PRELIMINARY EXPERIENCE OF PASSENGER AIRBAG DEPLOYMENTS IN AUSTRALIA

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ABSTRACT

19 cases of passenger airbag deployments in a frontal crash in which a passenger was present have been investigated. These investigations were conducted as part of an on-going study of vehicle crash performance and occupant injury currently on-going at the Monash University Accident Research Centre (MUARC). Preliminary results suggest that the US experience of fatalities caused by interaction of the passenger with the deploying airbag is not shared in Australia. This is probably because the seat-belt use in the study was high (18/19 or 95%). These preliminary results support the view that such airbags should be used as supplementary restraint systems. Further studies are planned to monitor the performance of passenger-airbags and to provide more in-depth analyses when more data are available.

INTRODUCTION

A picture is just beginning to emerge about the relative merits of driver-airbag effectiveness in frontal crashes. In countries where restraint use is high, driver airbags have been found to be relatively effective in preventing serious injury to the driver (Fildes et al, 1996; Langwieder et al, 1996; Morris et al, 1996).

However, as Huelke and Reed (1996) have observed, passenger side airbag effectiveness is relatively unknown for infrequently is there a passenger in the front seat when the airbag deploys.

As a necessary precursor to a more in-depth study, this is preliminary study of Australian experience with deploying passenger airbags. Initial experience of injury outcomes to restrained and unrestrained passengers in frontal crashes is recorded.

METHODOLOGY

The Monash University Accident Research Centre conducts in-depth research into car-crash performance and occupant injuries in Australian passenger cars involved in real world crashes. All vehicles in this study were involved in crashes of sufficient severity to warrant a tow-away from the scene of the crash.

In addition to the tow-away criteria, for inclusion in this study of passenger airbag deployments, the vehicles had to meet additional criteria; firstly, that the vehicle was involved in a frontal impact in which the principal direction of force (PDoF) applied to the front of the vehicle was between 2 o'clock and 10 o'clock; secondly, that there was a passenger in the front seat at the time of the crash; thirdly that the passenger airbag deployed during the crash

Front seat passengers were included in the study whether they wore the seat belt or not although 95% were in fact wearing their belts at the time of the crash. Seat belt use was determined retrospectively at the time of the vehicle inspection and was based on evidence of seat belt loading, such as markings on the seat belt webbing, buckle and tongue or distortion to the B-pillar cladding (the inspection procedure is described in some detail below).

Vehicle Inspections and Occupant Injury

All crashed vehicles were inspected by an engineer a few days after the crash at recovery yards and panel shops. Inspections were undertaken according to the National Accident Sampling System (NASS) procedure using an inspection proforma, modified where necessary to suit Australian conditions. Data were collected on seat belt use, airbag deployment, impact direction, vehicle damage (deformations and intrusions), occupant contacts and impact speed. The collision severity measures Delta-V and Equivalent Barrier Speed (EBS) were calculated in this study; Delta-V, was defined as the change in velocity from the moment of impact until the study vehicle separated from its impacting source (MUARC, 1992) while EBS was also used as a measure of collision severity. EBS is defined as the speed in the case vehicle at which equal energy would be absorbed in a frontal energy impact into a test barrier ie. an estimation of the velocity change at impact that would be required of a crash test if it were to re-create the same amount of crush that occurred in the real crash with a vehicle of equal mass and stiffness.

Both EBS and Delta-V were calculated by computer software (CRASH3), made available from the National Highway Traffic Safety Administration (NHTSA) in the U.S. The assessment and classification of injures was undertaken by State Registered Nurses, trained in the collection of injury information using the NASS system. Injuries were coded according to the Abbreviated Injury Scale system (AAAM, 1990).

RESULTS

In total, MUARC has gathered data from some 19 frontal crashes involving deployment of the passenger airbag where a passenger was present. Of these 19 occupants, all but one occupant wore the seat belt. The mean collision Delta-V was calculated to be 38.9km/h and the mean collision EBS was 39.1km/h. The object struck by the vehicles in the study is shown in table 1.

