Analysis of post-crash motorcycle helmet components in Klang Valley, Malaysia

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Abstract

The aim of this study was to investigate the association between helmet component characteristics with frequency and distribution of head and brain injury (diffuse and focal) among motorcyclists in Klang Valley, Malaysia.

In Malaysia, helmet law was implemented in 1973 (MIROS, 2008). To date, high helmet wearing rate was observed among Malaysian motorcyclists (i.e. 90% among riders) (World Health Organization, 2009). However, despite of this reasonably high rate, the fatality rate was shown to be 58%.

145 helmets were collected from participants involved in motorcycle crash. Helmets were analysed at Standards and Industrial Research Institute of Malaysia (SIRIM) laboratories. Examination comprised:

i) basic characteristics: type, brand, colour, weight, locally made or imported, product serial number
ii) physical characteristics of each component: thickness and material of the outer shell, thickness and density of the inner liner and type of the retention system
iii) damage or crash marks: on the outer shell, inner liner and retention system

Analysis of the material and quality of the material (i.e. degradation) was carried out for the outer shell and visor using the Fourier Transform Infra-Red (FTIR) analysis. Finally, scanning electron microscopy (SEM) was performed on selected outer shells and inner liner. Of the 145 helmets, 86.2% of half head helmets, 4.8% open face, 5.5% tropical and 3.4% full-face helmets. Majority of the helmets (89.7%) were size 60 (large). Age of the helmets ranged from a few hours after purchase to 20 years old (mean of 2.23 years). Mean weight for a tropical helmet was 0.72 kg, an open face, 1.09 kg, a half head, 1.24 kg and a full-face helmet, 1.62 kg. The tropical helmet was shown with the thinnest outer shell. Majority of the helmets were made of acrylonitrile butadiene styrene (ABS) (91.0%). All the selected ABS helmets showed evidence of degradation except for one helmet. All inner liners were made of the expanded polystyrene (EPS). The lowest and highest density among all the helmet types was shown in the half head helmets. In relation to damage, 86.2% of the outer shell showed signs of crash marks while 2.1% were structurally deformed. Most of the inner liners (97.9%) were intact while 9.7% of the buckles were structurally damaged. SEM showed microfractures in a degraded outer shell. The inner liner EPS cells, however were patent.

The thickness of the outer shell, inner liner and density of the inner liner of the SIRIM standard helmets were comparable with the international standard. However, degradation effect and the damage/non-damage characteristics of the inner liner could contribute to the overall performance of the helmet.