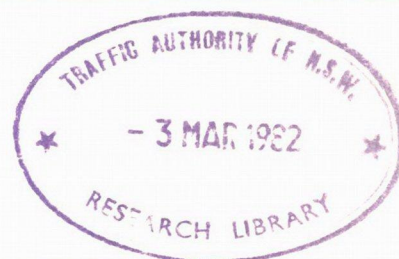


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TRAFFIC ACCIDENT RESEARCH UNIT



CHILDREN WEARING APPROVED RESTRAINTS AND ADULTS' BELTS IN CRASHES

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The Traffic Accident Research Unit was established within the Department of Motor Transport, New South Wales, in May 1969 to provide a scientific approach to the traffic accident problem.

This paper is one of a number which report the results of research work undertaken by the Unit's team of medical, statistical, engineering and other scientists and is published for the information of all those interested in the prevention of traffic accidents and the amelioration of their effects.

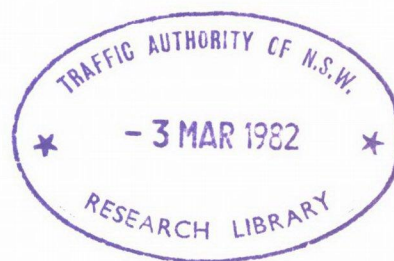


Commissioner

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NEW SOUTH WALES.

JANUARY, 1981

ISSN 0313 2854

ISBN 0 7240 4176 1

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ABSTRACT

This report is based upon an in-depth study (IMPACT 7) of 73 children who occupied cars in 231 crashes on New South Wales roads. The crashes were reported to involve children who were transported from the scene by ambulance. The study focused on restrained children under eight years of age. This was in view of legislation which provided legal impetus from March, 1977 in New South Wales for children to wear adult belts or child restraints of a type approved by the Standards Association of Australia if available when travelling in passenger vehicles.

Children in approved child restraints were afforded very good crash protection in often severe crashes when their restraints were installed correctly and not loaded directly by other parts of their vehicles. One child died when her child seat was broken from behind by boot luggage and the dislocated car rear seat back. Three point emergency locking retractor and lap/sash seat belts also provided very good protection. One fatality however was reached by deep side vehicle intrusion, and another occurred when the loose sash strap of a lap/sash belt lay across the face of a child. Lap belts were ineffective for two fatalities because of a lack of control of excursion and possibility of ejection. There was little doubt that the five children would have died if unrestrained.

ACKNOWLEDGEMENTS

This study would not have been possible without the co-operation of many organisations and individuals especially those members of the public who willingly provided much of the information upon which this report is based. The organisations that assisted generously included the Health Commission of N.S.W. and its emergency ambulance services, the New South Wales Police Department, the New South Wales Department of the Attorney General, the New South Wales Department of Justice, New South Wales Hospitals and the New South Wales Department of Main Roads.

Many staff of the Traffic Accident Research Unit provided valuable advice and assistance that contributed to the establishment of the study team and methods. Other Branches and Sections of the Department of Motor Transport, especially the staff of country registries played a notable role in the provision of vehicles and local advice in country areas.

Half of the cost of the work described was met by the Commonwealth Government of Australia, under the Transport Planning and Research (Financial Assistance) Act 1977, Project NMT 77/1.

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Engineering Assistants:	Dennis Murphy. Palle Johansen.

Field staff also contributed to the analysis of the data. Inferences drawn or conclusions made are those of the authors based on the information collected during the in-depth crash studies, and are not necessarily endorsed by the Department.

PREFACE

The following abbreviated key to child restraint types, based on Australian Standard 1754-1975 (Amended 1979) should be of assistance:

- Type A: Age range birth upwards (usually limited to 6 months). Includes infant carriers and restrained bassinets.
- Type B: For toddlers (usually 6 months to 4 years). Refers only to forward-facing chairs with full harnesses.
- Type C: Primarily for older children (say 3 years to 8 years). Refers only to full-harnesses to be used on original car seats or booster devices (Type G).
- Type D: For toddlers. Forward-facing enclosures, guards and barrier type devices.
- Type E: For toddlers. Rear-facing enclosures, guards and barrier type devices.
- Type F: For toddlers. Rear-facing chairs with harnesses and head-restraints.
- Type G: Primarily for older children. Anchored booster cushions and self-anchored chaises, for use with lap/sash belts provided for adults. Can also be used with Type C harnesses.

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1. SUMMARY

- (1) A study was made of 223 crashes in New South Wales reported in the period 14th November, 1977 to 31st May, 1978 as having involved a child under the age of eight years transported from the scene by ambulance. A further five children were identified through checks of Police fatal incident messages and three more were reported informally. Thus about 231 crashes were studied in all.
- (2) A subset of these crashes was studied in-depth, the subset consisting of the 35 crashes in which at least one of the under eight children was wearing an adult's seat belt or a child restraint approved by the Standards Association of Australia.
- (3) Only 46 children under eight years old were considered to have been wearing one of these protective devices in the 231 crashes. Four others wore unapproved child restraints and articles complying with the British Standard, and seven children in the eight to ten year age group wore adults' belts. They were in the selected 35 (15%) of 231 crashes.
- (4) This compared with 35 per cent under eight years old found restrained in an observation survey in Sydney in November/December, 1977.
- (5) Analysis of crash statistics in city and rural areas of NSW indicated that Sydney drivers have had about the same crash rate as country drivers, but their crashes resulted in only half the number of serious casualties (killed or hospitalised) among children aged less than 15 years. This suggested a lower usage of child restraints by country drivers.
- (6) Crash protection for 19 of the 20 child seat users was very good. The only fatality resulted when a child seat was broken by rear boot luggage and the child's head contacted the back of the driver's seat. The fatal injuries no doubt would have been avoided (as for the restrained sister adjacent) had the luggage been contained in the boot. The crash would have been unsurvivable for the unrestrained.

- (7) Five children wore three point emergency locking-retracting and 24 wore adjustable lap-sash belts, and eight wore lap belts in frequently severe crashes which were otherwise unsurvivable. One lap/sash belted fatality though died as a result of multiple injuries from contact with a deeply intruded side door against which no practicable countermeasure is likely to be effective. The other lap/sash belted fatality died from a fracture of the upper cervical spine because her head contacted a very poorly draped sash strap whilst she was asleep. She probably would have survived had the belt been worn more snugly. One rear lap belt wearer was ineffectively restrained and died after being ejected from his vehicle (the five other restrained child occupants survived). A girl seated on cushions and possibly wearing a rear lap belt died from head and neck injuries. The source of her injuries was uncertain but may have been from contact with the front seats. The impact was severe and unlikely to be survived if unrestrained.
- (8) Four lap/sash wearers were raised above their seats by blankets and other improvised booster supports. None of these children was seriously injured. The lap belted child on cushions was fatally injured though the role of the cushions was unknown.
- (9) Four children occupied bassinets, three of which were unsecured. A baby in an unsecured bassinet died from head contact with an intruding side door. Another baby was ejected from her unsecured bassinet but was unharmed. A baby in an unsecured bassinet and a baby in a secured bassinet were not ejected, and unharmed.

2. CONCLUSIONS

- (1) Children occupying approved child seats appeared to have been well protected from injury even in severe crashes. The level of protection was reduced when restraints were incorrectly installed in vehicles and children incorrectly installed in restraints.
- (2) Loading on the rear of child seats by unsecured rear seats or boot luggage induced collapse of the child seats or the anchor straps.
- (3) Children in adult belts with lap and sash configurations appeared to have been well protected even in severe crashes though a sash strap poorly placed or loosely adjusted near the head may cause injury.
- (4) Indications were that children possibly have been adequately restrained less frequently in country areas.

3. INTRODUCTION.

The study reported here follows an earlier in-depth study of children in crashes (Vazey, 1977). The study by Vazey dealt with children "who were ostensibly restrained in preparation for crashes, and who actually experienced collisions of the passenger cars in which they were travelling". Children in child restraints approved by the Standards Association of Australia (SAA) in adult belts as normally fitted to Australian cars, and in unapproved restraints and bassinets had been included. Much of the reporting format used by Vazey has been used in this report.

In the present study it was hoped to further identify short-comings principally in SAA approved child restraints and adult seat belts of Australian cars by in-depth investigations of crashes. It was anticipated that short-comings would relate to crash protection and normal (non-crash) use.

It was expected that crash experience would be gained of articles with type approval to the relatively new Australian Standard AS1754-1975, Child Restraints for Passenger Cars and Derivatives, which was a revision of Australian Standard ASE46-1970, Child-Restraining Devices for Passenger Cars.

Furthermore, the introduction of Regulation 110G of the Motor Traffic Act (Motor Traffic Act 1909 and Regulations) was intended to provide legal impetus in New South Wales to the wearing of approved child restraints and adult belts from 1 March, 1977, by children under eight years. Consequently a new study of restrained children in crashes was considered necessary.

This study, known as IMPACT 7, dealt with selected crashes which occurred between 14th November, 1977, and 31st May, 1978, inclusive.

4. METHOD.

4.1 APPROACH

Generally, a crash in this report refers to impact of a motor vehicle using public roads of New South Wales. A restrained child in this study was intended to be a person under eight years secured at the time of a crash in a child restraining device of a type approved by the Standards Association of Australia, or in an adult seat belt (emergency locking retractor, adjustable lap/sash or lap belt), or in combinations of the above. The children of this study were reported to have been conveyed to hospital or private medical practice as a result of the crash though some were apparently uninjured.