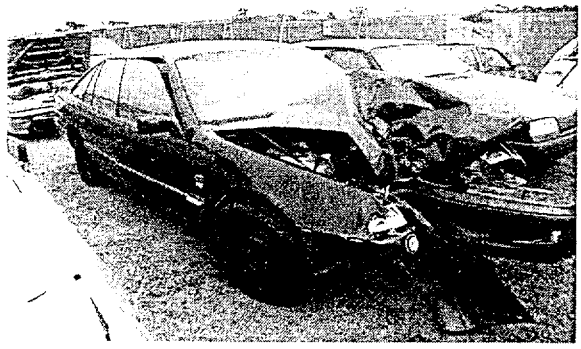
Collision Partner	N
Car	10
Tree	4
Pole	2
Truck	2
Van	1
Total	**19**

Table 1; Object Struck by 19 Vehicles in which Passenger airbag Deployed

With such a small number of examples of airbag deployments available, a definitive analysis was not possible. Therefore this paper offers only preliminary evidence of occupant experience with deploying passenger airbags as deduced from field studies in Australia. The following six cases are examples in which the passenger sustained a MAIS 2+ injury;

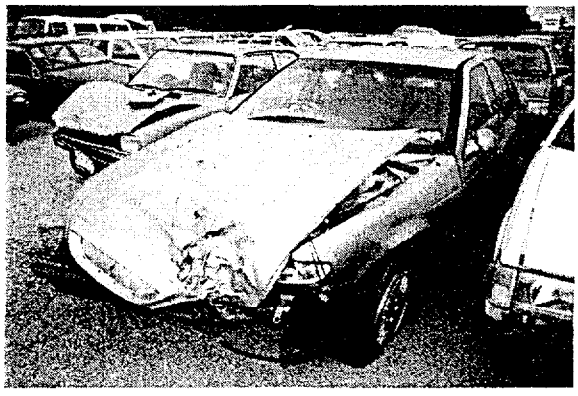
Case No. 1

This vehicle was involved in a frontal impact with a pole (CDC=12FYEW3) and the Delta-V and EBS were calculated to be 27km/h. The restrained front seat passenger, a 46 year-old male (height 165cm, weight 59kg) sustained 7 fractured ribs on the right-side of the chest (AIS = 3) together with a myocardium contusion (AIS = 3). In the absence of intrusion, both injuries were attributed to seat-belt interaction. The driver of the vehicle, a restrained female, sustained a fractured wrist (AIS = 2) and a sprained left ankle (AIS = 1).



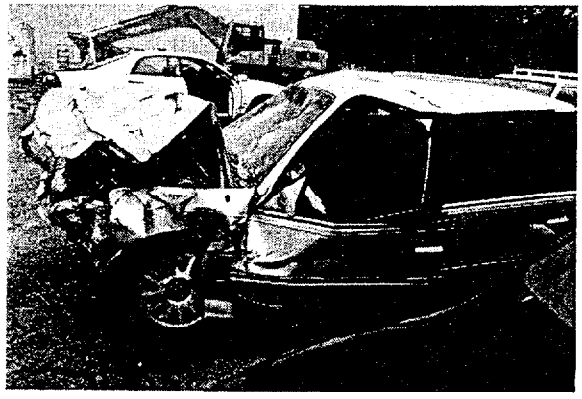
Case No. 2

This vehicle was involved in a frontal crash with a tree in which the Delta-V and EBS were both calculated to be 30km/h. The CDC was adjudged to be 11FZEW2. The front seat passenger, a 45 year-old female (height 160cm, weight 53kg) sustained contusions to the jaw and shoulder (AIS = 1; from the side window-frame) together with a contusion to the left hip (AIS = 1; seat-belt) and to both knees ((AIS = 1); which she claims she 'knocked' together). She was also knocked unconscious (AIS = 2) for a brief period (<15mins) from the head contact on the window-frame. The driver sustained a minor injury to the right knee (AIS = 1).



