 2002-2017

2016-17 average: 3.0/1000 hours
@ 1 concussion every 8.5 matches
# Concussion incidence by sport

<table>
<thead>
<tr>
<th>Sport</th>
<th>Concussion incidence/1,000 hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horse racing (amateur)</td>
<td>95</td>
</tr>
<tr>
<td>NFL</td>
<td>32</td>
</tr>
<tr>
<td>Horse racing (jumps)</td>
<td>25</td>
</tr>
<tr>
<td>Rugby Union (Professional – English Premiership)</td>
<td>20 @ one case every match</td>
</tr>
<tr>
<td>Horse racing (flat)</td>
<td>17</td>
</tr>
<tr>
<td>Boxing (Professional)</td>
<td>15</td>
</tr>
<tr>
<td>AFL</td>
<td>10</td>
</tr>
<tr>
<td>Soccer (Professional)</td>
<td>&lt;1</td>
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</table>
Awareness and Education initiatives

- **Sport led initiatives**
  - RFU Headcase
    - 50,000 module completions
    - 100K hits in 2017

- **Sport and external agency collaborations**
  - Sport & Recreational Alliance Educational sector concussion guidelines

- **Fully integrated sport and governmental initiatives**
  - Scottish Concussion Guidelines
Management – Community game

Head injury event + any symptom or any sign of concussion → removal from play/training and evaluation by a Health Care Professional
Recognise and Remove is associated with improved recovery

By 7 days after the injury: 72% of immediate removals were cleared versus just 40% of delayed.

Athletes not immediately removed: 5 days slower and had 2.2 times greater likelihood of prolonged recovery.

Asken et al., 2016, Journal of Athletic Training
97 Collegiate athletes 2008-15
Management – elite game drives Community game practice

Principles consistent with Community game

Higher level of knowledge amongst medical staff
Access to real-time video

Key difference is use of Side-line screening in elite sport where the consequences of a head impact is unclear

> 50% → < 10% concussed players remaining on the field
HIA PROTOCOL – CONCUSSION DIAGNOSIS

Head Injury Event +...

Permanent removal criteria
Video
Time of injury 50%

And/or
Abnormal HIA 2
(SCAT5)
Game day 25%

And/or Abnormal HIA 3
(SCAT5+)
36-48hrs 25%

HIA 1 Assessment is a triage tool and does not diagnose concussion
HIA 1 ASSESSMENT - TRIAGE TOOL V4

- Review of Video for IPR (pre and post HIA1)
- Maddock’s questions
- SAC (modified)
- Tandem gait
- Symptom check list
- Clinical signs
- Doctor performing HIA suspects concussion despite above tests being normal
The Head Injury Assessment Protocol
Can it be improved?

• The King-Devick (KD) test, has been promoted as a concussion screening tool.
• Preliminary studies → worsening of performance from baseline in patients with concussion
• Question - Is the K-D able to identify concussed players?

Read from left to right
Single digit numbers on 3 successive screens
Line spacing decreases
Time taken (@45secs) & errors recorded
Compared to best of 2 baseline times
King-Devick Premiership and Championship study 16-17

Derivation of study participants in primary analysis

Head impact event with the potential for concussion identified during match
n=274

Clear signs of concussion
Immediate & permanent removal from play
n=73

Off-field screening assessment with the HIA-1 and KD test
n=201

Missing data n=56

KD test abnormal:
n=87
Concussion diagnosed [TP] n=56
Concussion excluded [FP] n=31

KD test normal:
n=58
Concussion diagnosed [FN] n=38
Concussion excluded [TN] n=20