With the co-operation of the New South Wales Health Commission all ambulance stations in New South Wales were requested to advise the Central District Ambulance headquarters in Sydney whenever they transported a child to hospital from a motor vehicle crash. These notices were relayed by radio and telephone from stations within the Sydney metropolitan area and by telex message from country stations. To supplement information provided by ambulance services and to ensure as few incidents as possible escaped attention the police fatal incident message forms (P242's) were included as part of the notification system. Each morning the Unit received copies of the P242's. These forms are required to be completed within two hours of traffic crashes involving a fatality. The P242's were vetted each morning to check for crashes involving children nominated as the fatality or vehicle occupant.

Notifications were logged, on receipt, then passed to the Unit's Police Liaison Officer. He then contacted the police who attended the crash to obtain particulars of the parties and vehicles involved, together with their opinion on restraint usage. The calls provided the opportunity to introduce the Unit's field team to the police officers concerned and to obtain their clearance to proceed with the investigation when restraint usage was suspected.

At times the attending police were not able to provide information with confidence regarding child restraint usage. In these circumstances the field staff initiated their own enquiries through the ambulance and hospital personnel and the principals involved. The Police Liaison Officer also followed up each of the fatal notices identified as a possible case. Thus field staff only undertook in-depth investigations when there was the strong possibility of the children in question having been restrained in an approved manner. Consequently it was possible that some crashes relevant to the study were overlooked, but every endeavour was made to minimise such possibilities by thorough office enquiries.

Generally teams of behavioural scientists and engineers investigated crashes through interviews and vehicle, safety equipment and site inspections. Interviews often encompassed the children, parents, vehicle operators, witnesses, police and rescue services. Photographs, pocket tape recorders, field notes and certain police and ambulance forms were used to collect or store information. The procedures used to gather information were similar to those of previous in-depth studies (Vazey, 1977 and Herbert and Corben, 1977) with the emphasis on interviewing, inspections of vehicles and safety equipment, and injury data collection.

4.2 SAMPLE

Any child under eight years, thought to have been wearing an approved child restraint or adult's seat belt, and transported by New South Wales Ambulance from a road crash was included in the study.

This sample allowed the study of 223 crashes notified by ambulance services. A further five were identified by checking police fatal incidence messages, and three were notified informally making 231 in all during the period.

5. RESULTS

5.1 CRASH ANALYSIS

Of 223 notices scrutinised and eight other notifications 35 incidents became accepted as relevant in-depth crash studies for this report. Six crashes occurred in built up areas around Sydney, nine in country built up areas and 20 on highways and non-urban roads. Eleven crashes occurred on weekends and 24 on weekdays (21 of the 24 weekday crashes occurred between 6.00am and 6.00pm). Seventy three children occupied vehicles containing case subjects. Fifty seven children wore adults' belts or child restraints. Table (A1) of Appendix A details the age and types of restraints used by the children. Forty six of 66 children under eight years wore adults' belts or child restraints with SAA type approval (53 in total). Even in these vehicles, occupied by restrained children, there were still 12 who were completely unrestrained.

Tables of results are provided in Appendix A. Details of injuries to the child seat users are provided in Appendices B and C whilst Appendix B also provides details of crashes for all restrained children who received moderate injury or worse, or where vehicle damage was rated more than 4. (See Section 5.3)

5.2 CHILD CASUALTIES IN COUNTRY AREAS

It was disconcerting that in only 35 out of 231 crashes could it reasonably be considered that any child was wearing some form of approved restraint (including adults' seat belt). The 15 per cent wearing rate was particularly surprising because a survey by Croft (1977) in Sydney had shown 35 per cent of children to be restrained in daytime urban traffic.

In their paper presented to the Road Safety Initiatives 1980 Commemorative Conference, Melbourne, Herbert and Freedman (1980) dealt with the issue of child restraint publicity campaigns and their effects in city and country areas of NSW. They studied child passenger casualties, by address of driver. In order to have large numbers for analysis and to make use of available population data, the study was of drivers having casualties aged under 15 years. (The latest population data are for the year 1976). (Lukin 1980).

Analysis of the data provided in Table (A2) showed that the numbers for Newcastle and Wollongong were too small for conclusions to be drawn. It was clear however that Sydney drivers had significantly fewer child serious casualty crashes than drivers living in rural N.S.W., but did not have fewer total casualty crashes (that is, including minor casualties).

In other words, Sydney drivers had about the same crash rate as country drivers, but their crashes resulted in only half the number of serious casualties (killed or hospitalised) among children aged less than 15 years. This suggested a lower usage of child restraints by country drivers.

This was thought also to possibly explain why the dramatic increase in child restraint usage in Sydney has not been matched by an equally dramatic drop in child casualties across N.S.W. as a whole.

5.3 STUDY VEHICLES

Exterior damage to the study vehicles was described as for Vazey and Holt (1976). The directions of major collision forces which led to maximum damage rating in each crash were distributed as shown in Table (A3). Damage to the exteriors of case vehicles was rated again as described by Vazey and Holt (1976). The ratings are on a nine point scale and the distribution of the ratings is shown in Figure 1. Nearly 50% of vehicles were assessed as having vehicle damage ratings of more than 4, indicating extensive damage to many of the study vehicles. Major collision forces were from above (roll-over) in seven, from the side in 13 and from the front in 12 crashes. Crash damage resulted in intrusion of interior surfaces of the occupant compartment in 20 study vehicles, with the intrusion surfaces estimated to be within reach of 14 restrained children. Interior contact by some restrained children was noted where no vehicle intrusion had occurred.

5.4 CHILD SEATS AND THEIR OCCUPANTS

5.4.1. Seat and Child Installations. There were 20 children who occupied child seats and harnesses. These articles (described in Australian Standard ASE46-1970, Child-Restraining Devices for Passenger Cars, and Australian Standard AS1754-1975, Child Restraints for Passenger Cars and Derivatives as Type B child restraints) were forwarded facing and comprised

a harness with chair. The approved articles were intended for a range of children whose mass lies within 9 to 19kg and suitable for most children between six months and four years. Table (A4) of Appendix A summarises the child seats encountered in this study. Two articles were of a type approved to AS1754-1975, 14 to ASE46-1970, two to BS 3254 (British origin) and two were recognised as unapproved. The Safe-N-Sound brand was carried by 15 articles, Steelcraft by three, and there were the two British manufactured child seats. The preponderance of the Safe-N-Sound products reflected frequencies ($p < 0.05$) observed in the Croft surveys. The polarisation to the Safe-N-Sound brand in the crash study was thought to reflect consumer taste rather than a fundamental safety problem peculiar to Safe-N-Sound products.

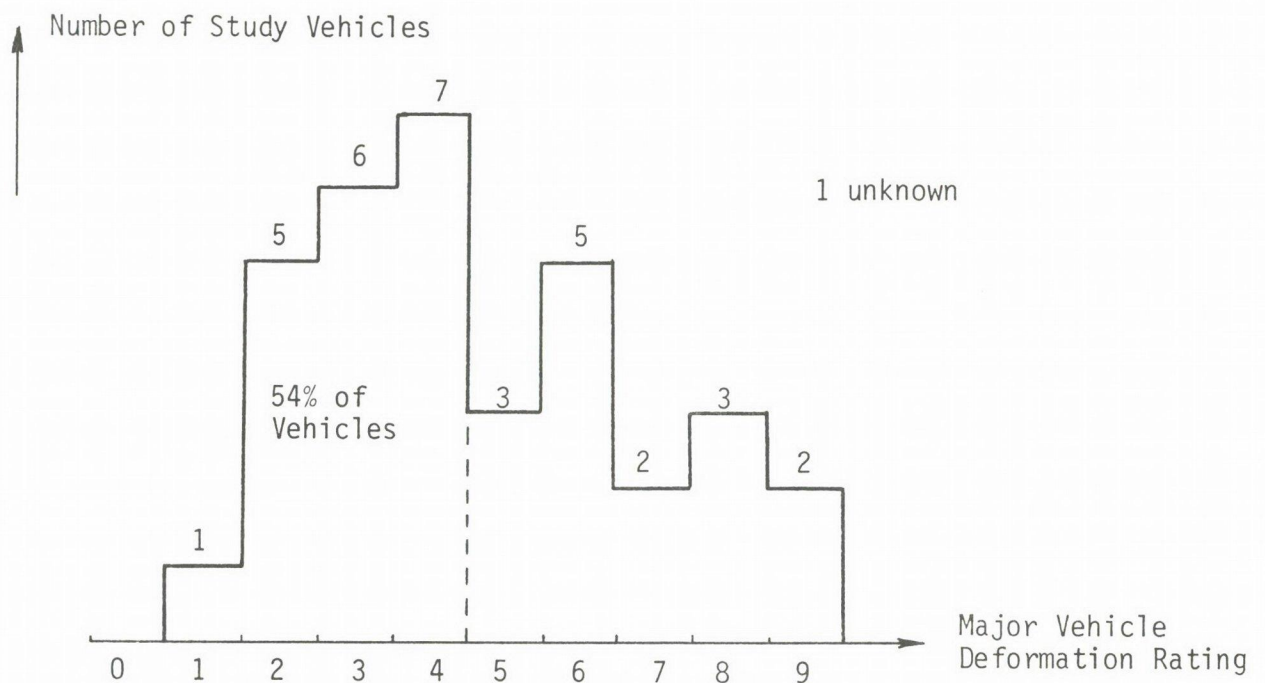


Figure (1) : Distribution of Major Vehicle Deformation Ratings.

There were 11 instances in which it was considered that the restraints had been installed in the vehicle in a manner dissimilar to that recommended by the manufacturers. Some installations had been effected without use of all anchor straps, incorrect passage of adult restraining belts about the child seats, or the use of combinations of adjacent adult belts which left the child seats leaning loosely.

