

A Comparison Of Branded Rugby Headguards On Their Effectiveness In Reducing Impact On The Head

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Introduction

Rugby Union has one of the highest incidences of concussion in contact sport and rates are continuing to increase. Furthermore, head impacts in the sport are also being linked to potentially fatal sequelae of concussion, such as Second Impact Syndrome and Chronic Traumatic Encephalopathy. Despite this, World Rugby refuses to endorse rugby headguards, the only available form of head protection available to players, as an effective way of preventing concussion.

Aim and Objectives

The aim of this research was to compare branded rugby headguards and evaluate their impact attenuation properties, in regards to concussion prevention. Testing was also carried out on multiple surfaces of the headguard to determine which areas of the cranium were best protected.

Methods and Materials

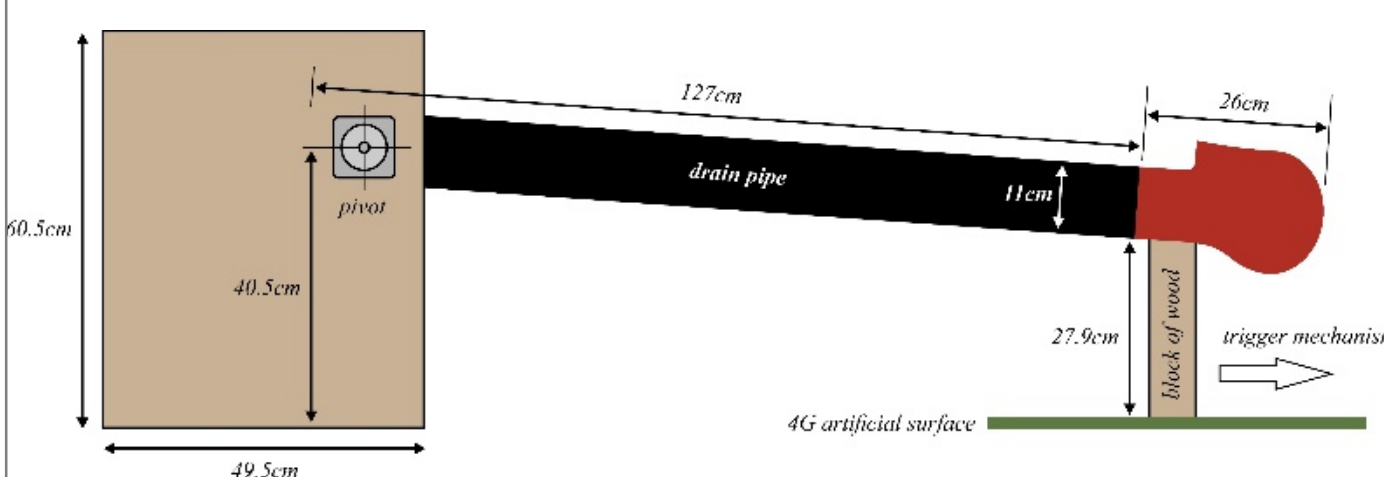


Figure 2. Dimensions of the testing rig used in headguard testing (Christie, 2017)

Seven different branded headguards were selected for testing, shown below in Figure 1. To evaluate the headguards a drop test mechanism was designed involving a testing rig shown in Figure 2. Each headguard was fitted on to the rigid headform and dropped onto five different surfaces of the headwear (front, back, left, right and top). The headguards were dropped onto a 4G artificial surface from a height calculated to generate an average force of 103.8g, a figure at the top end of the proposed concussion threshold (Pellman, *et al.*, 2003; Mihalik, *et al.*, 2007; *inter alia*). An accelerometer was attached to the headform to measure the linear acceleration experienced by the headform during impact with the ground. A mean peak acceleration for each drop position was calculated and compared with a baseline measurement.

Results

Each headguard produced a significant decrease in the mean peak acceleration from the baseline value (all $p < 0.01$). There was also a range in efficiency between the headguards seen in Table 1 which includes the overall mean peak acceleration for each headguard. The most effective headguard was the Canterbury Ventilator headguard which overall reduced the impact force by 39%. The least effective were the XBlades Elite and the Gilbert Evolution headguards which saw an overall force reduction of 24%.

Table 1. Mean peak acceleration (g) for each brand recorded during headguard testing

Brand of Headguard	Number of drop tests	Mean (g)	Standard Deviation	Average reduction from baseline (%)
Baseline	5	103.80	3.03	-
Canterbury	60	62.93	16.08	39.4
Impact	60	64.30	18.51	38.1
Optimum	60	66.01	14.07	36.4
Kooga	60	67.54	16.59	34.9
Adidas	60	69.12	17.07	33.4
XBlades	60	78.52	9.76	24.4
Gilbert	60	78.76	14.80	24.1

Further breakdown of the results by position is seen in Figure 3. The worst performing position at reducing impact forces was at the top for all 7 headguards, however, there was no discernible trend amongst the other positions. Post Hoc statistical analysis demonstrated that the best performing headguard was significantly different ($p < 0.05$) from the poorest performing headguard in each position tested.