Concussion diagnosed n=54
KD test abnormal [TP] n=33
KD test normal [FN] n=21

Missing data n=19
<table>
<thead>
<tr>
<th>Analysis</th>
<th>Sample n=</th>
<th>Missing data</th>
<th>TP</th>
<th>FN</th>
<th>FP</th>
<th>TN</th>
<th>Sensitivity (%, 95% CI)</th>
<th>Specificity (%, 95% CI)</th>
<th>LR (+) (95% CI)</th>
<th>LR (-) (95% CI)</th>
<th>PPV (%, 95% CI)</th>
<th>NPV (%, 95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KD test</td>
<td>145</td>
<td>56</td>
<td>56</td>
<td>38</td>
<td>31</td>
<td>20</td>
<td>59.6 (49.0-69.6)</td>
<td>39.2 (25.8-53.9)</td>
<td>0.98 (0.7-1.3)</td>
<td>1.03 (0.7-1.6)</td>
<td>64.4 (53.4-74.4)</td>
<td>34.5 (22.5-48.1)</td>
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<tr>
<td>HIA-1 test</td>
<td>180</td>
<td>21</td>
<td>83</td>
<td>28</td>
<td>6</td>
<td>63</td>
<td>74.8 (65.6-82.5)</td>
<td>91.3 (82.0-96.7)</td>
<td>8.6 (4.0-18.6)</td>
<td>0.3 (0.2-0.4)</td>
<td>93.3 (95.9-97.5)</td>
<td>69.2 (58.7-78.5)</td>
</tr>
</tbody>
</table>

Players undergoing off-field screening (total n=201)

King-Devick concussion test performs poorly as a screening tool in elite rugby union players: a prospective cohort study of two screening tests versus a clinical reference standard.
Concussion diagnosis

• Remains a clinical diagnosis supported by largely subjective assessment tools
Making sense of the evidence

Is mild traumatic brain injury without loss of consciousness associated with an increased risk of dementia diagnosis in military veterans?

Consider limitations & generalisability

JAMA Neurol.
Online May 7, 2018.
Building the Evidence - The Brain Study

• Investigate the potential effects of playing Rugby Union and concussion on long-term health of elite Rugby Union players

• Initial (blind) recruitment into General Health study

• Face-to-face 2.0 – 2.5 hour physical and cognitive assessments of >150 retired Rugby players over 50 years old

• Comparison with general population data from a ‘1946 birth cohort’

• 80 players seen, 20 with dates booked and 2nd wave of recruitment about to start
A word about Prevention

Tackling concussion in professional rugby union: a case–control study of tackle-based risk factors and recommendations for primary prevention

Matthew J Cross,1,2 Ross Tucker,3 Martin Raftery,3 Ben Hester,3 Sean Williams,2 Keith A Stokes,2 Craig Ranson,4,5 Prav Mathema,5 Simon Kemp1

182 tackles that led to medically diagnosed time-loss concussion

4,619 competition matched control tackles from 28 matches
Analysis framework

- Time in the Match
- Tackle Direction
- Accelerating Player
- Number of Tacklers

- Preceding Event
- Number of Tacklers
- Player Speed
- Contact Location

- Player Position
- Ball Carrier Position
- Tackle Type
- Tackler Position

CONCUSSION

NON-MODIFIABLE
MODIFIABLE
What are the most important risk factors?
CONCUSSION TACKLE RISK – HOW DO WE MOVE TO THE LEFT?

**Low Risk**
- Passive shoulder tackle
- Side on & back tackles
- Low tackles
- Bent at waist players
- Low speed tackler
- Non accelerating tackler

**High Risk**
- Active shoulder tackle
- Front on tackles
- Higher tackles
- Upright players
- High speed tackler
- Accelerating tackler

**Spectrum of risk**
- **Type**
- **Direction**
- **Height/area of contact**
- **Body position**
- **Speed**
- **Acceleration**
Summary

• Complex and emotive subject with an immature but rapidly evolving knowledge base

• Whilst our understanding of the long-term consequences emerge optimal acute management and safe return is key

• Collaborative research is in progress to develop practical assessment tools, objective diagnostic tools and gain a deeper understanding of recovery and long term risks

• Prevention/risk reduction must now be the focus