Other improvisations incorrectly utilised adult belts or their anchorages when only belts of the child seat should have been used. This generally resulted in slackness in the installation. Two child seats had been secured to wooden panelling in a camper van. The panelling was an unsound base and broke away under crash forces.

Five children were thought to have been belted into their child seats inappropriately. Some parents had used harness lower sash guide slots instead of upper slots for children over 14 kg mass. Others allowed loose adjustment in the harness and, in the case of an unapproved article, no use of harness.

5.4.2 Child Seat Damage. Nine child seats evidenced notable crash damage. Eight of these articles were involved in severe crashes. Loads applied by the decelerating child were complicated and aggravated by incorrect installation (007E, 019D, 036F, 0370(ii) and additional loading by parts of the vehicle (035E, 036D, 0370(ii)). Fractures of adult sash strap keyways involved children P007D and P013F.

There were serious consequences when other parts of the vehicle applied additional crash loads. For example, the upper anchor straps of the child seat of child 035E broke away from the seat shell when the rear seat of the vehicle was pushed forward by boot luggage. The child seats of children 036D and 036F were deformed and fractured heavily in part by the decelerating rear folding seat of their station sedan. For child 007E incorrect installation precipitated torsional loads which twisted her Steelcraft C58 restraint. The child's upper torso penetrated side glazing as a consequence. The Safe-N-Sound Trisafe Mk7 of child 019D, installed using two adjacent lap/sash belts in the back of a small car, suffered gross fractures of the seat shell in that configuration. The assemblies of a number of child seats (P007D, 007E, 036F) probably were loose prior to the crashes as indicated by loose or missing nut and bolt components.

5.4.3 Crash Protection. The injury pattern for the 16 children who occupied Type B child seats with ASE46-1970 or AS1754-1975 type approval is shown in Table (A5). Only four of the children received injuries considered severe or worse (AAAM, 1976) when evaluated against the Abbreviated Injury Scale (A.I.S.).

There was one fatality in a Type B article. Child 035E received fatal brain stem injuries when the upper anchor straps broke away from the child seat (as described previously). The child seat rotated about its lower anchor strap and the child's face impacted the driver's seat back near the head restraint.

Child 036D survived a fractured skull on the right side, probably from impact with the adjacent roof pillar which had moved slightly over and into her head space. The loosely installed child seat promoted head excursion. The child received multiple fractures of the lower limbs from unknown sources. Child 019C received multiple fractures and facial lacerations from contact with a deeply intruded dash assembly.

There were five instances of moderate injury to the various body regions. Child 036D received a fractured skull with no underlying brain injury from contact with the side roof pillar. Child 035E, in addition to her fatal injuries, received bruising of the right lung and fractured left radius and ulna, also probably from contact with the driver's seat. Child 036F received a fractured clavicle, fractures of both femurs with abrasions to the face, chest and iliac crests. The occupant space around child 036F was intruded only marginally. The sources of the fractures to both femurs and facial abrasions were not determined. The fractured right clavicle, at the mid-span of the bone, possibly resulted from loading by the right harness strap. Abrasions to the chest and both iliac crests probably resulted from loading by the harness also.

Minor injuries prevailed amongst the children. Cuts to the face and body from flying glass, and harness strap abrasions to the neck, clavicle anterior chest and abdomen were noted.

The four children occupying other than SAA approved child seats received only minor injuries.

5.4.4 Rescue from Child Seats. In general this study did not deal with the issue of rescue from child seats or other restraints, as rescuers frequently had not been available for interview. Nevertheless, there appears to have been little difficulty encountered with extracting children from the Type B child seats of this study. A few details follow:

After a car had rolled onto its side against a tree the father had stated that rescue of his son (P016F) in this awkward configuration had been easy. It was noted that some rescuers had preferred to unbuckle or cut adult belts which had secured child seats and remove the child in the restraint from the vehicle. Child 035E was removed in her child seat which apparently was used as a body splint; and similarly for 0370(i).

5.5 CHILDREN IN ADULT BELTS

5.5.1 Adult Belts. The adult belts examined in this study were of three types: emergency locking retractor belts (ELR's) as fitted in the front outer seating positions, adjustable lap/sash belts (lap/sash) fitted to the front and rear outer seating positions, and adjustable lap only belts as fitted in the central seating positions of Australian cars.

The adult belts worn by children in this study had been fitted to vehicles manufactured in 1969 or later, and thereby complied with Australian Design Rules (ADR's) of the Australian Transport Advisory Council. The ADR's for seat belts aimed to provide good and comfortable fit by controlling anchorage locations and webbing layout. The intention was that crash protection would be improved with frequent wearing and good wearing practice. The seat belts designed under the ADR's were intended to be suitable for persons about six years and older, for all seating positions except for that of the driver. In the present study 30 of the 37 children who wore adult belts were about six years old or younger. It was hoped, therefore, that the performance of the seat belts worn by children in this study might provide further insight into the efficacy of adult seat belts for the younger child in general. The injury pattern for the 37 children who wore adult seat belts is shown in Table (A6).

5.5.2 Retractors (ELRs). There were five children who wore ELRs. The children, in left front seats, received minor injuries only.

Of note were the circumstances of child 030C. She was a four year old girl nursed by her father. The sash belt passed over the father's left shoulder and under the girl's left shoulder. The lap belt was buckled over the girl's lap. She received a bruise on the forehead, grazes under the left armpit from the sash webbing, a sore knee and cut left ankle when the station sedan rolled over.

5.5.3 Lap/sash Belts. There were 24 children who occupied lap/sash belts. Eighteen children received minor or no injuries. Minor injuries took the form of seat belt abrasions, abrasions and lacerations from contact with vehicle interiors or lacerations from flying glass.

Two children received minor or moderate injuries. Child 014F, a four year old boy in the rear left seat of a station sedan, suffered a fractured clavicle probably from contact with the intruding side door and lacerated and bruised left foot which was jammed by the intruding door against the squab of his own seat. He had been seated with his right foot tucked under his bottom and left foot dangling between the door and the side of his seat squab. The sash straps of his and the adjacent girl's seat belts had been inadvertently jammed under the upper restraining locks of the rear folding seat.

Child 020D was a six year old girl who probably wore her rear right lap/sash belt loosely. She received abrasions to the cheek and nose and a fractured left leg from unknown sources. The front of the sedan impacted a tree.

Two other children received severe injuries. Child 003D was a seven year old boy in the right rear seat of a sedan which was intruded deeply on the left side doors by another sedan. The boy suffered a contused left lung, left kidney, tense abdomen and fractured pelvis probably from contact with his seat belt and the adjacent unrestrained occupants. His unrestrained sister in the left rear seat and a dog in the middle seat were killed. Child 023D, a seven year old boy, received a displaced fracture of the right clavicle probably from contact with the intruding side door of his sedan which was impacted on the right side by another sedan. Two children were fatally injured. Child 004C, a four year old girl, received a fracture of the upper cervical spine with cord injury and seat

belt abrasions to the left face and across the lower abdomen and pelvis when her sedan impacted a roadside culvert. The little girl had been asleep with a loosely adjusted sash strap tucked under the left side of the head. Her head lay on a pillow against the left front door. At impact, contact of her face with the poorly placed seat belt in combination with her sleeping posture probably caused the cervical fracture.

Child 032C, a six year old girl, was retarded and had the proportions of an infant. She had worn the left front lap/sash belt with the sash passed behind the left shoulder. Her fatal injuries resulted from contact with the deeply intruded left front door of the sedan which had been side impacted by another sedan. It was most probable that she would have received fatal injuries even if the belt had been worn correctly.

5.5.4 Boosted Lap/sash Wearers. There were four children who wore lap/sash belts and were raised above their seats. All received minor injuries only. Child 035D was a girl, about five years, who was restrained on two cushions on the rear right seat in a very severe head on collision. She received belt bruises and a cut on the right neck. Child 038C in the front left seat was a girl, about nine years, restrained whilst seated on folded blankets. She received lacerations and shock. Her restrained brother on the rear left seat also was placed on folded blankets and received lacerations and shock. Their sedan suffered only minor damage when it struck an embankment and rolled over. The unrestrained five year old brother in the middle rear seat died from head injuries. Child 040D in the rear right seat of a sedan wore the lap part of his lap/sash belt when placed on a pillow. He received minor scalp lacerations and bruises when his sedan towing a caravan sideswiped another sedan.

5.5.5 Lap Belts. Eight children were thought to have worn lap belts. Two of the children were killed.

Three children occupied a station sedan which rolled over into a paddock. A five year old boy apparently wore his middle rear lap belt but was ejected from the vehicle during rollover. He sustained a fractured upper cervical spine probably from contact with the ground. A six year old girl and a ten year old boy occupied the optional rear deck bench seat and received only minor injuries.

A seven year old boy in the middle rear seat received a fractured clavicle possibly from contact with an adjacent adult when the left side of a station sedan side swiped a steel railing in a very minor crash.

A girl, about four years, had been placed in the centre rear lap belt on cushions prior to the crash. She was possibly wearing the lap belt at the time of the crash. The child received a fractured cervical spine, fractures of the skull, and fractures of the head of the right humerus and right fourth and fifth ribs possibly from contact with the back of the driver's seat. The two restrained adults in the front seats were killed.

5.5.6 Rescue from Adult Belts. There were no indications that rescue from adult belts involved difficulties with the belts themselves. A rescuer had preferred to cut a seat belt to effect rescue on one occasion.

5.6 BASSINETTES.

No bassinette restraint had gained approval to ASE46-1970 or AS1754-1975 at the time of this study but four bassinettes were in the vehicles occupied by restrained children of this study.

