REAL WORLD HEAD IMPACT DATA MEASUREMENTS ON JOCKEYS

Manuel A. Forero Rueda and Michael D. Gilchrist

School of Electrical, Electronic & Mechanical Engineering, University College Dublin, Belfield, Dublin 4, Ireland

KEY WORDS**:** Instrumentation, Head injury; Equestrian; Horse racing.

INTRODUCTION: A novel instrumentation system previously implemented on American football helmets (Greenwald et al. 2008) has been adapted and validated against a Hybrid III head and neck for use in an equestrian environment. This has been used to determine the forces applied to jockeys' heads during fall impacts in competition racing.

METHODS: Twelve professional Irish National Hunt jockeys participated in data collection of real life head impacts. Instrumented helmets were fitted to the jockeys to gather head impact data in case of a fall during a race. These helmets were fitted with sets of six linear accelerometers that, when appropriately aligned and used in conjunction with postprocessing techniques, provided the linear and angular acceleration values for the jockey's head defined along cartesian axes, the origin of which is at the centre of gravity of the jockey's head.

RESULTS: Fall/ride frequency was of 5%, ride average for the participating jockeys was of 300 rides/year. Four confirmed head impact events during racing with video data have been collected to date from different jockeys. The values for maximum linear and angular acceleration are shown in Table 1. None of these impact events led to head injury.

Table 1 Maximum linear and angular acceleration results for each fall

Fall Case	Linear Acceleration (g)	Angular Acceleration (rad/s^2)
1	31.3	1799.5
2	71.4	4403.0
3	47.7	3122.1
4	98.5	2428.3

DISCUSSION: Linear acceleration values are just below the accepted injury thresholds derived from the WSTC, where injury is expected above 100g for moderate duration impacts; therefore they were not expected to be related to injurious cases. From previous instrumented helmet data collected from American Football players (Greenwald et al. 2008), the data collected to date has a very low probability of concussion (<0.3).

CONCLUSION: This study is the first time that head impact linear and angular accelerations have ever been directly measured in equestrian activities in a real racing environment. The data can now be used to reconstruct head impacts through the use of video analysis and computational techniques. A larger data set will allow us to correlate linear and angular accelerations to head injury in jockeys. More actual fall measurements should be done in a more controlled environment to improve the frequency of positive results, and further technical improvements on the measurement system should be implemented to simplify the measurement procedure to optimize data collection in a horse riding environment.

REFERENCES:

Greenwald R, Gwin J, Chu J, Crisco J (2008). Head Impact Severity Measures for Evaluating Mild Traumatic Brain Injury Risk Exposure. *Neurosurgery*, 62(4), 789-98.

Acknowledgement

We would like to thank The Turf Club for financing this project.