

28th ECSS Anniversary Congress, Paris/France, 4-7 July 2023

Can instrumented mouthguard be used for computing head injury criteria for rugby collision investigation over elite players ?

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INTRODUCTION:

Using instrumented mouthguards for quantifying head acceleration during rugby games is promising for better understanding concussion occurrence [1]. However, defining a threshold for rugby is an issue. Several criteria were proposed for several [2] purposes but none were defined for rugby. Thus the objective of this study was to investigate if classical injury criteria are of interest for collision investigation in rugby based on instrumented mouthguards (iMG) measurements.

METHODS:

A call for volunteers was done over a male team of under 21 years old rugby players. They were equipped by instrumented mouthguards (boil and bite technology, Prevent biometrics) during their trainings. Collision selection threshold was set as 5g and then 10g over a 50ms window. Data were compared to video in order to eject false positive data. Eight different common injury criteria were computed on this dataset: GAMBIT, CP, HIC, RIC, PRHIC, HIP, BRIC and BrIC. Associated tolerance thresholds were computed.

RESULTS:

Over the 16 players who were asked to be part of the study, 15 volunteered. iMG were used during 8 training sessions and 7 official matches, corresponding to 1169 collisions. With a threshold set as 5g, there was 81% of true positive, 13% of false positive and 6% undetermined. With a threshold set as 10g, results were 93%, 4% and 3% respectively.

Among those, 25 impacts were associated to at least over one injury criteria and 2 were over 2 injury criterias. The BrIC criteria was the one conducting to the highest percentages of severity overtaking.

CONCLUSION:

Instrumented mouthguards seem to be a promising tool for measuring in-field head accelerations. Those may be of interest for coaches and medical staff to adapt players trainings for reducing their injury risk. However, current injury criteria were not created for rugby purposes and its choice highly influence computation output. Criteria may use linear and/or rotational components of measured head accelerations, and here, the one presenting the highest risk of being overtaken was based on rotational components. Unfortunately, data selection on the device is based on translational acceleration which may conduct to bias selection.

To conclude, this study highlight the interest of defining a proper injury criteria for rugby by presenting the high influence of criteria choice. Thus, a large scale study should be conducted to define criteria and threshold for helping staff to understand at-risk movements and eventually to better understand concussion occurrence.

[1] Jones et al. 2022 Ready for impact? A validity and feasibility study of instrumented mouthguards (iMGs), British Journal of Sports Medicine

[2] Hoshizaki et al. 2016 The development of a threshold curve for the understanding of concussion in sport, Trauma

Topic: Biomechanics

Presentation Poster

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