A six months old baby boy occupied an unrestrained bassinette on the rear seat of a sedan. The child was adjacent to door intrusion from side impact by another sedan. The child died as a result of head impact with the intruding side door. A three months old baby girl was well secured in her bassinette by a Micklem 701 bassinette restraint on the back seat of a sedan. The baby was uninjured in a severe frontal impact. A baby in an unrestrained bassinette on the rear seat of a station sedan was uninjured in a minor frontal crash. A six months old baby girl occupied a cane bassinette wedged in the centre rear position along the long axis of a sedan, partly between the front bucket seats. In the crash the bassinette tipped forward and the baby somersaulted onto the front seat to face downwards with her feet towards the front of the vehicle. She was uninjured despite her ejection.

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7. APPENDIX A : TABLES OF RESULTS.

TYPE OF RESTRAINT	AGES (YEARS)				
	Less Than 1	1 to 4 Inclusive	5 to 7 Inclusive	8 to 10 Inclusive	TOTAL
Type B Child Seat	5	15	0	0	20*
Emergency Locking Retractor Belt	0	1	3	1	5
Lap/Sash Belt	0	8	11	5	24
Lap Belt	0	4	3	1	8
Unrestrained	0	5	7	0	12
Bassinettes	4	0	0	0	4
TOTAL	9	33	24	7	73

(*Includes four not having SAA type approval).

TABLE (A1): Types of restraints and ages of children occupying
35 crashed vehicles studied in-depth.

Address of driver	1976 Child Population (Millions)	1979 All child car casualties		1979 Serious child car casualties	
		No.	Rate*	No.	Rate*
Sydney	0.708	1247	1761	200	282
Wollongong	0.058	109	1868	15	257
Newcastle	0.069	143	2059	25	360
Rural (rest of N.S.W.)	0.418	698	1669	244	584
All N.S.W.	1.254	2197	1752	484	386

* Rate = No./Pop.(M)

TABLE (A2): Address of drivers having child casualty crashes, N.S.W., 1979 (Children under 15 years old).

DIRECTION OF MAJOR COLLISION FORCE		NUMBER OF STUDY VEHICLES
Frontal	11 o'clock	3
	12 o'clock	4
	1 o'clock	5
		<hr/>
		12
Right Side	2 o'clock	2
	3 o'clock	5
	4 o'clock	0
Left Side	8 o'clock	0
	9 o'clock	3
	10 o'clock	3
		<hr/>
		13
Rear	5 o'clock	1
	6 o'clock	2
	7 o'clock	0
		<hr/>
		3
Above	13 o'clock	7
		<hr/>
		7
TOTAL		<hr/>
		35
		<hr/>

TABLE (A3): Directions of major collision forces for 35 crashed vehicles studied in-depth.

RESTRAINT	CHILD	RESTRAINT TYPE-APPROVAL	INSTALLATION*		RESTRAINT MAJOR CRASH DAMAGE
			Restraint IN Vehicle	Child in Restraint	
<u>Safe-N-Sound</u>					
Premier X4	P014B	ASE46-1970	X	✓	No
	035E	" "	✓	✓	Yes
	P010F	Not approved	X	X	No
KL	P010D	ASE46-1970	✓	X	No
	036D	" "	X	✓	Yes
	0370(i)	" "	X	✓	No
	0370(ii)	" "	X	✓	Yes
Trisafe Mk7	P007D	" "	✓	✓	Yes
	P009F	" "	X	X	No
	P013F	" "	✓	✓	Yes
	P016F	" "	X	✓	No
	019C	" "	✓	✓	Yes
	023F	" "	✓	✓	No
	012F	AS1754-1975	✓	✓	No
	019D	" "	X	✓	Yes
<u>Steelcraft</u>					
C58	007E	ASE46-1970	X	✓	Yes
	036F	" "	X	✓	Yes
C52	020F	Not approved	✓	X	No
<u>Others</u>					
Mothercare	P015F	BS 3254-1960	✓	✓	No
Britax Star Rider	028F	" "	X	X	No
TOTALS					
	20 Children		(✓9),(X11)	(✓15),(X5)	(Yes 9),(No 11)

* ✓: Installation similar to recommended manner.

X: Installation dissimilar to recommended manner, includes incomplete.

TABLE (A4): The Type B Child Seats encountered in the 35 crashed vehicles studied in-depth.

BODY REGION	A.I.S.						
	0 Nil	1 Minor	2 Moderate	3 Severe	4 Serious	5 Critical	6 Maximum
General	2	13*	0	1 (0370(i))	0	0	0
Head and Neck	11	3	1	0	0	1 (035E)	0
Thorax	15	0	1	0	0	0	0
Abdomen	15	0	1	0	0	0	0
Extremities	12	0	2	1 (019C)	1 (036D)	0	0

* Includes the scores of five children with minor injuries to the head and neck which were superficial and thus categorised as general.

Note: A further four children (two in Type B child seats with BS 3254 type approval and two in Type B child seats with no type approval) received minor injuries only.

TABLE (A5): Injury Pattern for 16 children who occupied Type B child seats with SAA type approval encountered in the 35 crashed vehicles studied in-depth.

BODY REGION	A.I.S.						
	0 Nil	1 Minor	2 Moderate	3 Severe	4 Serious	5 Critical	6 Maximum
General	3	33	1	0	0	0	0
Head and Neck	30	3	0	0	0	4*	0
Thorax	33	0	0	3	1*	0	0
Abdomen	34	1	0	1	0	1*	0
Extremities	30	0	4	3	0	0	0

* 1 score involved child 032C.

TABLE (A6): Injury pattern for 37 children who wore adult seat belts in the 35 crashed vehicles studied in-depth.

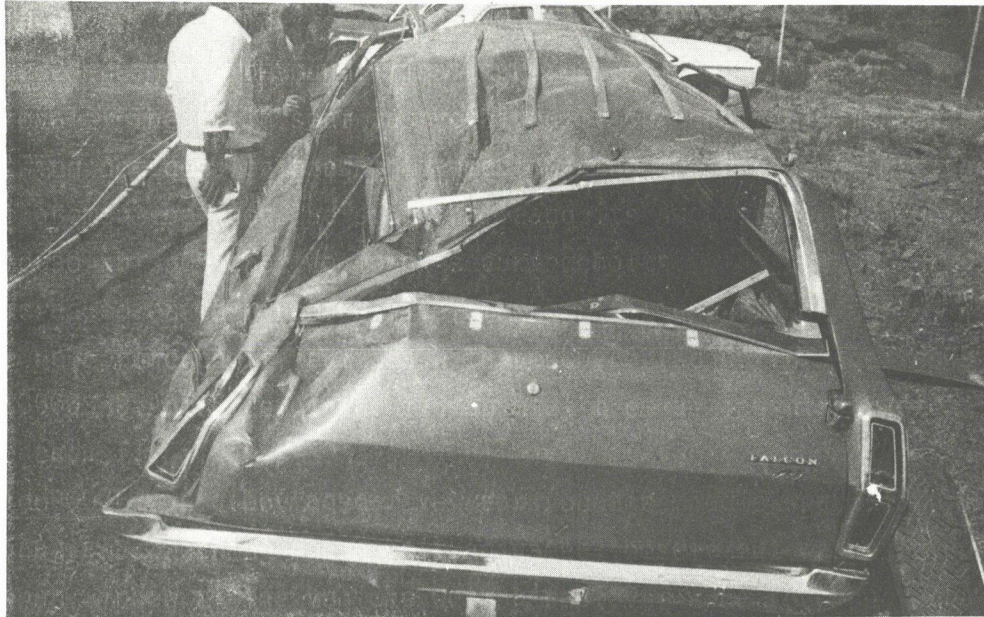
8. APPENDIX B: SUMMARIES OF SERIOUS CRASHES

Details are provided of crashes involving the restrained children who received moderate injury (AIS=2) or worse, or vehicles receiving damage rated at 5 or more.

Included are summaries of case studies :
P007, P009, P013, 002, 003, 004, 014, 019, 020, 021, 023, 024, 030, 032, 035, 036, and 037. Extent of damage of 14 case vehicles was rated at 5 or more, two at 4 and one was at 1 on a nine point scale.

Abbreviated Injury Scores (A.I.S.), Overall Abbreviated Injury Scores (O.A.I.S.) and Injury Severity Scores (I.S.S.) also are included.

DETAILS OF IMPACT 7 CASE NUMBER P007



Study Vehicle P007 was a 1977 Ford Falcon station sedan. The Falcon veered off the right side of a sweeping left hand bend, down an embankment and rolled end for end and sideways coming to rest in a field. Maximum vehicle damage was rated as 8, force direction was assessed at 13 o'clock.

Child P007C was a boy aged five years on the front left seat. He wore an emergency locking retractor well reeled out to accommodate his partly prostrate sleeping position. He received an A.I.S. of 10000, O.A.I.S. of 1 and I.S.S. of 1 from a cut to his left hand.

Child P007D was a boy aged three years on the rear right seat. He was secured in a Safe-n-Sound Trisafe Mk.7 child seat with AS E46-1970 type approval. The child seat was retained by an adjustable lap/sash belt allowing noticeable lateral movement of the child seat. Excessive displacement between the seat shell and its supporting base was related to loose nuts on the two lower securing bolts. The supporting base was cracked on the inboard side of the right upper sash guide. There were no apparent difficulties with rescue. The child received an A.I.S. of 10000, O.A.I.S. of 1 and I.S.S. of 1 from a minor laceration to the forehead.

Child P007E was a boy aged five years on the middle rear seat. He probably was wearing a lap belt adjusted loosely but was ejected through an open window of the vehicle during rollover. He received an A.I.S.

of 15300, O.A.I.S. of 5 and I.S.S. of 35 and died because of a fracture of the cervical spine, probably received on contact with the ground.