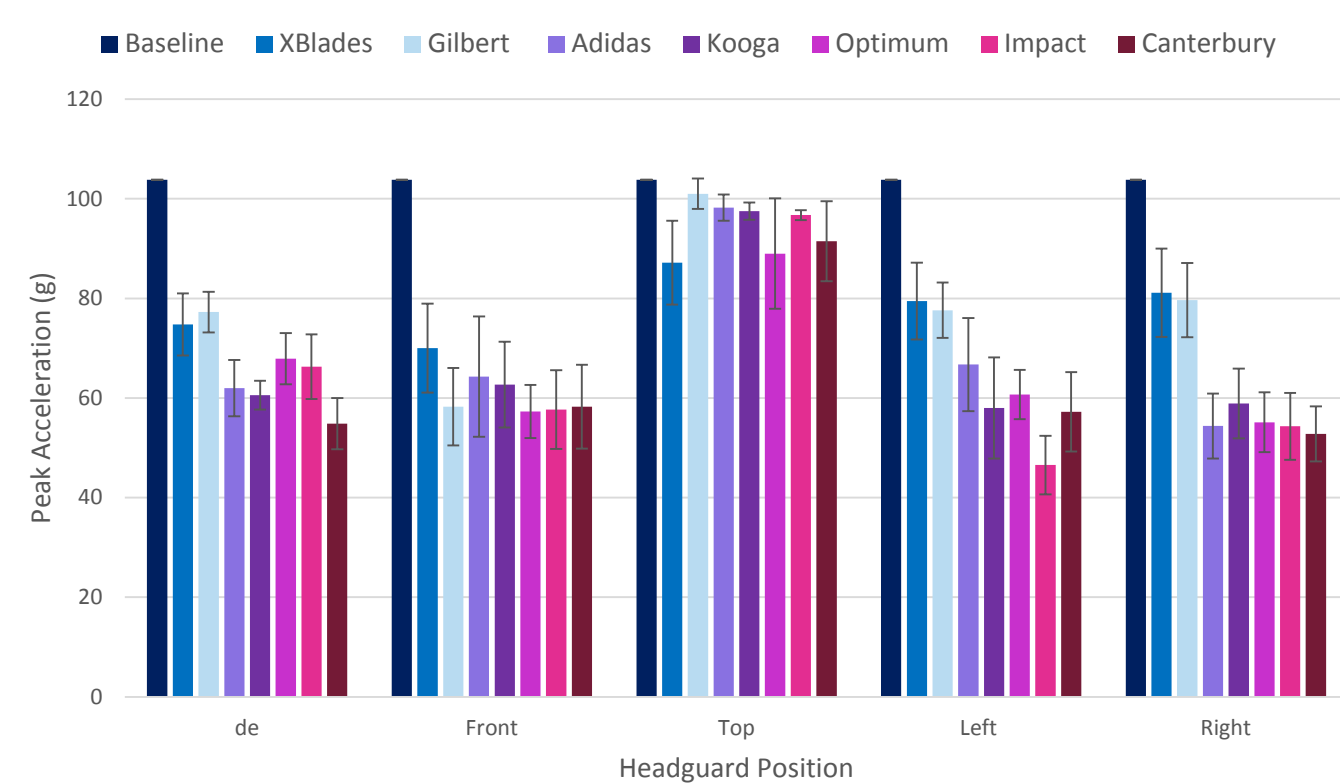


Figure 3. Mean peak acceleration (g) recorded in each headguard position

Discussion

The results demonstrated that all the headguards included in testing were effective at reducing impact forces ($p < 0.01$). Furthermore there was a variation in the efficiency seen between the seven headguards. The headguards which produced the largest force reduction, such as the Canterbury and Impact headguards, were also most effective when tested on the sides, the site head impacts in rugby have been shown to be most common (King, *et al.*, 2015).

With research pointing to a concussion threshold of between 80-100g (Pellman, *et al.*, 2003; Mihalik, *et al.*, 2007; *inter alia*) all the overall mean peak acceleration values were below this figure. However, individual drop tests did surpass 80g: 45% of those involving the least effective XBlades headguard, compared to only 18% in the most effective Canterbury headguard. Furthermore the XBlades headguard had at least one drop test exceed 80g in all positions, where as only the top position crossed the threshold for the Canterbury headguard.

This study is limited in that it relied upon lab testing: prior research in this field indicates positive testing of headguards in the lab does not always translate into reduction in concussion rates on the rugby field.

Conclusion

Overall, the results indicate it would be beneficial to wear a headguard during rugby play as they do demonstrate impact attenuation properties. There was also a clear difference in performance between the tested brands, establishing the Canterbury headguard as the most effective. However, as only one model of headguard from each brand was tested; further research evaluating other models should be considered.

References

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Figure 1. Branded headguards selected for testing (left to right): Adidas Rugby Headguard (£34.95), Impact RWC Tartan Headguard (£39.99), Kooga Combat Headguard (£28.99), Canterbury Ventilator Headguard (£42.00), XBlades Headguard Elite (£34.99), Optimum Hedweb Classic Headguard (£24.99) and Gilbert Evolution Headguard (£34.99).