Anti-lock Braking System on Bicycles: A Pilot Study on Influence on Stability

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I. INTRODUCTION

Improving the safety for cyclists has been identified as a big challenge in the road safety area [1-2]. Bicycle accidents are among the most common road traffic injuries producing severe injuries and injuries leading to permanent medical impairment. Hospital data shows that bicycle accidents account for half of all road accidents in Sweden leading to permanent medical impairment. Since 2008, the cyclist road user group has been the largest accident group, requiring hospitalisation for at least one day [3]. In Sweden, the STRADA database holds both police and hospital injury data, from crashes in the Swedish road transport system. Hospital data in STRADA has shown that the majority of disabling injuries of cyclists are sustained in single accidents, which are not recorded by the police. The distribution of Risk of Permanent Medical Impairment (RPMI) 10%+ injuries of cyclists in 2014 are shown in Figure 1, showing that the main categories are head and upper arm/shoulder injuries.

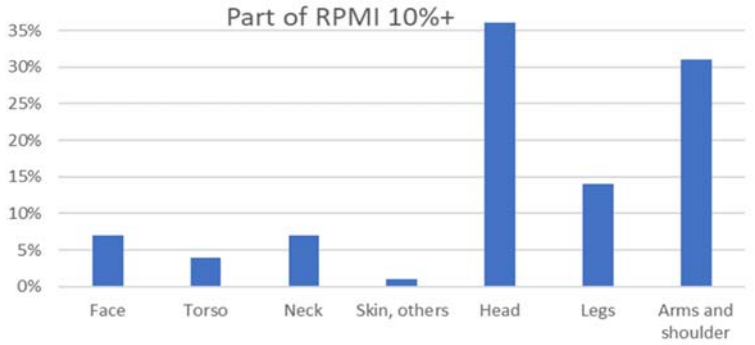

Figure 1. The distribution of RPMI 10%+ injuries of cyclists (Swedish Strada data 2014).

In terms of countermeasures head injuries can be prevented by helmets but how to address injuries to the shoulder? One possibility is to make the cycle more stable, which has been explored in this study. Studies highlight that a bicycle becomes unstable when the front or rear wheel locks, which can be prevented by an Anti-lock Braking System (ABS) [4]. ABS has been shown to reduce the risk of injury to motorcyclists due to increased stability during the breaking events [5]. The effect of ABS on nose-over accidents has recently been presented by an ABS manufacturer [6]. The present study aimed to investigate the effect of ABS on the stability of bicycles during braking events. The research question posed was: Can the stability of bicycles be improved during a braking event through ABS fitted on the front wheel? The question sought answers through bicycle brake tests with and without ABS.

II. METHODS

A bicycle with a closed frame (men´s bicycle) was tested. The bicycle was of the make Crescent and had a V-brake on the front wheel. Two types of tests, with and without ABS, were performed. The ABS was of the Safe Anti-Locking Braking System (SABS) V1 model, delivered by the company King Industries Inc. in Canada. The brakes were activated by a pneumatic device mounted below the horizontal part of the frame. A Hybrid II crash test dummy, a 50th percentile male, represented a cyclist in the tests. The bicycle was mounted on a sled and released at a speed of 17 km/h. The brakes were then activated by a battery connected to the pneumatic device that was disconnected once the bicycle had run 200 mm. The brakes were applied with maximum force on the front wheel.

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III. INITIAL FINDINGS

The results showed that the ABS on the front wheel of a standard bicycle prevented the front wheel from locking at maximum braking and the rear wheel thereby retained contact with the surface during the whole event, Fig. 2a. Breaking distance was then approximately 4 meters. In the case of full-braking without ABS the front wheel locked and the rear wheel lifted from the ground, Fig. 2b. Consequently, the bicycle only balanced on the front wheel and the braking distance in this case was then approximately 2 meters.

Fig. 2a. Front wheel braking with ABS.

Fig 2b. Front wheel braking without ABS.

IV. DISCUSSION

The results of the pilot study indicate that an ABS can improve the stability of a bicycle during a braking event, by ensuring that both wheels stay in contact with the surface during the whole braking event. To fully evaluate the effects of ABS on the stability of a bicycle during braking, a much more extensive test set-up and test matrix is needed, including variables such as: surface friction, type of tyres and brakes, different types of bicycles, etc. The ABS tested in this study was not specifically designed for a specific bicycle. The brake distance of an ABS specifically designed for a particular bicycle model and brake type might differ from that measured in this study. To quantify the improvements in terms of reduced impact forces on the cyclists would require a test method for bicycles, which is yet to be established. Virtual testing may be used utilising knowledge gained in the field of vehicle occupant impact simulations using Human Body Models [7-9].

V. ACKNOWLEDGEMENT

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VI. REFERENCES

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