Child P007F was a boy aged eight years on the rear left seat. He was effectively restrained by an adjustable lap/sash belt and received an A.I.S. of 10000, O.A.I.S. of 1 and I.S.S. of 1 because of a 50mm laceration to his right foot.

Child P007G was a girl aged six years on the right side of a rear-facing seat fitted as a manufacturer's accessory in the rear luggage bay of the station sedan. She wore a reportedly snugly fitting lap belt which secured her in the crash. She received an A.I.S. of 10000, O.A.I.S. of 1 and I.S.S. of 1 from a minor laceration to the left lower leg.

Child P007H was a boy aged ten years on the left side of the rear-facing seat and wore a lap belt. He received an A.I.S. of 10000, O.A.I.S. of 1 and I.S.S. of 1 because of lacerations to the face from contact with an unsecured sewing machine in the luggage bay.

Other Occupant: The 28 year old mother and driver did not wear the emergency locking retractor seat belt available because it reportedly had become seized in the retracted position before the crash. The retractor was observed to be fully retracted and to resist reel out, after the crash. The mother received a fractured right wrist and a chipped vertebra.

DETAILS OF IMPACT 7 CASE NUMBER P009

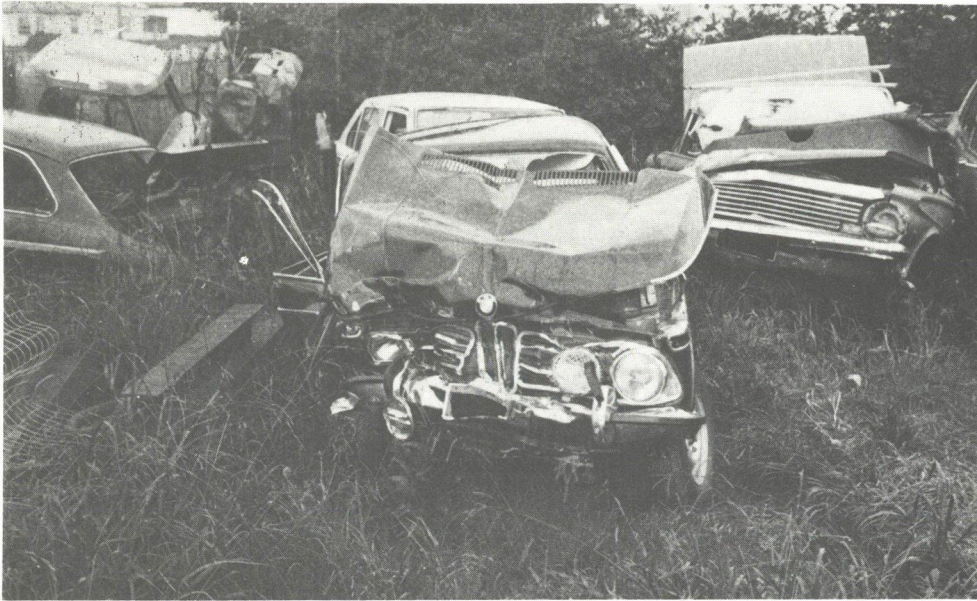


Study Vehicle P009 was a 1972 Holden Torana four door sedan. At a four way intersection the Torana was impacted on its right side doors by a Ford Falcon sedan which approached from the right of the Torana. After the first impact the Torana rotated and rolled onto its left side then on to its roof. Maximum vehicle damage was rated as 5, force direction was assessed at 3 o'clock.

Child P009F was a boy aged one year ten months on the rear left seat. He was in a Safe-n-Sound Trisafe Mk.7 child seat with AS E46-1970 type approval. The lower pair of sash slots were used in spite of the child having attained 15kg mass (contrary to recommended use). The device was installed incorrectly having the adjustable lap/sash belt passed around the front panels of the device instead of the correct seat belt passages between the seat shell and base. The child received an A.I.S. of 10000, O.A.I.S. of 1 and I.S.S. of 1 because of the harness induced shallow abrasion across his right clavicle.

Other Occupants: The unrestrained 24 year old mother received minor bruising. A six months old baby boy in an unrestrained bassinet placed along the rear seat adjacent to the intruding car side (with head near the right door) died as a result of a fracture of the skull with underlying brain damage.

DETAILS OF IMPACT 7 CASE NUMBER P013



Study Vehicle P013 was a 1971 BMW 2002 two door sedan. The right front corner of the BMW impacted a Holden sedan which had turned across the path of the BMW to enter a petrol service station. Maximum vehicle damage was rated as 8, force direction was assessed at 2 o'clock.

Child P013F was a boy aged two years four months on the rear left seat. He was effectively restrained by a Safe-n-Sound Trisafe Mk.7 child seat with AS E46-1970 type approval. The child seat was secured by an adjustable lap/sash belt. A 15mm crack had originated at the left upper sash keyway with associated scuffing. Scuffing was noted also on the left side of the lap strap channel. There were no apparent difficulties with rescue. The boy received an A.I.S. of 11000, O.A.I.S. of 1 and I.S.S. of 2 as a result of a loosened left lower canine and first premolar, a split tongue, lacerated lower lip, and abrasion to the base of the right neck from the harness.

Other Occupants: The 36 year old stepfather who drove wore his adjustable lap/sash belt. He was knocked unconscious and received a broken left wrist and seat belt abrasions to the chest. The 28 year old stepmother on the left front seat wore an adjustable lap/sash belt. She received a laceration to the left knee and seat belt abrasions to the chest and neck. A three months old baby in a bassinet effectively secured by a Micklem 701 bassinette restraint was uninjured.

DETAILS OF IMPACT 7 CASE NUMBER 002



Study Vehicle 002 was a 1977 Datsun 240K four door sedan. In heavy rain and on approaching a left hand bend the Datsun crossed to the incorrect side of the road and collided with the right front side on an oncoming vehicle towing a caravan. Maximum vehicle damage was rated as 7, force direction was assessed at 1 o'clock.

Child 002D was a boy aged six years eleven months on the rear right seat. He was effectively restrained by an adjustable lap/sash belt and received an A.I.S. of 10000, O.A.I.S. of 1 and I.S.S. of 1 as a result of a laceration of the left eyebrow and a bruised left thumb.

Child 002F was a girl aged eight years ten months on the rear left seat. She was effectively restrained and received an A.I.S. of 10000, O.A.I.S. of 1 and I.S.S. of 1 from a minor abrasion to the right foot from her sandal buckle.

Other Occupants: The 33 year old father who drove wore an emergency locking retractor belt and received a minor laceration over the left eye. The mother on the left front seat wearing an emergency locking retractor belt received minor injuries (details unknown). A six months old baby girl in an unrestrained bassinette on the rear seat was uninjured.

DETAILS OF IMPACT 7 CASE NUMBER 003

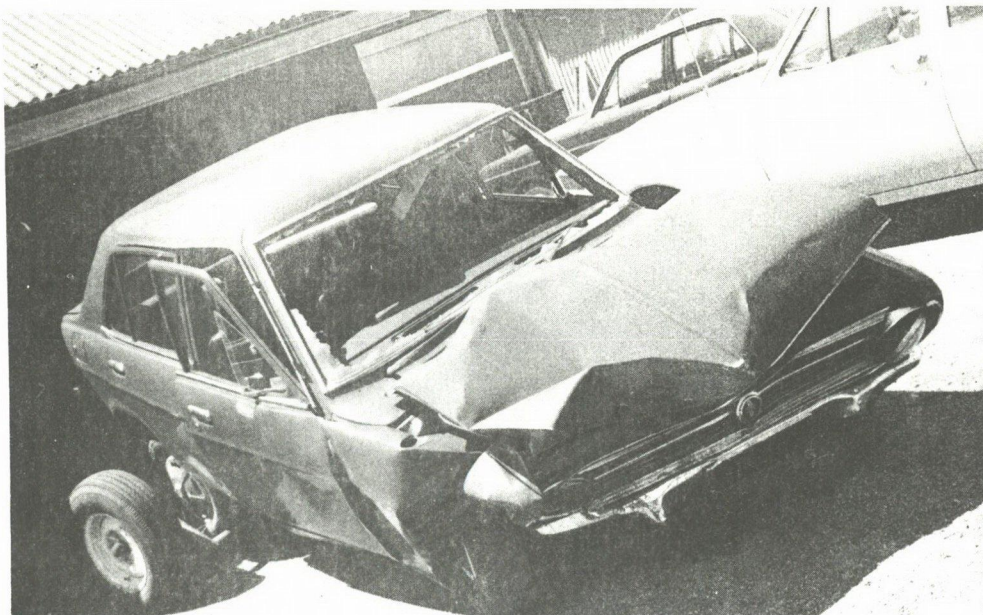


Study Vehicle 003 was a 1974 Holden Torana four door sedan. In rain the Torana rotated sideways on a curve and the left rear door and side panel were impacted by an oncoming V8 Torana sedan. Maximum vehicle damage was rated as 5, force direction was assessed at 9 o'clock.

Child 003D was a boy aged seven years one month on the rear right seat. He wore an adjustable lap/sash belt and received an A.I.S. of 10333, O.A.I.S. of 4 and I.S.S. of 27 from a contused left lung and left kidney, a tense abdomen and fractured pelvis.

Other Occupants: The 44 year old father who drove wore an adjustable lap/sash belt and received a fracture to the base of the skull and a bruised left arm. The 40 year old mother on the left front seat wore an adjustable lap/ sash belt and received multiple lacerations which required five days hospitalisation. The 12 year old girl on the left rear seat adjacent to the vehicle intrusion was unrestrained and died as a result of intercranial haemorrhage and torn falx tentorium. A dog on the middle rear seat died.

