Abrasion Resistance Performance of Clothing Worn by Australian Motorcyclists

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I. INTRODUCTION

Motorcycle crashes account for an increasing proportion of road traffic trauma around the world [1]. Soft tissue injuries are the most commonly occurring injuries to crashed motorcyclists [2]. Protective clothing has been developed in order to help prevent these injuries, yet the performance of protective clothing in Australia is still variable [2]. While Australian riders are encouraged to use protective clothing [3], there are currently no mechanisms in place to help maintain a high quality of performance among products available to Australian motorcycle riders. To address the variability in performance of motorcycle clothing observed in recent Australian crash studies, there have been calls to introduce some formal mechanism to ensure the safety performance of available garments, or at least to provide riders with information to assist them in making informed purchasing decisions [2]. This investigation assesses the performance of motorcycle clothing worn by crashed motorcyclists in the real world as well as in a laboratory environment.

II. METHODS

In-depth crash investigation procedures were used to investigate 92 motorcycle crashes. Riders were recruited from three Sydney hospitals and one regional hospital from August 2012 to August 2014. Medical records were examined and the clothing worn by the riders was inspected and retained for laboratory testing, where possible. If unable to obtain clothing, the type of clothing was recorded and new clothing items were purchased to the same specifications.

Experimental Testing

The abrasion resistance of the clothing worn by motorcyclists was tested in a laboratory environment. Experimental testing was conducted using the Cambridge Abrasion machine located at Deakin University according to EN13595-2, the EU Standard test procedure for assessing abrasion resistance of motorcycle protective clothing. In this procedure, the time taken for the combined layers of materials in each garment to hole was measured. A total of 32 garments, including 50 different materials, were available and tested.

Analysis

The overall performance of the clothing was examined by investigating soft tissue injury outcomes (excluding contusions) at each site of clothing damage. A random effects logistic regression was used to examine the association between soft tissue injury and abrasion time. The random effect was fit for each person and was conducted to account for within-subject variability. Modelling took account of whether garments were designed for motorcycle use and fitted with impact protection at the damage site, in addition to type of damage, rider age, impact speed and object struck. The probability of soft tissue injury against abrasion time was determined with 95% confidence intervals.

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III. INITIAL FINDINGS

There were 633 individual points of damage over the entire sample of riders. Injury occurred at 165 of these locations (26%). Soft tissue injuries (excluding contusions) occurred at 69 of these points of damage (11.6%). Extensive damage, where there was complete failure of the material so that the rider's skin became exposed, occurred in 117 of the 633 locations of damage (18.5%). Motorcycle protective clothing helped prevent injuries, whereas riders who were not wearing protective clothing had over double the odds of soft tissue injury (OR: 2.564, 95% CI: 1.010-3.875).

With an increase in abrasion time, as measured on the Cambridge abrasion machine, a rider's odds of suffering a soft tissue injury decreased, but this association was not significant (p=0.14), see Table I. An abrasion of 1 second was associated with a 19% reduction in the odds of soft tissue injury compared to an almost instantaneous (time=0 seconds) abrasion time, while an abrasion time of 7 seconds was associated with a 77% reduction in the odds of soft tissue injury.

According to the probability curve generated, an abrasion time of 7 seconds equates to a 24% probability of soft tissue injury. An abrasion time of 4 seconds equates to a 37% probability of soft tissue injury and a 1 second abrasion time carries a 53% probability of soft tissue injury.

TABLE I
PROBABILITY AND ODDS RATIO OF SOFT TISSUE INJURY BASED ON ABRASION TIME FOR THE EU STANDARD 13595-2, 1-, 4- AND 7-SECOND THRESHOLDS

	Probability of soft tissue injury		Odds ratio	
	Estimate	95% CI	Estimate	95% CI
1 second	0.53	0.41, 0.64	0.81	0.61, 1.07
4 seconds	0.37	0.19, 0.60	0.43	0.14, 1.32
7 seconds	0.24	0.05, 0.63	0.23	0.03, 1.63

IV. DISCUSSION

The large number of garments experiencing extensive damage highlights the variable quality of clothing worn by Australian motorcyclists. However, wearing clothing designed for motorcycle use did help prevent soft tissue injuries in the crashed motorcyclists. Additionally, the materials which resisted abrasion damage for a longer time, as measured on the Cambridge abrasion machine, were associated with lower odds of injury. On average, the materials used in motorcycle jackets could withstand abrasion for just 1.5 seconds. Therefore, on average, the use of these jackets is associated with an approximate 50% probability of soft tissue injury during a crash. While this is better than no protection at all, it is far from optimal and unlikely to meet the expectations of those using this clothing who assume they will be protected from soft tissue injury in the event of a crash.

The results of this work demonstrate the validity of the approach currently taken in EN13595 to assess abrasion resistance of clothing designed to protect motorcyclists from soft tissue injury. They also highlight the need to provide a mechanism to maintain a high quality of clothing sold to motorcyclists.

V. REFERENCES

[1] World Health Organization, *Global status report on road safety*, 2013.
[2] de Rome, L., *Accid Anal Prev*, 2011.
[3] Transport for NSW, *NSW Motorcycle Safety Strategy*, 2012.