Case No. 3

This vehicle was involved in a head-on crash with a second vehicle on a two-lane highway (CDC = 12FYEW4). The Delta-V was calculated to be 59km/h and the EBS 62km/h. There was approximately 22cm of intrusion on the passenger side at facia level. The restrained front seat passenger, a 55 year-old female (height 173cm, weight 65kg) sustained bi-lateral fractured wrists (AIS = 2; from upper facia or airbag) together with subluxation of C3 and C4 (AIS = 2; non-contact injury), and a lacerated left thumb. The driver sustained numerous minor injuries (MAIS = 1).



Case No. 4

This vehicle was involved in a partial over-lap crash with a tree (CDC = 12FREE6) and the Delta-V and EBS were calculated to be 58km/h. There was approximately 12cm of intrusion at the front seat passenger's facia level whilst the intrusion on the driver's side was substantially greater (35cm). The front seat passenger, a 6 year-old restrained male (height and weight unknown) sustained a fractured sternum (AIS = 2) from interaction with seat belt. The driver, a 40-year old male sustained numerous serious lower limb injuries (MAIS = 3) together with other cuts and bruises.

Case no. 5

This vehicle was involved in a collision with a second vehicle at an intersection. The CDC was 10FLEW2 and the Delta-V was calculated to be 16km/h. The 74 year-old restrained female passenger (height 173cm, weight 68kg) sustained a fractured wrist (AIS = 2; possibly from 'fling' from the airbag onto a harsh interior surface) together with bruising to the right lower limb (AIS = 1). The driver sustained minor bruising only (MAIS = 1).

In addition to these cases, MUARC has investigated three crashes in which injuries have been sustained through direct interaction with the airbag. All of these cases have resulted in minor bruising or abrasions only to the occupants.

The study has investigated only one crash involving an unrestrained front passenger. This is of particular interest since in the case of non-restraint use, the airbag becomes the primary restraint system:

Case No. 6

The vehicle struck a pole head-on (12FLEN4) and the Delta-V and EBS were calculated to be 49km/h. The occupant, a 17 year-old male (165cm, 70kg) sustained bruising to the back of the head (AIS = 1; possible interaction with rear seat passenger) only.

Of the remaining ten cases we have investigated, no anomalies were observed in terms of occupant interaction with the airbags. In all these cases, the driver MAIS was observed to be equal to or greater than the MAIS of the passenger. Collision Delta-V's for these cases ranged between 20-41 km/h. All the occupants in these remaining cases wore the seat belt.

DISCUSSION

Preliminary experience of passenger airbag deployments in Australia has shown that such systems do not present problems in terms of injury outcomes to restrained occupants. Out of the 19 passengers seated in front of the deploying airbag, this study found two isolated example of where an AIS 2 or above injury could be possibly attributable to the deploying bag (Case No's. 3 & 5 listed above). However, the evidence in each case is not conclusive since there are confounding factors. In other exemplar cases, minor surface injuries to the face and forearms have been observed but these may be trade-off injuries against more severe injuries that may have been experienced without the airbag deployment. This preliminary study supports the view that the seat-belt should always be worn when a passenger airbag is present. This is primarily because in our predominantly restrained sample of passengers, we have not witnessed the same problems as those experienced in the US (Huelke and Reed, 1996) when unrestrained passenger interact with the deploying airbag.

In some cases, it is debateable whether the deploying airbag provided any additional protection over what may be expected of the seat-belt system. This is so particularly where there was an absence of compartmental intrusion at the facia-level and where the collision severity was relatively minimal. Approximately one-third of the cases we have investigated may fall into this category.

It is stressed that this study is only a preliminary review of experience to date in Australia. When more data are available, it will be possible to undertake a case-control approach whereby an enhanced investigation of the effects of passengers airbags on occupant injury outcomes can be undertaken. With a more in-depth study, the issue of inappropriate deployments can be investigated more thoroughly.

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