DETAILS OF IMPACT 7 CASE NUMBER 004



Study Vehicle 004 was a 1972 Datsun 1200 four door sedan. The Datsun crossed to the incorrect side of the road, continued on to jump a shallow culvert and impacted its far bank. Maximum vehicle damage was rated at 6, force direction was assessed as 1 o'clock.

Child 004C was a girl aged four years on the left front seat. Whilst asleep the child wore an adjustable lap/sash belt with the loose sash strap draped under the left side of the head on a pillow against the left front door. She received an A.I.S. of 15000, O.A.I.S. of 5 and I.S.S. of 26, and died as a result of a fracture of the upper cervical spine with injured cord, with seat belt abrasions across the left face, lower abdomen and pelvis.

Other Occupant: The 36 year old mother who drove wore an adjustable lap/sash belt and received a fractured right leg and arm, facial lacerations and seat belt abrasions across the chest and left hip.

DETAILS OF IMPACT 7 CASE NUMBER 014



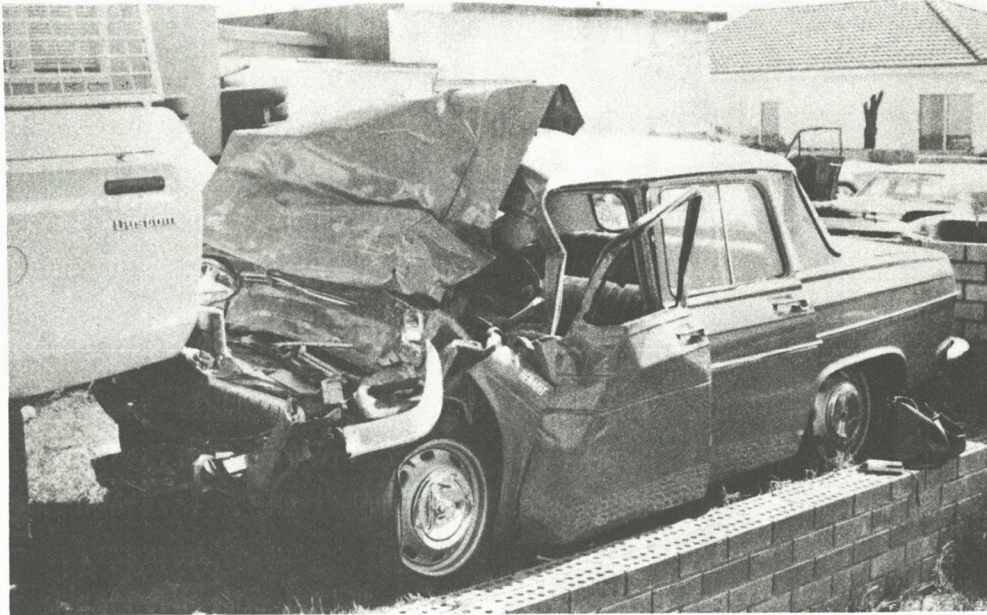
Study Vehicle 014 was a 1973 Ford Fairmont station sedan. The Fairmont veered from a straight section of road where its left side collided with a tree. Intusion resulted mainly on the left middle roof pillar and rear door. Maximum vehicle damage was rated at 6, force direction was assessed as 10 o'clock.

Child 014D was a girl aged three years on the rear right seat. She wore a loosely adjusted lap/sash seat belt. The sash strap was caught behind the folding-seat top latch. She received an A.I.S. of 10000, O.A.I.S. of 1 and I.S.S. of 1 as a result of lacerations to the face and forearms from flying glass.

Child 014F was a boy aged four years on the rear left seat adjacent to the vehicle intrusion. He wore a loosely adjusted lap/sash belt. His sash strap was caught behind the folding-seat top latch. He received an A.I.S. of 10002, O.A.I.S. of 2 and I.S.S. of 5, from a fractured left clavicle and lacerations and contusions to the left foot which became jammed by the intruding door. He was a friend of the girl.

Other Occupant: The mother of the girl drove. She wore an adjustable lap/sash belt and was knocked unconscious in the crash.

DETAILS OF IMPACT 7 CASE NUMBER 019



Study Vehicle 019 was a 1969 Renault R10 four door sedan. The Renault veered across double yellow lines at a crest in the road and collided with the front of a Ford F100 Utility. Maximum vehicle damage was rated at 9, force direction was assessed as 12 o'clock.

Child 019C was a girl aged two years eight months and occupied the front left seat. She was secured in a Safe-n-Sound Trisafe Mk.7 child seat with AS E46-1970 type approval. The child seat was retained by an adjustable lap/sash belt. The child was effectively restrained despite gross vehicle intrusion of her cabin space. The metal leg of the child seat had been deformed on loading into the seat squab, and the shoulder straps and harness showed heavy loading. Rescue was achieved by cutting the lap/sash belt free of the child seat and removing it with the occupant from the vehicle. The child received an A.I.S. of 11003, O.A.I.S. of 3 and I.S.S. of 11 from multiple facial lacerations, a fractured right clavicle, fractured right second and third metacarpal necks and fractured left femur, with abdominal and right ankle lacerations and abrasions to the left forearm and right shoulder.

Child 019D was a baby girl aged 11 months and occupied the right rear seat. She was secured in a Safe-n-Sound Trisafe Mk.7 child seat with AS 1754-1975 type approval. The child seat was retained by a combination of the lap and sash strap carrying the tongue of the right rear seat belt and the lap strap carrying the buckle of the left rear seat belt. Webbing passage was correct though. The child seat received a fracture at the crotch strap

slot running to the edge of the moulding, and an extensive fracture running from the outboard corner of the right upper adult belt sash guide down the back of the moulding to the metal frame at the right hinge point. Despite the imminent collapse of the moulding which supported the adult seat belt the child received only an A.I.S. of 10000, O.A.I.S. of 1 and I.S.S. of 1 from abrasions to the chin, and anterior neck because of contact with the sash straps.

Other Occupant: The 30 year old mother who drove was secured by an adjustable lap/sash belt and received fractures from the second to the seventh right ribs with respiratory embarrassment, a posterior dislocation of the right hip, facial and leg lacerations. Intrusion was not as deep on her side as that of her daughter's on the left front seat.

DETAILS OF IMPACT 7 CASE NUMBER 020



Study Vehicle 020 was a 1973 Ford Falcon four door sedan. The Falcon struck a pothole in the road, veered left and collided with a tree. Maximum vehicle damage was rated as 7, force direction was assessed at 11 o'clock.

Child 020C was a girl aged seven years who occupied the front left seat. She was effectively restrained by an emergency locking retractor belt and received an A.I.S. of 10000, O.A.I.S. of 1 and I.S.S. of 1 from a bruised and tender left knee.

Child 020D was a girl aged six years on the rear right seat. She was restrained by a loosely adjusted lap/sash belt and received an A.I.S. of 11002, O.A.I.S. of 2 and I.S.S. of 6 from abrasions to the nose and left maxilla area and over the cervical spine, abrasions over the left thigh and left tibia with a fracture of the left tibia.

Other Occupants: The 28 year old mother who drove wore an emergency locking retractor belt and received a bruise over the left maxilla, bruised left wrist and hand and a fracture of the right seventh rib. A baby girl aged 11 months on the rear left seat was in a Steelcraft C52 Majestic child seat of an unapproved type secured by an adjustable lap/sash belt. The available harness reportedly was not fastened around the child but the abdominal barrier and crotch strap reportedly restrained the child partially. She was mildly concussed.

DETAILS OF IMPACT 7 CASE NUMBER 021



Study Vehicle 021 was a 1977 Ford Cortina station sedan. In heavy rain the Cortina veered left from a freeway and its whole left side collided with a guardrail. Maximum vehicle damage was rated as 1, force direction was assessed at 10 o'clock.

Child 021D was a six year old boy wearing an adjustable lap/sash belt on the rear right seat. He received an A.I.S. of 11000, O.A.I.S. of 1 and I.S.S. of 2 from a minor head injury resulting in bleeding nostrils and swelling and tenderness over the left mandible.

Child 021E was a seven year old boy wearing a lap belt in the middle rear seat. He received an A.I.S. of 10003, O.A.I.S. of 3 and I.S.S. of 10 from a laceration to the left forehead and fractured left clavicle.

Other Occupants: The father who drove wore an emergency locking retractor and was uninjured. The mother in the left front seat wore an emergency locking retractor and received a bruised arm. The grandfather in the rear left seat wore an adjustable lap/sash belt and was uninjured.

DETAILS OF IMPACT 7 CASE NUMBER 023



Study Vehicle 023 was a 1974 Holden Torana four door sedan. The Torana proceeded across a main divided road and its right side doors were impacted by a Datsun 120Y approaching from the Torana's right. As a result the Torana rolled over. Maximum vehicle damage was rated at 4, force direction assessed as 3 o'clock.

Child 023D was a seven year old boy who wore an adjustable lap/sash belt on the rear right seat adjacent to the vehicle intrusion. He received an A.I.S. of 00003, O.A.I.S. of 3 and I.S.S. of 9 from a displaced fracture of the right clavicle.

Child 023F was a baby boy aged one year on the rear left seat. He was secured in a Safe-n-Sound Trisafe Mk.7 child seat reportedly with AS E46-1970 type approval. He was uninjured. Rescue from the child seat was reported by the mother as easy.

Other Occupants: The mother who drove wore an adjustable lap/sash belt and suffered a bruised right thigh. The 19 year old uncle in the front left seat wore an adjustable lap/sash belt and suffered a cut elbow. The five year old girl in the rear middle seat probably was unrestrained. She was knocked unconscious, with haematoma of the left eye and abrasions, fractures of the first to sixth ribs on the right side with respiratory embarrassment.

