

Use of instrumented mouthguards for rugby collisions quantification: a preliminary study on elite players

Max Petetin^{1,2}, Laura Valdes-Tamayo³, Thomas Provot^{1,3}, Antoine Kneblewski², Olivier Rouillon², Philippe Rouch^{1,3}, Maxime Bourgain^{1,3}

¹ EPF Graduate School of Engineering, 3bis rue Lakanal, 92330 Sceaux, France

² Racing 92, 11 Avenue Paul Langevin, 92350 Le Plessis Robinson, France

³ Institut de Biomécanique Humaine Georges Charpak, Arts et Métiers Institute, 151 boulevard de l'hôpital, 75013 Paris, France

Introduction

Rugby is a worldwide played sport involving dynamics events when players' heads could be exposed to impacts. Those can lead to concussions which may have long term harmful effects on brain. In field, decision on concussion is of high interest but remains complex to manage. Currently, independent medical doctor should take the decision of maintaining the supposed concussed player on the field based on the Sports Concussion Assessment Tool (SCAT). This tool is mainly based on subjective parameters [1]. Up to now, developed technologies, such as sensors integrated in a headband or over the skin or instrumented helmets [2] have not been able to quantitatively measure concussion occurrence in-field. Thus, developing a way to help doctors to take a decision based on quantitative criteria (count and severity of collisions) and in-field, would be of interest. To that purpose, instrumented mouthguards (iMG) seem to be a good candidate as they measure both linear and rotational accelerations and velocities. By comparing to the video recording, iMG based study has been shown to be of interest for American football to investigate concussion, but it has not been done for rugby.

Thus, the objective of this study was to investigate the feasibility of using instrumented mouthguards for quantifying head impacts during rugby games.

Methods

This study was approved by a local ethical committee and conducted under the supervision of the Racing92 medical doctor. Fourteen players of a French elite rugby team (U21 team of the Racing92) volunteered to wear a thermosettable iMG (Prevent, "boil and bite" technology, Edina MN). They were able to test it and to use it during several training sessions. Each player was asked about the comfort after each session. Constructor recommendations (settings and trainings) were followed. To select events, a threshold should be set, based on measured linear head acceleration with a minimal value of 5 *g*. In the current study, two were defined: 5 *g* and 10 *g* [3].

Video and iMG data were collected during one match and were manually synchronized. Then they were analysed by a sport data scientist and a strength and conditioning coach. Video analysis combined with on-field visualization was considered as the reference. For each detected impact by the iMG, the corresponding video instant was checked, and reverse. If the considered player had/had not a head acceleration on the video, it was considered as true/false positive.

Results

For this match, only 8 equipped players were playing. Over the match, a total of 111 head accelerations ($>5 g$) were measured. Ninety six out of 111 were verified with the video (45 between 5 and 10 g), 9 were not verified at the video (false positive) and 6 undetermined (the camera does not permit to verify). For acceleration over 10 g , 56 were measured, 52 were verified on the video, 4 were undetermined and 0 were false positive. Four measured accelerations between 5 and 10 g , were assumed as underestimated and 5 noticeable impacts were not detected and were considered as false negative.

Discussion

For this team and this match, the acceptability of the mouthguard was good as no player claimed discomfort. However, before the match, 2 players faced difficulties with their iMG as it usually fell, and one had a compatibility problem with his jaw. Using a custom fit mouthguard may be of interest for them. Those iMG appeared to have a good reliability between 86% and 93% of true positive detection. However, caution should be paid as in-field true value is difficult to verify. Regarding the amount of impacts between 5 and 10 g , a specific attention should be paid as it may be conducting to a cumulative concussion over the season.

Conclusion

Instrumented mouthguard appeared to be a promising candidate to measure in field head accelerations. However its reliability and acceptability should be better investigated. Its use should be optimized to be a more reliable real time help for coaches and medical staff in a match environment.

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