

## Energy Attenuation Performance of Impact Protection for Motorcyclists

Bianca Albanese, Lauren Meredith, Tom Whyte, Tom Gibson, Liz de Rome,  
Michael Fitzharris, Matthew Baldock, Julie Brown

### I. INTRODUCTION

Energy attenuation provided by motorcycle impact protectors (IPs) is a mechanism that can be used to reduce loads transferred to the body of motorcyclists. Impact protectors have been shown to reduce the overall injury risk in motorcycle crashes [1] and severity of fracture injuries in laboratory tests [2-3]. However, previous research shows little evidence that commonly used motorcycle IPs are effective in reducing the risk of fractures in real-world crashes. Motorcycle IPs usually comply with the European Standard EN1621-1, which sets minimum energy attenuation requirements. This study aims to examine the effectiveness of IPs worn by Australian riders in crashes, in terms of EN1621-1 energy attenuation requirements and injury outcomes.

### II. METHODS

Motorcycle riders (n=90) were recruited as part of a previously reported in-depth study [4]. Details of IPs worn were collected from interview and clothing was inspected, where possible. Clothing damage and/or the presence of impact injuries were used to identify body regions impacted. Impact injuries, (i.e. fractures, dislocations, avulsions) due to impact to shoulders, elbows, hips and/or knees were identified from medical records.

Impact protectors were harvested from clothing (n=76) and categorised as CE certified or not. They were then tested to the energy attenuation requirements of EN1621-1. The IPs were impacted in three separate locations using a 5 kg mass released from a height, so that kinetic energy on impact was 50 J. The average and maximum transmitted force of the three tests were recorded. An IP was said to meet the EN1621-1 energy attenuation requirements if the force transmitted was below a maximum threshold for both the average and maximum energy transmitted. Associations between energy attenuation and impact injury were examined using logistic regression, accounting for repeated measures. The association between CE certification and impact injury was examined using Fisher's Exact test.

### III. INITIAL FINDINGS

Seventy-six IPs were collected from 19 riders. Twenty-six impact locations were identified. Four separate riders each sustained a fracture in an identified impact location; clavicle (2), olecranon (1), or scapula (1). Ninety-two percent of the IPs were CE marked, and 83% passed the energy attenuation requirements of EN1621-1. No significant difference was found between impact injury and meeting EN1621-1 requirements ( $p = 0.5$ , Fisher's Exact test), or between CE certification and impact injury ( $p = 0.6$ , Fisher's Exact test) (Table I). There was no association between the performance of IPs in the energy attenuation EN1621-1 test in terms of the average force transmitted and presence of impact injury (OR = 1.1, 95% CI: 0.91-1.24). However, as maximum force transmitted increased, there was a higher likelihood of impact injury occurring (OR = 1.1, 95% CI: 1.01-1.2).

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TABLE I  
 OCCURRENCE OF IMPACT INJURY IN RIDERS WITH CE CERTIFIED IMPACT PROTECTION  
 AND IMPACT PROTECTION THAT PASSED EN1621-1 ENERGY ATTENUATION REQUIREMENTS

		CE Certified (n=26)		Passed EN1621-1 Requirements (n=26)	
		Yes	No	Yes	No
<b>Impact Injury</b>	<b>Yes</b>	3 (14%)	1 (20%)	3 (14%)	1 (25%)
	<b>No</b>	18 (86%)	4 (80%)	19 (86%)	3 (75%)

#### IV. DISCUSSION

Impact protectors are an important feature of motorcycle protective clothing, designed to attenuate energy resulting from a direct impact. This study examined the effectiveness of IPs worn by Australian riders who had been involved in crashes, in terms of EN1621-1 energy attenuation requirements and injury outcomes. Although most IPs met EN1621-1 requirements for energy attenuation, meeting this requirement was not associated with a reduced likelihood of the injuries studied. This study presents a cohort of crashed riders who were admitted to hospital following a motorcycle crash, possibly biasing serious injury cases. Furthermore, it is a relatively small sample size, with a small number of injured riders, which restricts the analysis. However, the small number of riders in this study with impact injuries in regions covered by IP suggests there may be of some benefit, apart from the ability of the IP to attenuate energy when tested to EN1621-1.

#### V. ACKNOWLEDGEMENTS

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#### VI. REFERENCES

- [1] de Rome, L. *et al.*, *Accid Anal Prev*, 2011.
- [2] Nygren, A., Institut fur Zweiradsicherheit, 1987.
- [3] Otte, D. *et al.*, *AAAM*, 2002.
- [4] Brown, J. *et al.*, *Austrroads* [online], 2015.

**Erratum**

**Energy Attenuation Performance of Impact Protection for Motorcyclists**

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**III. INITIAL FINDINGS**

Line 2 – “Ninety-two” changed to “Ninety-six”

Line 4/5 – Delete “, or between CE certification and impact injury ( $p = 0.6$ , Fisher’s Exact test)”

Table 1 –

TABLE I  
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		CE Certified (n=26)		Passed EN1621-1 Requirements (n=26)	
		Yes	No	Yes	No
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Changed to

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AND IMPACT PROTECTION THAT PASSED EN1621-1 ENERGY ATTENUATION REQUIREMENTS

		CE Certified (n=26)		Passed EN1621-1 Requirements (n=26)	
		Yes	No	Yes	No
Impact Injury	Yes	3 (12%)	1 (100%)	3 (14%)	1 (25%)
	No	22 (88%)	0 (0%)	19 (86%)	3 (75%)