DETAILS OF IMPACT 7 CASE NUMBER 024



Study Vehicle 024 was a 1976 Holden Gemini four door sedan. The Gemini descended a steep winding road, veered right and rolled down the adjacent steep embankment coming to rest in a creek bed. Maximum vehicle damage was rated at 8, force direction was assessed at 13 o'clock.

Child 024C was a boy aged 9 years on the front left seat. He wore an emergency locking retractor belt and received an A.I.S. of 11000, O.A.I.S. of 1 and I.S.S. of 2 from a bilateral periorbital haematoma (blackened eyes) and a laceration to the base of the right thumb.

Child 024D was a girl aged four years on the rear right seat. She wore a loosely adjusted lap/sash belt and received an A.I.S. of 10000, O.A.I.S. of 1 and I.S.S. of 1 from a bruised right shoulder over the midpoint of the clavicle from the seat belt.

Other Occupants: The 30 year old father who wore the driver's emergency locking retractor belt was knocked unconscious and received lacerations to both hands from flying glass and a seat belt abrasion to the chest. The 28 year old mother in the rear left seat wore a tightly adjusted lap/sash belt, received seat belt abrasions to the right breast and died from a fracture to the base of the skull.

DETAILS OF IMPACT 7 CASE NUMBER 030

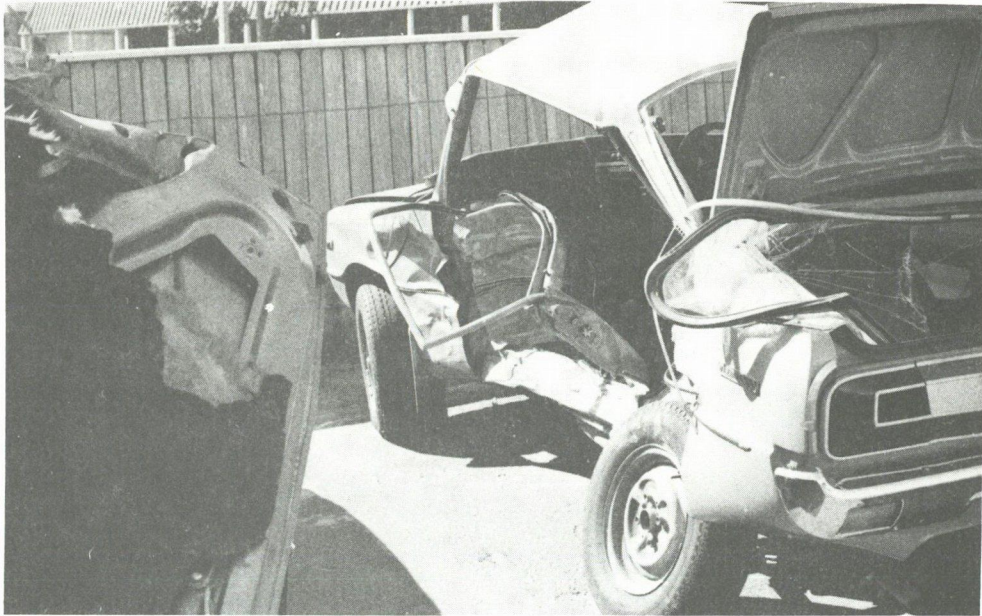


Study Vehicle 030 was a 1974 Ford Falcon four door sedan. The Falcon veered across the incorrect side of the road, rolled heavily and the rear roof area collided with a wooden light pole. Maximum vehicle damage was rated as 6, force direction assessed as 13 o'clock.

Child 030C was a girl aged four years nursed by her father on the front left seat. The 95kg father and 26kg daughter shared the available emergency locking retractor with the sash strap passed over the left shoulder of the father and under the left arm of the daughter with both encompassed by the lap strap. The daughter received an A.I.S. of 10000, O.A.I.S. of 1 and I.S.S. of 1 as a result of a tender area over the left axilla (armpit) from the seat belt, a painful left knee, small laceration to the left ankle, and a bruise to the central forehead.

Other Occupants: The 45 year old driver wore his emergency locking retractor belt and suffered concussion. The 29 year old father was knocked unconscious and suffered fractures of the 8th and 10th ribs.

DETAILS OF IMPACT 7 CASE NUMBER 032

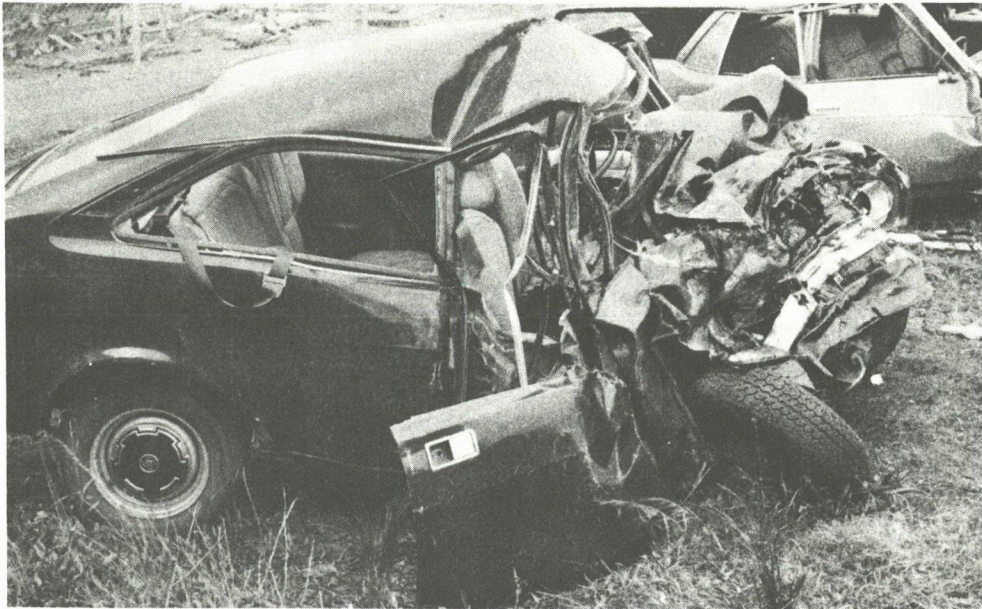


Study Vehicle 032 was a 1973 Mazda 1300 two door sedan. After negotiating a right hand bend the Mazda veered across oncoming traffic when the left side door and rear panel were impacted by a Holden sedan towing a trailer. Maximum vehicle damage was rated at 5, force direction was assessed as 10 o'clock.

Child 032C was a retarded girl aged six but having the much smaller stature of an infant. She occupied the front left seat and was wearing the lap portion of a lap sash belt, firmly adjusted, with the sash strap passed under the left arm behind her. She was seated adjacent to the vehicle intrusion and received an A.I.S. of 15452, O.A.I.S. of 5 and I.S.S. of 66 and died as a result of a fracture dislocation of the cervical spine, fractured maxilla, ruptured liver and right lung, and fractured right femur, with seat belt abrasions across the abdomen.

Other Occupant: The 20 year old driver wore her adjustable lap/sash belt and suffered a broken right arm, a laceration to the chin, and seat belt abrasions over the pelvis and right shoulder. The driver was a teacher of the child.

DETAILS OF IMPACT 7 CASE NUMBER 035



Study Vehicle 035 was a 1974 Leyland Marina two door coupe. The Marina collided head on with a Chrysler Valiant which had crossed to the incorrect side of the road. The rear car seat cushion had displaced forward about 80mm on the right and 100mm on the left. The rear seat back had disengaged from its upper supports and had been pushed forward about 120mm by the boot barrier which had been deformed by the moving boot luggage. Maximum vehicle damage was rated at 9, from 1 o'clock. Child 035D was a girl aged four years eleven months on the rear right seat. She had been seated on top of two thin cloth covered cushions filled with foam pieces, and wore a firmly adjusted lap/sash belt. She received an A.I.S. of 10000, O.A.I.S. of 1 and I.S.S. of 1 from minor lacerations around the left eye, abrasions to the base of the right neck and clavicle and across the abdomen from the seat belt and a contusion over the mid-lumbar spine.

Child 035E was a girl aged three years on the rear middle seat. She was secured in a Safe-n-Sound Premier X4 child seat with AS E46-1970 type approval. The child seat was fixed by two upper straps to the rear parcel shelf and a bottom strap bolted to the floor pan. The combined crash loads applied by the child and boot luggage on the child seat caused the upper

straps to break away from the shell. The seat shell sustained major fractures as the child-in-seat rotated to contact the seat back of the driver's seat. Rescue involved removal of the child seat together with the child. This child received an A.I.S. of 15202, O.A.I.S. of 5 and I.S.S. of 33 and died four days later as a result of a brainstem (midbrain) lesion, compound fracture of the nose, minor bruising of the right lung and fractures of the left radius and ulna.

Other Occupants: The 31 year old father who drove wore an adjustable lap/sash belt and died from traumatic disruption of the chest. The 30 year old mother on the front left seat wore an adjustable lap/sash belt and sustained a torn major neck ligament, a displaced left rib, an extensive laceration to the forehead and bruised left foot.

DETAILS OF IMPACT 7 CASE NUMBER 036



Study Vehicle 036 was a 1977 Ford Cortina station sedan. The Cortina collided with a Holden sedan which had been travelling in the opposite direction, lost control and veered to the incorrect side of the road. Maximum vehicle damage was rated at 6, force direction was assessed as 2 o'clock. Failure of the rear seat back retention brackets caused the seat to press against the rear seat occupants.

