COULD LOWERING THE TACKLE HEIGHT LAW TO BELOW THE CHEST IN RUGBY UNION REDUCE LONG-TERM BRAIN DEGENERATION?

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INTRODUCTION

The tackle height law in rugby union has been an area of concern for many years. It is currently set at the line of the ball carrier's shoulder. Tierney et al. (2017) previously demonstrated that tackling at the ball carrier's chest/shoulder accounts for nearly half of all tackler concussions. Lowering the tackle height has been put forth as a recommendation but the evidence base for this is limited. Before tackle height laws can be changed, it is essential to examine the biomechanics of tackling on ball carrier head kinematics to understand the demands that the tackle places on the ball carrier. This is particularly important considering that repetitive sub-concussive impacts have been linked to brain degeneration (Baugh, 2012) and rugby players are already showing signs of this (Hume et al, 2016). Therefore, the goal of this study is to use Model-Based Image-Matching (MBIM) and human volunteer tackles in a marker-based 3D motion analysis laboratory to examine the severity of a legal tackle to the shoulder/chest of the ball carrier (with no head contact) and the effect of tackles above and below the chest on ball carrier inertial head kinematics, respectively.

MATERIALS AND METHODS

MBIM, a novel approach that utilises multiple camera view video and a skeletal model to extract six degree of freedom head kinematics directly from video, was used to measure the ball carrier head kinematics during a real-world tackle to the chest/shoulder region (Fig1a).

Furthermore, 20 tackles in a 3D motion analysis laboratory were executed by two pairs of professional rugby union players (Fig1b). Ball carrier head kinematics for tackles above and below the chest of the ball carrier were compared using the Mann-Whitney U test as the data was non-parametric.

(a) (b)

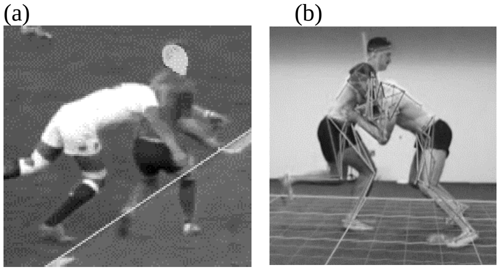

Figure 1 (a) The MBIM technique applied to the ball carrier's head, for a given video frame, in a real-world tackle to the posterior chest/shoulder region and (b) a staged tackle in the 3D motion analysis laboratory at the time of impact.

RESULTS

From the real-world tackle, the estimated ball carrier peak resultant change in head angular velocity was 30.4 rad/s (23.1 rad/s, 14.0 rad/s and 21.8 rad/s in the coronal, sagittal and transverse direction, respectively). In the staged tackles, the median peak resultant head linear and angular acceleration and change in head angular velocity values for tackles above the chest were greater than for below the chest (Table 1). Both angular acceleration ($p=0.03$; ES=0.50) and change in angular velocity ($p<0.01$; ES=0.64) demonstrated statistical significance and a large effect size. However, differences in linear acceleration did not demonstrate statistical significance and had a moderate effect size ($p=0.10$; ES=0.36).

	Above Chest	**Below chest**	**p-value**	**Effect size**
Angular Velocity (rad/s)	6.8 (5.2-9.1)	3.0 (1.8-4.3)	<0.01	0.64
Angular Acceleration (rad/s^2)	320 (240-470)	147 (78-363)	0.03	0.50
Linear Acceleration (g)	9.0 (4.8-10.9)	5.1 (3.1-6.8)	0.10	0.36

Table 1 The median ball carrier peak head kinematics for above and below chest tackles (with p-values and effect sizes.)

DISCUSSION

The results of the study support the proposition of lowering the current tackle height law. Due to the real-world tackle (MBIM), the ball carrier head kinematics indicated a greater than 75% chance of sustaining a concussion, based on the literature (McIntosh et al, 2014). This was the case even though no contact was made with the ball carrier's head. Therefore, repeatedly engaging in this type of legal tackle may be detrimental for long-term brain health. However, by lowering the tackle height law to below the chest, ball carrier inertial head kinematics can be reduced significantly, thus reducing the repetitive loading placed on the brain.

REFERENCES

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