

Sport-Related Concussion and Video Analysis of Wearable Impact Sensor Data in Rugby League



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Bachelor of Medical Radiation Science in Diagnostic Radiography

A thesis submitted in fulfilment of the requirements for the degree of
Master of Philosophy

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Statement of Originality

I hereby certify that the work embodied in the thesis is my own work, conducted under normal supervision. The thesis contains no material which has been accepted, or is being examined, for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made. I give consent to the final version of my thesis being made available worldwide when deposited in the University's Digital Repository, subject to the provisions of the Copyright Act 1968 and any approved embargo.

Lauchlan Carey

Acknowledgement of Authorship

I hereby certify that this thesis is in the form of a series of papers. I have included as part of the thesis a written declaration from each co-author, endorsed in writing by the Faculty Assistant Dean (Research Training), attesting to my contribution to any jointly authored papers.

Publication 1: Carey, L., Stanwell, P., Terry, D.P. *et al.* Verifying Head Impacts Recorded by a Wearable Sensor using Video Footage in Rugby League: a Preliminary Study. *Sports Med - Open* **5**, 9 (2019)

By signing below I confirm that Lauchlan Carey contributed to study design, data collection, and the drafting, revising and finalising of the manuscript to the publication entitled “Verifying Head Impacts Recorded by a Wearable Sensor using Video Footage in Rugby League: a Preliminary Study.”

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Date: 8 November 2021

Peter Stanwell
Date: 17 November 2021

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Note

The referencing style in this thesis changes for the two publications due to journal specific requirements

Abstract

Background: Rugby league is a full-contact collision sport that carries a high risk of sport-related concussion. There are few studies in rugby league that utilise video analysis and wearable head impact sensor data together to investigate head impact exposures across a full season.

Purpose: To verify wearable head impact sensor data using video analysis and describe game-play characteristics and head biomechanics that contribute to concussion in rugby league.

Methods: The x-Patch™ was used for a season of men's semi-professional and junior boys representative level rugby league. A total of twenty-nine players were monitored and game-day footage by a trained videographer was recorded and analysed to verify head impacts and describe impact rates, playing and gameplay characteristics of video-verified head impacts.

Results: The x-Patch™ recorded a total of 1,403 impacts $\geq 20g$ between game start and finish across the two studies in this thesis, of which 1,296 (92%) were verified on video. In study 1, the number of video-verified impacts $\geq 20g$, per playing hour, was 7.8 for forwards and 4.8 for backs. Impacts resulting in concussion had a much greater peak linear acceleration ($M = 76.1g$, $SD = 17.0$) than impacts that did not result in concussion ($M = 34.2g$, $SD = 18.0$; Cohen's $d = 2.4$). Study 2 found 73.2% of all verified impacts $\geq 20g$ were determined to be direct head impacts and occurred at a rate of 5.2 impacts per game hour.

Conclusion: There were high rates of agreement between video-verified and sensor recorded game play impacts $\geq 20g$ and also a number of triggered events that occurred during gameplay that did not correlate with an impact on video review. The use of a secondary source, such as video review, to verify x-Patch™ recorded impacts is extremely important when analysing total head impact exposure as failure to remove 'false-positive' impacts may inflate player's cumulative and average head impact exposures.

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