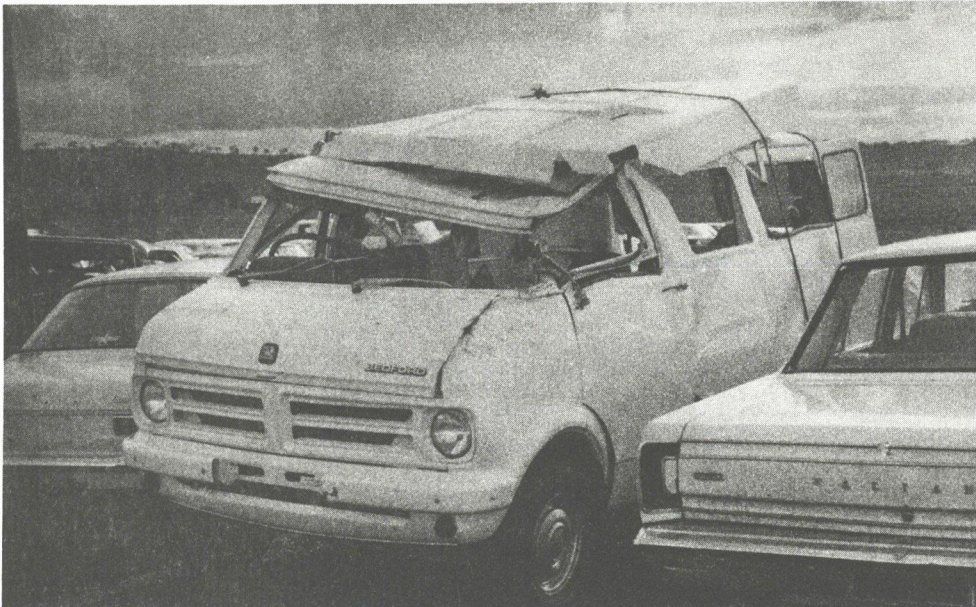
Child 036D was a baby girl aged eight months and occupied the rear right seat. She was secured in a Safe-n-Sound KL child seat with AS E46-1970 type approval. The seat was installed differently from recommended practice having the two individual lower anchor straps looped together and connected to the lap portion of the rear right adjustable lap sash belt. The lower straps normally are anchored separately to the floor pan. The two individual upper anchor straps had been passed over the vehicle's folding rear seat and anchored to the floor of the rear deck. The seat shell had fractured into two pieces and the upper seat retention straps had shown signs of heavy loading with tearing. The harness was intact. Rescue involved no apparent difficulties. The child received an A.I.S. of 12004, O.A.I.S. of 4 and I.S.S. of 21 and survived a fracture of the skull and fractures of both femurs and both tibias and fibulas.

Child 036E was a girl aged four years two months on the rear centre seat. Prior to the crash she had been seated on top of two pillows and secured by a lap belt. She possibly was secured at the time of the crash in this manner. She received an A.I.S. of 25302, O.A.I.S. of 6 and I.S.S. of 38 and died as a result of fractures of the front and base of the skull and cervical spine, fractures of the head of the right humerus and right fourth and fifth ribs. The source of her injuries was uncertain but may have been from contact with the front seats.

Child 036F was a boy aged two years ten months and occupied the rear left seat. He was secured in a Steelcraft C58 child seat with AS E46-1970 type approval. The child seat was secured by the rear left adjustable lap/sash belt with the sash passing to the right (not correctly, to the left) of the seat belt bracket located at the top and middle of the rear frame. The bolt securing the seat shell to the frame at the top distorted but the seat shell and harness remained intact. Rescue involved no apparent difficulties. The child received an A.I.S. of 10022, O.A.I.S. of 3 and I.S.S. of 9 from facial lacerations, harness abrasions to the right neck and both iliac crests, a fractured right clavicle and fractures of both femurs. He also suffered mild haematuria (blood in the urine) probably from contact with the crotch strap.

Other Occupants: The 49 year old grandmother who drove wore an emergency locking retractor and died from a haemopneumothorax and multiple fractures. The 27 year old mother on the front left seat also wore an emergency locking retractor and died from a haemopneumothorax and multiple fractures.

DETAILS OF IMPACT 7 CASE NUMBER 037



Study Vehicle 037 was a Bedford commercial vehicle, about five years old, converted to a campervan with heavy particle board furnishings and a lift up roof panel. After overtaking a vehicle the Bedford veered left and rolled over landing heavily on the left front corner of the roof. Maximum vehicle damage was rated at 4, force direction assessed as 13 o'clock.

Child 0370(i) was a girl aged four years. She was secured in a Safe-n-Sound KL child seat with AS E46-1970 type approval. The child seat had been installed, by bolting it to the particle board in the living area of the left side of the van, and faced inwards. The child seat remained connected to the particle board. Rescue involved cutting the child seat with child from the wooden panel and transporting by ambulance together. The little girl received an A.I.S. of 31000, O.A.I.S. of 3 and I.S.S. of 10 from deep facial lacerations, the loss of two lower incisors, abrasions to the chest and a deep laceration to the left forearm.

Child 0370(ii) was a girl aged two years six months. She was secured in a Safe-n-Sound KL child seat with AS E46-1970 type approval installed in a similar manner to face her sister opposite. This child seat, together with the mounting board, separated from the vehicle in the crash. In spite of this there were no apparent rescue difficulties. The girl received an A.I.S. of 10000, O.A.I.S. of 1 and I.S.S. of 1 from a bruise below the left eye.

Other Occupant: The 31 year old mother who drove wore an adjustable lap/sash belt and received facial lacerations, sore neck and bruising to her right limbs.

9. APPENDIX C : CHILD SEATS AND MINOR INJURIES.

Appendix C was included to provide details of child seat users who occupied vehicles in which no restrained child received moderate or more serious injuries. Appendix C actually is a supplement to Appendix B which provides details of all the occupants of vehicles in which any restrained child received moderate or more serious injuries.

Appendix C discusses child seat users of case studies: P010, P014, P015, P016, 007, 012 and 028.

CASE P010. In a moderate frontal crash a girl (P010D) aged three years six months on the rear right seat occupied a Safe-N-Sound KL child seat conforming to ASE46-1970 and was uninjured. The four securing straps of the child seat appeared correctly connected to the vehicle though the top straps had become twisted across the top of the seat back. Adjustment appeared inappropriate for the child with the lower (instead of the higher) pair of sash slots being used. The girl's nine months old sister (P010F) on the rear left seat occupied an unapproved Safe-N-Sound Premier X4. The two top anchor straps were securely bolted to the rear parcel shelf but the lower single anchor strap was not connected to the vehicle. The seat harness was considered loosely adjusted for the infant who received a minor bruise to her left neck probably from contact with the sash strap. Rescue of both children involved no apparent difficulties.

CASE P014. In a minor frontal crash a boy (P014B) aged three years six months occupied a Safe-N-Sound Premier X4 child seat conforming to ASE46-1970. The child seat was located on the middle of the front bench seat of a station sedan. The two top anchor straps were extended over and down the seat back with the end fittings sharing the common inboard anchor points of the front adult belts. The crotch strap, where it passed under the seat shell, was interlocked with the lap belt beneath. The boy received a minor abrasion to the top of the left shoulder probably from the sash strap. Rescue involved no apparent difficulties.

CASE P015. In a minor frontal crash a two year old boy (P015F) on the rear left seat of a car occupied an English Mothercare child seat to BSI 3254. The child seat was similar to a Safe-N-Sound KL article having four anchor straps connected to the car, correctly in this instance. The boy received a bloodied nose. Rescue involved no apparent difficulties.

CASE P016. In a moderate crash involving car rollover a boy (P016F) aged one year seven months on the rear left seat occupied a Safe-N-Sound Trisafe MK7 to ASE46-1970. The child seat was restrained by a lap/sash belt which passed correctly in the channel between shell and support frame but the sash was not passed through the key way at the top of the moulding. The boy received a cut lip from contact with an unrestrained collapsible stroller and a bruise on the forehead. In spite of the vehicle having come to rest on its left side, rescue of the child by the father (driver) apparently involved no difficulties.

CASE 007. In a moderate right side crash a girl (007E) aged one year nine months occupied a Steelcraft C58 child seat to ASE46-1970. The child seat was located slightly to the right of centre on the rear seat of a car. It was restrained by a combination of the right rear lap/sash belt (which was passed incorrectly between the shell and rearward part of the supporting steel frame and not appropriately around the front of the frame) and connected to the buckle strap of the centre rear lap belt. An upper retention strap required for this device at the middle or right side seating positions was not used. The child seat distorted markedly and the shell fractured in the crash. Neither the nut nor spacer bolt connecting shell and frame at the top of the assembly were present on the child seat post crash. The child received multiple lacerations from excursion through the right side glazing when the child seat rotated sideways in response to crash forces. Rescue involved no apparent difficulties.

CASE 012. In a moderate right side crash a girl (102F) aged one year three months on the rear right side of the car occupied a Safe-N-Sound Trisafe Mk7 to AS1754-1975. The child seat was restrained correctly by a lap/sash belt. The girl received a diagonal contusion to the anterior chest probably from contact with the sash strap. There was no apparent difficulties with rescue.

CASE 028. In a moderate left side crash a two year old girl (028F) on the rear left side of the station sedan occupied an English Britax Star Rider to BSI 3254. The two upper anchor straps were passed over the rear folding seat and connected to the floor of the rear parcel shelf. The two lower anchor straps were not connected to the anchorages provided between the seat squab and cushion. The buckle for the child seat harness caused its straps to twist when engaged. The girl received a bump to the left of the top of her head. There were no apparent rescue difficulties.