Motorcyclists Crashes into Race Tracks and Normal Road Barriers: Kinematic Analysis and Correlation with Test Procedures

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I. INTRODUCTION

In 2013, 1680 people died in traffic crashes in Spain. This figure has been decreasing steadily over the last 11 years. Other indicators such as the ratio between fatalities and injured people exhibit the same behaviour [1]. Although there is no a clear measure of exposure, the number of vehicles in Spain has grown over the same period. Between 2004 and 2013 and partially due to legislation changes [2], the number of motorcyclists has grown in Spain by 7% with more than 2.8 million motorcycles registered in 2013 [1]. Motorcyclists represented almost 18% of all fatalities in Spain in 2013 showing the smallest fatality reduction of all user groups between 2004 and 2013 (- 3%) [1]. A particularly severe type of motorcycle collision is the crash into road barriers due to losing control of the motorcycle. Previous studies have demonstrated the higher injury risk of these crashes compared to other motorcycle crashes [3] [4]. In the USA, the likelihood of being fatally injured as a motorcyclist in a collision against a road barrier was reported to be 80 times higher than for passenger car occupants [5]. Several studies have attempted to characterise the injury severity risk factors involved in these impacts including the type of barrier, orientation and speed of the rider with respect to the barrier/ground and influence of different motorcycle technologies in the impact configuration [6-9]. Some of these efforts resulted in the adoption of the European Technical Specification CEN/TS 1317-8 in which a modified Hybrid III test dummy with a helmet is launched sliding on the ground in a head-on impact at 30 degrees and 60 km/h against different locations of Motorcycle Protective Systems (MPS). MPS consist of a lower continuous rail that is installed in existing W-beam barriers to prevent the sliding motorcyclist from passing under the upper W-beam and impact into other rigid roadside obstacles.

However, there is evidence that a significant share of motorcyclist impacts against roadside barriers happen in upright position with the rider still attached to the motorcycle. This configuration is even more relevant when the vehicle is equipped with ABS brakes [9]. In parallel to the aforementioned CEN/TS 1317-8, the International Federation of Motorcycles (FIM) proposed an internal regulation of roadside protection used in the racing tracks during competition. This regulation requires barriers to provide a certain level of deceleration of a body-block in vertical position, impacting the barrier at different speeds in free flight.

Given the two very distinct impact configurations addressed in these two standards, this work aims at providing answers to the following question:

- What are the most common orientations (spine angle wrt. the ground) of the rider in impacts against roadside barriers both in normal roads and in racing tracks?
- Is there a correlation between predominant rider orientation in crashes and test procedures, both for normal roads barriers and racing tracks barriers?

II. METHODS

The study is based on the detailed video analysis of 110 crashes of motorcycles (engine displacement > 50 cc) into roadside barriers. The videos are publicly available at www.youtube.com [10] Crashes occurring in racing tracks and normal roads were included. The only exclusion criterion was low video quality that prevented from recording the study variables.

The information recorded from each case was:

- o Video of the crash
- o Angle of the spine with respect to the ground
- o Estimated impact angle between the rider and the barrier
- o Rider body region(s) impacting against the barrier
- o Estimated impact speed (if possible)

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III. INITIAL FINDINGS

One of the relevant variables collected in this research is the angle of the rider spine with respect to the ground, as test procedures in regulations define an upright position in the case of race track barriers and a supine position for normal road barriers. Video analysis of crashes in racing tracks shows that the predominant spine angle wrt. the ground is mainly low, being the pilot both in prone/supine position (see Figure 1).

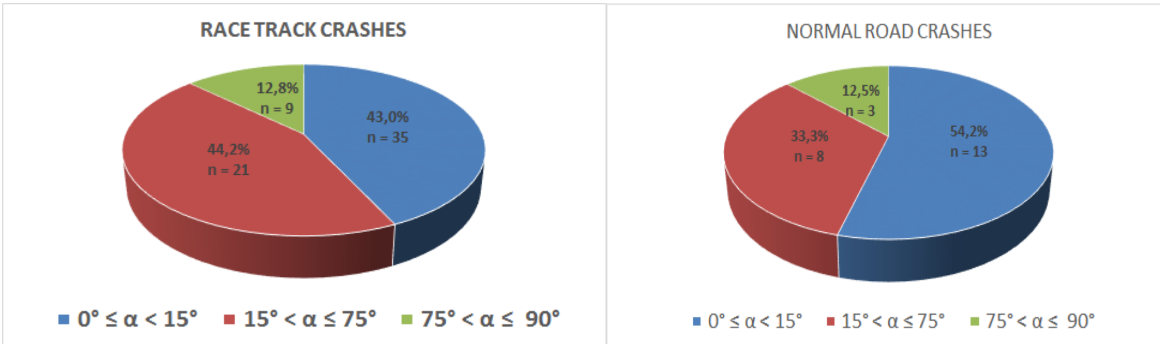

Fig. 1. Distribution of rider spine angle wrt. the ground in race tracks / normal roads crashes.

Video analysis of crashes in normal roads shows a quite similar spine angle distribution (see Figure 1).

IV. DISCUSSION

For race track crashes, the pilot spine – ground angle distribution found in the video analysis shows mostly low angles, which is not well represented in the barrier test procedure applied, consisting of a body-block vertically impacting the barrier at different speeds in free flight. For normal road crashes, the motorcyclist spine – ground angle distribution found is consistent with the barrier test procedure defined by CEN/TS 1317-8, consisting of a full dummy sliding and impacting the barrier in supine position. During the conference, the rest of the available data, like the spine-barrier angle and rider position will be shown and discussed in the same way, comparing results to test procedures in standards.

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